How to Interpret the Commercialization of Microfinance: Mission Drift or Mission Division? *

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Abstract

The commercialization trend in microfinance, once an entirely non-profit industry, has triggered much debate about its direction. While some argue that the transition to a for-profit sector is a necessary step towards efficiency, others believe that profit-seeking will result in mission drift, i.e., a diversion away from its original mission of helping the poor. I offer a novel theoretical explanation for this polarization. The model presented has two distinguishing features. First, the costs of lending are increasing in poverty. Second, social investors have one of two distinct welfare goals: helping the poorest of the poor (Rawlsian) or maximizing consumer surplus (utilitarian). When costs are unobservable, commercialization signals low costs, which appeals to utilitarian investors but dissuades support by Rawlsian investors due to the wealthier borrowers associated with low costs. Therefore, so long as the Rawlsian philosophy is dominant, all MFIs (microfinance institutions) operate as non-profits. However, once utilitarian preferences take over, MFIs with wealthier clientele (the marginal poor) offer high repayment to investors to stand apart from MFIs that operate in highly impoverished communities and incur high costs. They cannot afford this signal and remain non-profit. In conclusion, utilitarian investors drive the commercialization trend, which divides the microfinance mission. For-profits attract more resources into the industry and serve the marginal poor while non-profits carry on the more costly task of serving the poorest of the poor.

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"...the future of microfinance is unlikely to follow a single path... Commercial investment is necessary to fund the continued expansion of microfinance, but institutions with strong social missions, many taking advantage of subsidies, remain best placed to reach and serve the poorest customers..."

Cull et al. (2009, p. 169)

1 Introduction

Since the 1980s, microfinance has grown rapidly to become a large industry.[1] Once limited to a few non-profits, microfinance has not only grown but also witnessed a surge of for-profits.[2] Dieckmann et al. (2007) state that microfinance has provided an increasingly attractive venue for socially responsible investment. Nevertheless, while some have interpreted for-profits' entry as a sign of the industry's health and success, others have expressed a concern that commercialization leads to profit-seeking and "mission drift." The latter term refers to a diversion of microfinance away from its original mission of alleviating poverty. However, proponents of the for-profit model see it as a necessary step towards efficiency. In this paper, I provide a novel theoretical explanation for this polarization.[3]

My model is motivated by two empirical observations. First, studies such as Cull et al. (2007, 2011) find that commercialization correlates negatively with measures of outreach to the poor. Second, evidence such as Gonzalez (2007); Husain and Pistelli (2016), reveal that microfinance costs are increasing in poverty. In other words, non-profit MFIs (microfinance institutions) tend to serve customers that are poorer and more costly than those served by more commercial MFIs. These findings point to the fact that social investors fund two distinct types of microfinance: one that targets extreme poverty and is typically non-profit, and another that is more commercial and has lower costs. Ghosh and Van Tassel (2013) present a theory that explains the investors' support of the latter type. They focus on the agency problem of cost unobservability and show that high interest rates charged by social investors filter high-cost institutions out of the market. However, this theory does not explain why investors would focus on low-cost MFIs, given that they come at the expense of MFIs that target extreme poverty. This theory also cannot explain why the latter MFIs persist in the market despite high costs.

The above observations suggest that each type of MFI, i.e., non-profit and for-profit, appeals to a different group of investors with varying degrees of concern about targeting the poorest within the poor. I present a model that captures this variation by allowing for two

[1] According to the Global Outreach & Financial Performance Benchmark Report - 2015, the global loan portfolio of microfinance reached $92.4 billion in 2015 (8.6% annual growth), with 116.6 million borrowers around the world (13.5% annual growth). For more information, visit: `http://www.themix.org/mixmarket/publications/2015-global-outreach-and-financial-performance-benchmark-report`

[2] For example, according to Microbanking Bulletin No. 20, for-profit institutions formed 81% of the Indian microfinance market in 2009. For