Effective Cost of Borrowing from Microfinance Institutions

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Abstract

It has been observed lately that the dependence on moneylenders for borrowing needs of poor borrowers remained stable despite the presence of MFIs, particularly in developing economies. This is surprising given the fact that MFIs charge relatively lower interest rate as compared to moneylenders. The paper explains this trend by arguing that the effective cost of borrowing from MFI is higher relative to the effective cost of borrowing from moneylender. It is due to the additional burden incurred in the form of transaction costs in case of MFI borrowing. Simulation results also support this phenomenon

Keywords: Microfinance, Group lending, Informal finance, Transaction cost, Effective cost

JEL classification: G21, O16, O17

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1. Introduction

Some recent estimates show that there are about 3,600 microfinance institutions (MFIs) serving about 190 million clients, of which nearly 130 million are poorest (Reed, 2011 as cited in Goto, 2012). This translates to the impact of microfinance on one in every 37 people on earth (ibid.). It is largely driven by following the group lending model of Grameen Bank in the form of self-help group (SHG) bank - borrower linkage program in the Indian context. According to Sa-dhan, an association of MFIs in India, group loans account for more than 90% of the total loans disbursed by MFIs in India (Shankar, 2007).

The success of microfinance group lending has led to an extensive and growing literature on the subject. The models of Stiglitz (1990), Besley and Coate (1995), Ghatak (1999) , Aghion (1999) and Aghion and Gollier (2000) show how Grameen type group lending with joint liability helps to mitigate the effect of information asymmetry between the lender and the borrower by exploiting the local information about the borrowers. This is made possible through borrowers' participation in group formation, peer monitoring, and imposing social sanctions on the defaulting borrowers, among others.

Notwithstanding the extensive and still growing literature on microfinance and group lending, most theoretical literature has approached the group based lending from the lenders' perspective. Under group lending with joint liability, dynamic incentives and weekly repayment schedule, lenders can charge lower interest rate due to decreased information asymmetry (and consequent reduction in cost of screening and monitoring of borrowers) and yet achieve high repayment rate. This is a perspective from the lender. However, borrowers need to bear transaction costs when they borrow in groups. This includes the opportunity cost of attending weekly repayment meetings, cost of travelling to attend meetings etc. The problem of borrowers' transaction costs in group lending has been discussed by Chung (1995), Bhatt and Tang (1998) (who term these costs as 'hidden beasts'), Pal (2002), Karduck and Seibel (2004), Dehem and Hudon (2013), among others. With the inclusion of these transaction costs in the regular interest cost, the effective cost of borrowing from MFI may increase up to the level of cost of borrowing from moneylenders (ML) and this may defeat the very purpose of introducing group-based lending and reducing dependence on ML who are observed to charge very high interest rates.

In this paper, we attempt to understand the trade-off that a typical borrower faces when she has a choice of borrowing from MFI or from ML. The trade-off originates because of the additional burden on the borrower in the form of transaction cost when she borrows from MFI while at the same time incurring a relative lower interest cost. On the other hand, borrowing from ML comes at higher interest cost without incurring any transaction cost. Hence, there is no unambiguous answer to the question of which option (borrowing from MFI or from ML) is viable from the borrower's perspective assuming the unavailability of competing MFIs.

We provide a theoretical framework around the effective cost of borrowing from MFI. We consider two alternative frameworks. The first framework expresses transaction cost as a mark-up over the interest cost and computes the total cost of credit using the internal rate of return (IRR) methodology. We name this as effective MFI interest rate. The second framework expresses the effective cost of MFI borrowing in terms of borrowers' payoff functions and compares it with the effective cost of ML borrowing per unit of capital. This determines the maximum MFI interest rate at which the effective cost of MFI borrowing remains lower than that of ML borrowing. We call this maximum MFI interest rate as reservation MFI interest rate.

We extend the theoretical results derived on effective MFI interest rate and reservation MFI interest rate by performing numerical simulations. The parameter estimates to perform simulations are taken from transaction cost estimation studies done in the Indian context, primarily Karduck and Seibel (2004), Shankar (2007), Dehem and Hudon (2013), among others. Results show that the effective cost of borrowing from MFI is higher or lower relative to the effective cost of borrowing from ML depending upon credit requirement, transaction cost burden, installment size, among others. Borrowers may find comparative advantage in borrowing individually from ML as compared to borrowing in a group from MFI when the credit requirement is low as in the case of poor and marginal borrowers. These results partly explain the relative stable dependence on ML credit market in economies having group lending microcredit activities.

The paper is organized into five sections. This introductory section gives an overview about the context, objective and a brief mention of results derived. Section 2 and 3 formulates expressions for effective MFI interest rate and reservation MFI interest rate respectively. It is followed by the simulation results on effective MFI interest rate and reservation MFI interest rate in sub-sections 4.1 and 4.2 respectively. Section 5 concludes the paper.

2. Effective MFI interest rate

We assume that there is a project which requires an investment of amount K at the beginning of period 1 and will realize returns at the end of period 2 with full certainty. The project is assumed to be indivisible implies investment of amount less than K will not produce any returns in period 2. There is an MFI which offers group loans at an interest rate of r ($r > 0$), while ML provides individual loans at an interest rate of m, where $m > r$. MFI contract involves repaying in installments, while ML contract does not involve any installments and the entire loan amount needs to get repaid at the end of period 2.

Borrowers are assumed to be identical and are endowed with a project requiring an investment of amount K. In addition, they are assumed to be poor and marginal with no personal wealth and cannot afford to offer any collateral. The representative borrower needs to repay some amount, s, to MFI with interest r as an installment at the end of period 1, and the remaining (K - s) with interest at the end of period 2 (Jain and Mansuri, 2003). It is assumed that there is no restriction on the amount borrowed either from MFI or from ML.

When a borrower borrows from MFI, she incurs transaction costs, T_c ($T_c > 0$) and is assumed to be fixed. On the other hand, borrowing from ML does not involve any transaction costs for the borrower. Ahmed (1989) argues that transaction costs are primarily incurred prior to or at the time of obtaining the loan. Hence, we assume that the net effective amount borrowed for an individual borrower reduces to ($K – T_c$) (Ahmed, 1989; Rojas& Rojas, 1997). Also, we assume that MFI charges interest rate on flat rate basis. It implies that interest liability is calculated as a fixed percentage of the initial loan amount rather than the amount outstanding (declining) during the loan term.

Suppose E is the effective MFI interest rate ($E > 0$) and A_1, A_2 are the repayments to MFI at the end of 1st and 2nd period respectively. We assume that MFI is profit maximizer period by period (Jain, 1999; Aghion, 1999) and repayments happen with interest in both first and second period. A_1 is the amount of first installment (s) paid to MFI with interest at the end of first period and A_2 is the remaining amount (K – s) to be repaid with interest at the end of second period.

To determine the effective MFI interest rate, we use the method of internal rate of return (IRR). The IRR method is used to determine the rate at which the future cash outflows should be discounted so that its present value equalizes the effective amount borrowed. Given the assumption of two periods and making use of IRR formula, we have the following:

$$K - T_c = \frac{A_1}{(1+E)} + \frac{A_2}{(1+E)^2}$$

Putting $A_1 = s(1+r)$ and $A_2 = (K-s)(1+r)$, the above expression is re-written as:

$$K - T_c = \frac{s(1+r)}{(1+E)} + \frac{(K-s)(1+r)}{(1+E)^2}$$

Solving for E yields the following effective MFI interest rate E*,

$$E^* = \frac{\sqrt{4(K-s)(1+r)\left(K-T_c\right)+s^2(1+r)^2} + s(1+r) - 2\left(K-T_c\right)}{2\left(K-T_c\right)} \tag{1}$$

Proof: See Appendix 1

For E* to have meaningful value, the term inside square root should be non-negative. This always holds true when we have $K > T_c$. The restriction on amount borrowed (K) being larger than transaction costs (T_c) is in congruence with the transaction costs estimation studies done in the Indian context like Karduck and Seibel (2004), Dehem and Hudon (2013) etc.

The comparative statics results on the effective MFI interest rate show that:

Lemma 1 An increase in transaction cost leads to increase in effective interest rate.

Lemma 2 The relation between effective interest rate and amount borrowed is negative.

Lemma 3 An increase in actual MFI interest rate charged results in an increase in effective MFI interest rate.

Lemma 4 There is a positive relation between MFI installment amount and effective MFI interest rate.

Proof: See Appendix 2

The above lemmas establish that effective MFI interest rate is higher than the actual MFI interest rate when T_c is assumed to be high or K is relatively low or both. This is shown by lemma 1 and lemma 2 wherein the relation between E* and T_c is positive and the relation between E* and K is negative. Lemma 3 shows an increased interest cost burden results in an increased effective cost of borrowing. An increased installment size is also associated with higher effective MFI interest rate. This is due to the fact that the installment amount s if gets invested at the end of period 1 (instead of paying back to MFI) will earn some returns by the end of period 2. Hence, there is an opportunity cost involved in spending the amount s to repay MFI installment at the end of period 1. This leads to higher effective cost of borrowing from MFI.

3. Reservation MFI interest rate

In this section, we attempt to provide an alternative theoretical framework to the trade-off of borrowing from MFI or from ML in the form of borrowers' payoff functions. As in the previous section, we assume that MFI contracts are group lending contracts while the ML contracts are individual contracts. The interest rate charged by MFI (r) is lower while that of ML (m) is higher. There is a project which requires an investment of amount K (K > 0) at the beginning of period 1 and is expected to fetch returns at the end of period 2. A representative borrower is assumed to be poor and marginal with no ability to offer collateral.

The MFI group lending contract specifies an installment amount s which needs to be repaid at the end of period 1 and the remaining amount (K – s) needs to be repaid at the end of second period with interest. Since returns are only realized at the end of period 2, hence the borrower borrows from ML an amount of s(1+r) to repay MFI installment (Jain and Mansuri, 2003). There are transaction costs T_c involved in borrowing from MFI. T_c indicates total transaction cost burden per member in a group of 2 members. Therefore, the effective cost of borrowing from MFI (EC_{MFI}) per unit of amount borrowed for an individual borrower becomes:

$$EC_{MFI} = \frac{1}{K}\left[s(1+r)(1+m) + 2(K-s)(1+r) + T_c(1+r)\right] \tag{2}$$

The first component, s(1+r)(1+m), is the amount which needs to be repaid to ML at the end of second period with interest rate m. The second component, 2(K-s)(1+r), is the residual amount which needs to be paid back to MFI adjusted for joint liability (assuming 100% joint liability share and probability of default). The last component, $T_c(1+r)$, is the opportunity cost of transaction cost amount, assuming that if it gets invested, it will earn returns at the rate of r. The whole expression is divided by K to get per unit cost.

The effective cost of borrowing from ML (EC_{ML}) per unit of amount borrowed for an individual borrower takes the following form:

$$EC_{ML} = \frac{K(1+m)}{K} = (1+m) \tag{3}$$

The component K(1+m) is the total cost of borrowing when she borrows the entire amount K from ML. The expression is divided by the amount borrowed K to get per unit cost.

To derive an expression for the maximum MFI interest rate r at which the effective cost of borrowing from MFI remains lower than that of ML, we put

$$EC_{MFI} \leq EC_{ML}$$

$$\frac{1}{K}\left[s(1+r)(1+m) + 2(K-s)(1+r) + T_c(1+r)\right] \leq (1+m)$$

Solving for r leads to the following,

$$(1+r) \leq \frac{K(1+m)}{s(1+m) + 2(K-s) + T_c}$$

$$r \leq r^* = \frac{(K-s)(m-1) - T_c}{s(1+m) + 2(K-s) + T_c} \tag{4}$$

where $r^* = \frac{(K-s)(m-1) - T_c}{s(1+m) + 2(K-s) + T_c}$

r* can be interpreted as the 'reservation' level of MFI interest rate at which the effective cost of borrowing per unit of amount borrowed from MFI and from ML are equal. At this reservation MFI interest rate, the borrower is indifferent between borrowing from MFI and borrowing from ML. When the actual interest rate charged r is greater than r*, the effective cost of borrowing from MFI exceeds the effective cost of borrowing from ML and borrower will prefer to borrow from ML. The opposite holds true when the actual interest rate charged r is lower than r*. Therefore,

If $r > r^*$, then $EC_{MFI} > EC_{ML}$ (5)

If $r < r^*$, then $EC_{MFI} < EC_{ML}$ (6)

However, the reservation r* derived above can take negative values also particularly when transaction costs are too high. As shown in equation (6), if r is lower than r* then the effective cost of borrowing from MFI is less and borrower will prefer to borrow from MFI. However, if r* is negative, MFI cannot offer loans at r lower than r*. This is due to the assumption of MFI being profit maximizer. For r* to be non-negative, it must satisfy the condition of $(K-s)(m-1) \geq T_c$. The installment amount s cannot be greater than the amount borrowed K which implies the expression (K – s) is non-negative. Transaction costs T_c is assumed to be strictly positive. Hence, to satisfy the condition of $(K-s)(m-1) \geq T_c$, ML interest rate m has to be at least of the level of 1.

The comparative statics results on reservation MFI interest rate are used to derive the following lemmas:

Lemma 5 Reservation interest rate falls with the increase in transaction cost.

Lemma 6 An increase in amount borrowed results in an increase in reservation level of interest rate.

Lemma 7 There is a positive relation between ML interest rate and reservation interest rate.

Lemma 8 A marginal increase in installment amount is associated with a lower level of reservation MFI interest rate.

Proof: See Appendix 3

Lemma 5 implies borrower will be willing to pay lower r* to MFI if T_c increases. Higher amount borrowed is associated with higher reservation MFI interest rate. This implies MFI's pool of clients gets increased with the higher K and consequent increase in r* as shown by equation (6). An increase in ML interest rate increases the cost of alternate source of credit (ML) and hence leads borrowers willing to pay higher r* to MFI. An increase in installment amount raises the amount borrowers need to borrow from ML, s(1 + r), to repay MFI installment. ML loans are availed at higher interest cost m. This translates to relative lower borrowing from MFI and is associated with lower level of reservation r*.

4. **Simulation results**

To gain some insight to the theoretical results derived above, we perform simulations on the effective MFI interest rate E* and reservation MFI interest rate r*, changing one of the parameters among s, K, m, r and T_c at a time, while keeping others at some constant value. The range of parameter estimates are taken from reviewing some of the empirical studies done in the Indian context. The most relevant in our context are Karduck and Seibel (2004), Banerjee and Duflo (2010), Dehem and Hudon (2013), Pradhan (2013) and Seenivasan (2015). Although Shankar (2007) also estimated transaction costs in the Indian context, however the attempt was made from the lender's (MFI) perspective and not from the borrower's perspective.

Karduck and Seibel (2004) estimated average loans outstanding from SHGs at INR (Indian Rupee) 6,690 per member annually at the lending rate of around 24% per annum. The annual transaction cost is estimated at INR 156 per member. Banerjee and Duflo (2010) pegged ML interest rate of around 57% per annum. Dehem and Hudon (2013) estimated average loan size separately for rural and urban borrowers at around INR 3,884 and INR 3,878 per borrower respectively. There is a wide variation observed in average annual transaction costs among rural and urban borrowers at an approximate of INR 290 and INR 350 per member respectively. Pradhan (2013) observed that ML interest rate varies to the extent of 50% or more in the Indian context. The paper showed around one-third of the ML debt is borrowed at an interest rate of around 20-25%, while another one-third (approx. 38%) is borrowed at an interest rate of more than 30%.

In particular, we consider the parameter range of K between 3800 and 6800, T_c between 150 and 400, and s between 1500 and 3500. We consider the r values varying in the range of 12% and 25%, and m values varying in the range of 100% and 200% in the respective simulation results on effective MFI interest rate and reservation MFI interest rate. While keeping parameter values at some constant level, we have kept r at 24% as per the RBI mandate in the Indian context (Karduck and Seibel, 2004; Seenivasan, 2015). The installment amount (s) is assumed to be one half of amount borrowed (K) in most of the simulation cases shown below. The relevant graphs are shown in the respective cases. The graphs below plot effective MFI interest rate/reservation MFI interest rate on Y-axis and the parameter considered on X-axis.

4.1 Simulation results on effective MFI interest rate

We consider four cases in total described in Table 1 below. We fix three parameters at a time and change any one of the parameters among s, K, T_c and r. This is shown under header Fixed (parameters fixed at a particular value) and Variable (parameter changing value in a continuous range) in the table below. We consider four to five parameter combination values for each case. These four cases on effective MFI interest rate are shown in figures 1 to 4.

Table 1: Parameter combinations considered in simulation results on effective MFI interest rate

Figure 1		**Figure 2**	
Fixed	Variable	Fixed	Variable
s, K, T_c	r (0.12, 0.25)	s, r, T_c	K (3800, 6800)
a) s = 1950, K = 3900, T_c = 350		a) s = 1950, r = 0.24, T_c = 350	
b) s = 1950, K = 3900, T_c = 290		b) s = 1950, r = 0.24, T_c = 290	
c) s = 3350, K = 6700, T_c = 350		c) s = 3350, r = 0.24, T_c = 350	
d) s = 3350, K = 6700, T_c = 290		d) s = 3350, r = 0.24, T_c = 290	
e) s = 3350, K = 6700, T_c = 160		e) s = 3350, r = 0.24, T_c = 160	

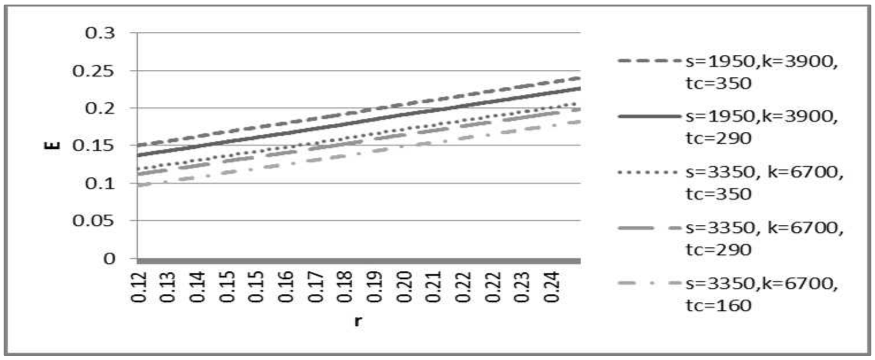
Figure 3		**Figure 4**	
Fixed	Variable	Fixed	Variable
s, r, K	T_c (150, 400)	r, K, T_c	s(1500, 3500)
a) s = 1950, r = 0.24, K = 3900		a) K = 3900, r = 0.24, T_c = 350	
b) s = 2800, r = 0.24, K = 3900		b) K = 3900, r = 0.24, T_c = 290	
c) s = 3350, r = 0.24, K = 6700		c) K = 6700, r = 0.24, T_c = 350	
d) s = 5000, r = 0.24, K = 6700		d) K = 6700, r = 0.24, T_c = 290	
		e) K = 6700, r = 0.24, T_c = 160	

Source: The author

The graph in figure 1 shows effective interest rate E on Y-axis and actual interest rate r on X-axis. When amount borrowed is relatively high (6700), effective interest rate turns out to be lower than actual interest rate r in the entire range of r (0.12, 0.25). It holds true for all the three cases c, d and

e. At the lower K values (3900), effective interest rate E is higher than actual interest rate r under certain combination of parameter values (s, T_c). However, with K being 6700, E becomes lower than r because of economies of scale.

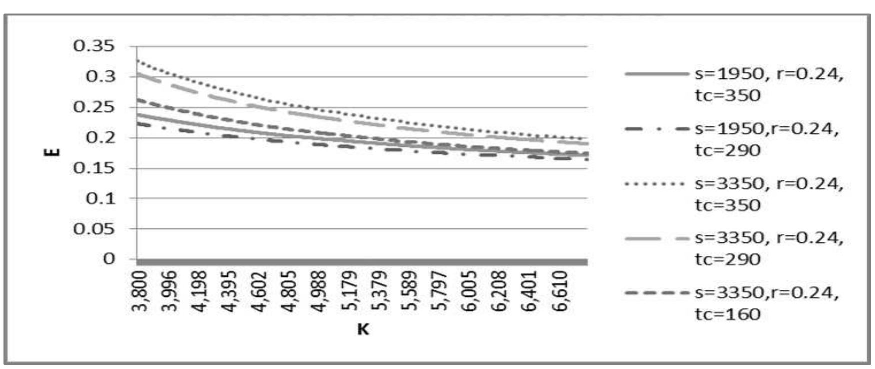
Figure 1: Effective MFI interest rate as a function of interest rate r



Source: The author

The graph in figure 2 shows effective interest rate E on Y-axis and amount borrowed K on X-axis. The divergence in effective interest rate among the five cases considered is high at lower values of amount borrowed and becomes lower as K increases. Graphs show with the increase in amount borrowed K, effective interest rate converges to the actual interest rate of 0.24, and after a certain threshold becomes lower than 0.24. When the installment size is small (1950), effective rate is shown to be lower than interest rate r in the entire range of K considered (3800, 6800). This holds true for both cases a and b. Effective rate becomes higher than r when the amount borrowed is low and installment size as a percentage of amount borrowed is high.

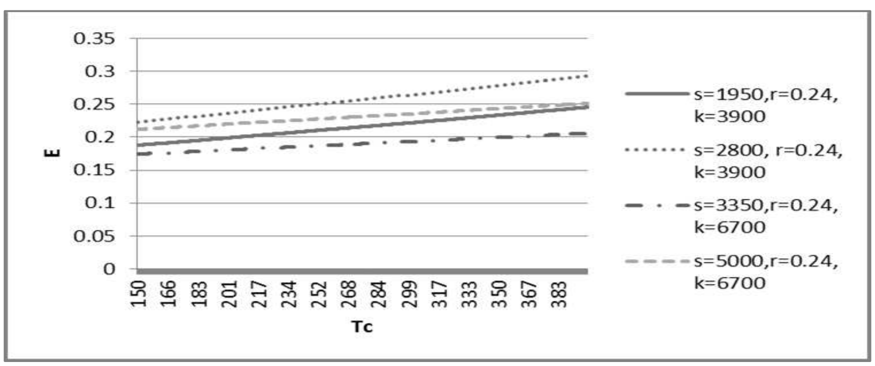
Figure 2: Effective MFI interest rate as a function of amount borrowed K



Source: The author

The graph in figure 3 puts effective interest rate E on Y-axis and transaction costs on X-axis. The change in effective rate with response to a unit change in transaction cost also depends upon the amount borrowed. The curve is relatively steeper for cases a and b when K is small (3900) as compared to the cases c and d when K is high (6700). This shows transaction cost impacts poor borrowers relatively more who are believed to have low requirement of credit. E is higher than r for high transaction cost values and relatively low values of amount borrowed in most of the parameter combinations considered. However, these results depend to a great extent upon the size of installment as a percentage of amount borrowed. When installment size is one-half of the amount borrowed (3900), E is higher than r when T_c is more than 370 on an average (case a).With installment size of about 75% of amount borrowed (3900) as in case b, E is shown to be higher than r for T_c being in the range of (210, 400). In case c with K and s at 6700 and 3350 respectively, effective rate is lower than interest rate r in the entire range of T_c considered. However, if s is increased to 5000 (~70% of K) as in case d, E becomes higher than r when transaction costs lie in the range of (330, 400).

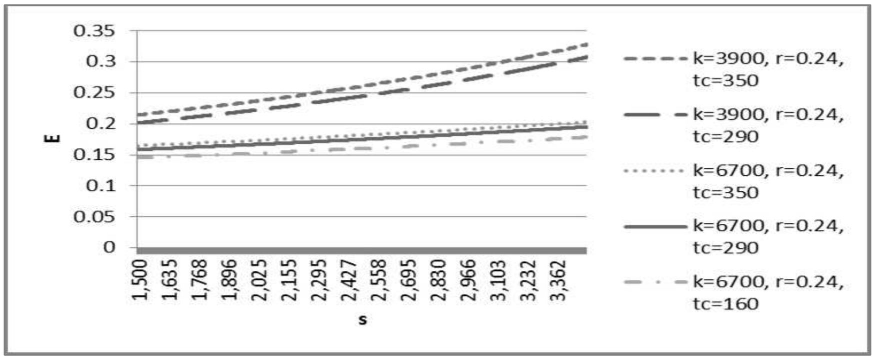
Figure 3: **Effective MFI interest rate as a function of transaction costs T_c**



Source: The author

The graph in figure 4 shows effective interest rate E on Y-axis and installment size s on X-axis. The positive relation is found between increasing installment size s and effective interest rate E. However, the rate of change in effective interest rate is observed to be high (shown by steeper curve) when K is relatively small at 3900 as shown in the graphs of cases a and b.

Figure 4: Effective MFI interest rate as a function of installment size s



Source: The author

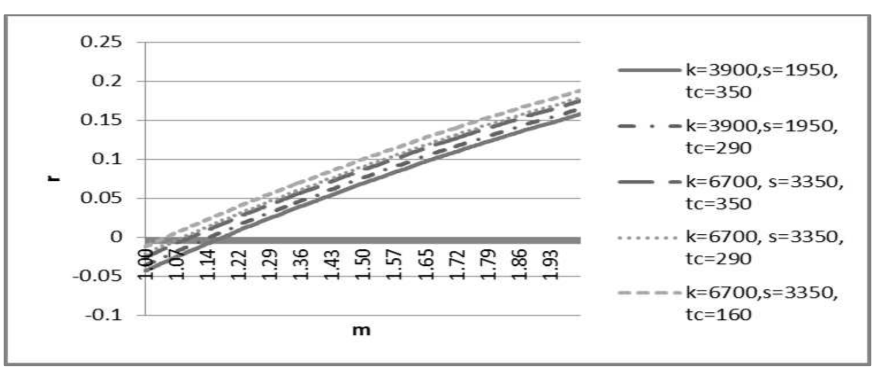
4.2 Simulation results on reservation MFI interest rate

As in previous sub-section, we have four cases described in Table 2 below. We fix three parameters at a time and change any one of the parameters among s, K, T_c and m. These four cases on reservation MFI interest rate are shown in figures 5 till 8.

Figure 5 shows reservation MFI interest rate as a function of ML interest rate. With m values varying in the range of (1, 2), reservation r* is positive beyond a certain threshold of m. When K is relatively low at 3900 and installment size being one half of it, reservation r* becomes positive when m crosses a threshold of 1.18 given transaction cost level of 350 as in case a. A decrease in transaction cost level to 290 in case b leads to lower corresponding threshold m of 1.15.

The threshold m beyond which reservation r* becomes positive is lower in case of higher K (6700). For given values of K and s at 6700 and 3350 respectively in cases c, d and e, higher transaction cost levels lead to increase in threshold m. Threshold m is 1.05 in case e, gets increased to 1.09 in case d and further to 1.10 in case c.

Figure 5: Reservation MFI interest rate as a function of ML interest rate m



Source: The author

Table 2: Parameter combinations considered in simulation results on reservation MFI interest rate

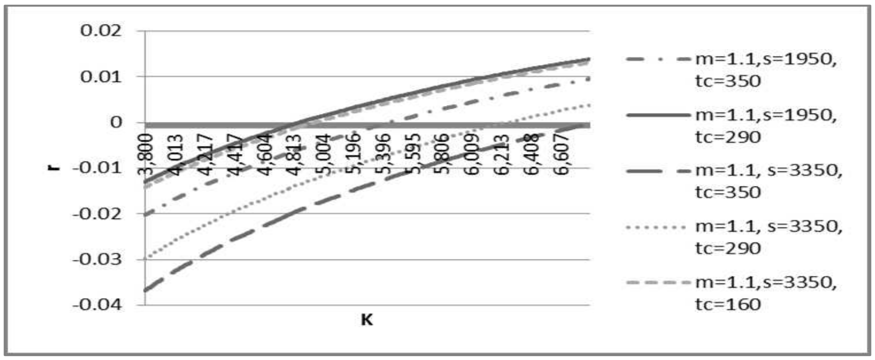
Figure 5		Figure 6	
Fixed	Variable	Fixed	Variable
s, K, T_c	m (1, 2)	s, m, T_c	K (3800, 6800)
a) K = 3900, s = 1950, T_c = 350		a) m = 1.1, s = 1950, T_c = 350	
b) K = 3900, s = 1950, T_c = 290		b) m = 1.1, s = 1950, T_c = 290	
c) K = 6700, s = 3350, T_c = 350		c) m = 1.1, s = 3350, T_c = 350	
d) K = 6700, s = 3350, T_c = 290		d) m = 1.1, s = 3350, T_c = 290	
e) K = 6700, s = 3350, T_c = 160		e) m = 1.1, s = 3350, T_c = 160	

Figure 7		Figure 8	
Fixed	Variable	Fixed	Variable
m, T_c, K	s (1500, 3500)	m, K, s	T_c (150, 400)
a) m = 1.1, K = 6700, T_c = 350		a) m = 1.1, K = 6700, s = 3350	
b) m = 1.1, K = 6700, T_c = 290		b) m = 1.1, K = 6700, s = 4690	
c) m = 1.1, K = 6700, T_c = 160		c) m = 1.1, K = 3900, s = 1950	
d) m = 1.1, K = 3900, T_c = 350		d) m = 1.1, K = 3900, s = 2730	
e) m = 1.1, K = 3900, T_c = 290			

Source: The author

Figure 6 shows the reservation MFI interest rate as a function of amount borrowed K. The reservation r* is shown to be positive for high values of parameter K. In case a, r* becomes positive when K is greater than the level of 5450, while in case b it happens when K is greater than the level of 4850. At higher installment size values of 3350, r* is positive for K being higher than 4950 when transaction cost is fixed at the level of 160 as in case e. An increase in transaction cost from 160 to 290 leads to increase the threshold K from 4950 to 6250 (case d). A further increase in transaction cost levels to 350 (case c) leads to negative r* for all the values of K in the range of (3800, 6800).

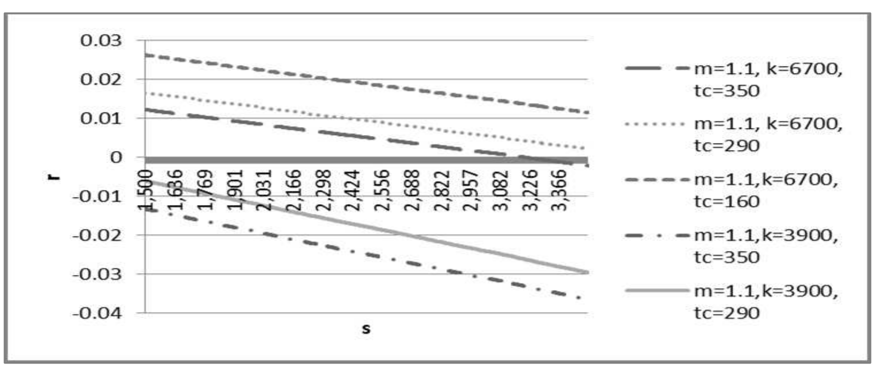
Figure 6: Reservation MFI interest rate as a function of amount borrowed K



Source: The author

The graph in figure 7 shows reservation MFI interest rate as a function of installment size s. A higher installment size reduces the reservation r* borrowers are willing to pay to MFI. For the given levels of K and m, a higher transaction cost leads to lower reservation r* and hence shifts the r* curve downwards as shown in the r* curves for cases a, b and c. This implies borrowers are willing to pay less interest rate for each level of installment size when there is an increased transaction cost burden. Reservation r* is negative for all values of s when the amount borrowed is low (K = 3900) as shown in cases d and e.

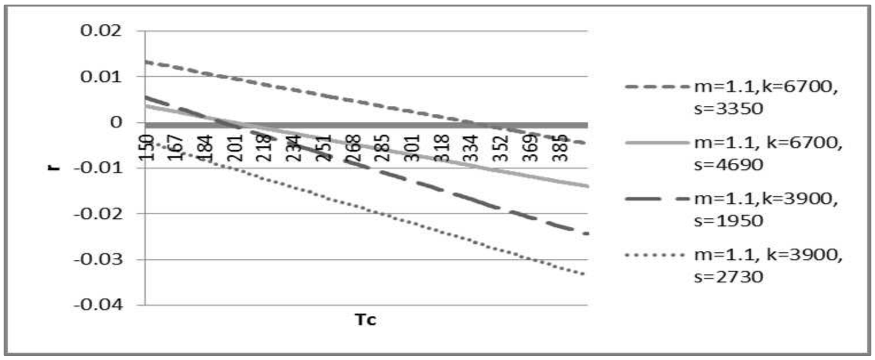
Figure 7: Reservation MFI interest rate as a function of installment size s



Source: The author

Figure 8 depicts reservation MFI interest rate as a function of transaction cost. With the given level of amount borrowed and ML interest rate, higher installment size reduces reservation interest rate. This is shown by graph for case b lying below the graph for case a and similarly graph for case d being below the graph for case c.

Figure 8: Reservation MFI interest rate as a function of transaction cost T_c



Source: The author

The rate of change in reservation r* is low (curve is flatter) when the amount borrowed is high at 6700 compared to the case when it is less (3900). It is shown by the graphs for case a and b being flatter than the corresponding graphs for case c and d. This implies reservation r* is more responsive to transaction cost levels for poor borrowers who are having low requirement of credit.

5. Conclusion

To conclude, the effective cost of borrowing from MFI is high whenever there is higher transaction cost, higher installment size (as a % of amount borrowed) and lower amount borrowed. An increase in amount borrowed leads to decrease in effective MFI interest rate, while a higher installment size and transaction cost leads to increase in effective interest rate. An increase in amount borrowed is associated with higher reservation interest rate, while the relation with respect to installment size and transaction cost is negative.

These results show that effective cost of borrowing from MFI is higher for poor and marginal borrowers who are in need for smaller amount of credit, although these are the set of borrowers to whom MFI lending is designed to be targeted. It is primarily explained by the higher transaction cost burden when borrowers borrow from MFI. Therefore, from the policy standpoint, these results reiterate the importance of reducing transaction costs to enhance borrower welfare as Bhatt and Tang (2001), Field and Pande (2008), Laureti (2012) and several other authors have pointed out.

Appendix 1

Computing effective MFI interest rate E* (equation 1)

Amount borrowed (effective) = K - T_c

Suppose A_1 and A_2 are the amount paid to MFI at the end of 1st and 2nd period respectively. E is the effective rate of interest. By IRR formula, we have the following:

$$K - T_c = \frac{A_1}{(1+E)} + \frac{A_2}{(1+E)^2}$$

$A_1 = s(1+r)$ and $A_2 = (K-s)(1+r)$. Putting these values in the above equation yields the following:

$$K - T_c = \frac{s(1+r)}{(1+E)} + \frac{(K-s)(1+r)}{(1+E)^2}$$

$$\left(K - T_c\right)(1+E)^2 = s(1+r)(1+E) + (K-s)(1+r)$$

Put (1+E) = z and solve for z,

$$\left(K - T_c\right)z^2 - s(1+r)z - (K-s)(1+r) = 0$$

$$\left(z - \frac{s(1+r)}{2\left(K-T_c\right)}\right) = \pm \frac{\sqrt{4(K-s)(1+r)\left(K-T_c\right) + \left(s(1+r)\right)^2}}{2\left(K-T_c\right)}$$

Ignoring the negative sign and substituting the value of z yields,

$$E = E^* = \frac{\sqrt{4(K-s)(1+r)\left(K-T_c\right) + s^2(1+r)^2} + s(1+r) - 2\left(K-T_c\right)}{2\left(K-T_c\right)}$$

E* is the effective MFI interest rate.

For E* to have meaningful value, the term inside square root should be non-negative i.e.

$$4(K-s)(1+r)\left(K-T_c\right)+s^2(1+r)^2 \geq 0$$

With K > T_c (given that $s \leq K$), the above inequality always holds true.

Appendix 2

Comparative statics of effective MFI interest rate E*

1. $\dfrac{\partial E^*}{\partial T_c}$

$$\frac{\partial E^*}{\partial T_c}=\frac{1}{2\left(K-T_c\right)^2}\left[\left(K-T_c\right)\left\{\frac{-2(K-s)(1+r)}{\sqrt{}}+2\right\}+\left\{\sqrt{}+s(1+r)-2\left(K-T_c\right)\right\}\right]$$

where $\sqrt{}=\sqrt{4(K-s)(1+r)(K-T_c)+s^2(1+r)^2}$

$$\frac{\partial E^*}{\partial T_c}=\frac{1}{2\left(K-T_c\right)^2\sqrt{}}\left[2(K-s)(1+r)\left(K-T_c\right)+s(1+r)\left\{s(1+r)+\sqrt{}\right\}\right]$$

$$\frac{\partial E^*}{\partial T_c}>0$$

Hence, there is a positive relation between T_c and E*, because K >= s and K > T_c.

2. $\dfrac{\partial E^*}{\partial K}$

$$\frac{\partial E^*}{\partial K}=\frac{1}{2\left(K-T_c\right)^2}\left[\begin{array}{l}\left(K-T_c\right)\left\{\frac{1}{2\sqrt{}}\left(4(K-s)(1+r)+4(K-T_c)(1+r)\right)-2\right\}\\-\left\{\sqrt{}+s(1+r)-2\left(K-T_c\right)\right\}\end{array}\right]$$

$$\frac{\partial E^*}{\partial K}=\frac{1}{4\left(K-T_c\right)^2\sqrt{}}\left[4\left(K-T_c\right)(1+r)(-K+K-T_c)-2s(1+r)\left\{\sqrt{}+s(1+r)-2\left(K-T_c\right)\right\}\right]$$

$$\frac{\partial E^*}{\partial K} = \frac{1}{4\left(K - T_c\right)^2 \sqrt{\;}}\left[-4\left(K - T_c\right)(1+r)T_c - 4E^* s(1+r)\left(K - T_c\right)\right]$$

$$\frac{\partial E^*}{\partial K} = \frac{-(1+r)\left(T_c + E^* s\right)}{\left(K - T_c\right)\sqrt{\;}}$$

$$\frac{\partial E^*}{\partial K} < 0 \text{ for } E^* > 0$$

3. $\dfrac{\partial E^*}{\partial r}$

$$\frac{\partial E^*}{\partial r} = \frac{1}{2\left(K - T_c\right)}\left[\frac{1}{2\sqrt{\;}}\left(4(K-s)\left(K - T_c\right) + 2s^2(1+r)\right) + s\right]$$

$$\frac{\partial E^*}{\partial r} = \frac{1}{2\left(K - T_c\right)\sqrt{\;}}\left[2(K-s)\left(K - T_c\right) + s^2(1+r) + s\sqrt{\;}\right]$$

$$\frac{\partial E^*}{\partial r} > 0$$

4. $\dfrac{\partial E^*}{\partial s}$

$$\frac{\partial E^*}{\partial s} = \frac{1}{2\left(K - T_c\right)}\left[\frac{1}{2\sqrt{\;}}\left(-4\left(K - T_c\right)(1+r) + 2s(1+r)^2\right) + (1+r)\right]$$

$$\frac{\partial E^*}{\partial s} = \frac{2E^*(1+r)\left(K - T_c\right)}{2\left(K - T_c\right)\sqrt{\;}}$$

$$\frac{\partial E^*}{\partial s} = \frac{E^*(1+r)}{\sqrt{\;}}$$

$$\frac{\partial E^*}{\partial s} > 0 \text{ for } E^* > 0$$

Appendix 3

Comparative statics of reservation MFI interest rate r*

1. $\dfrac{\partial r^*}{\partial T_c}$

$$\frac{\partial r^*}{\partial T_c} = \frac{1}{\left[s(1+m)+2(K-s)+T_c\right]^2}\left[-s(1+m)-2(K-s)-T_c-K(K-s)(m-1)+T_c\right]$$

$$= \frac{-K(1+m)}{[\ ]^2} < 0$$

2. $\dfrac{\partial r^*}{\partial K}$

$$\frac{\partial r^*}{\partial K} = \frac{1}{\left[s(1+m)+2(K-s)+T_c\right]^2}\left[\left(s(1+m)+2(K-s)+T_c\right)(m-1)-2\left((K-s)(m-1)-T_c\right)\right]$$

$$\frac{\partial r^*}{\partial K} = \frac{(1+m)\left(s(m-1)+T_c\right)}{[\ ]^2}$$

$$\frac{\partial r^*}{\partial K} > 0 \text{ for } m > 1$$

3. $\dfrac{\partial r^*}{\partial m}$

$$\frac{\partial r^*}{\partial m} = \frac{1}{\left[s(1+m)+2(K-s)+T_c\right]^2}\left[\left(s(1+m)+2(K-s)+T_c\right)(K-s)-s\left((K-s)(m-1)-T_c\right)\right]$$

$$\frac{\partial r^*}{\partial m} = \frac{1}{[\ ]^2}\left[2s(K-s)+2(K-s)^2+KT_c\right]$$

$$\frac{\partial r^*}{\partial m} > 0$$

4. $\dfrac{\partial r^*}{\partial s}$

$$\frac{\partial r^*}{\partial s} = \frac{1}{\left[s(1+m)+2(K-s)+T_c\right]^2}\begin{bmatrix} \left(s(1+m)+2(K-s)+T_c\right)(1-m) \\ -\left((K-s)(m-1)-T_c\right)(m-1) \end{bmatrix}$$

$$\frac{\partial r^*}{\partial s} = \frac{K(1-m)(1+m)}{[\ \ ]^2}$$

$$\frac{\partial r^*}{\partial s} < 0 \text{ for m > 1}$$

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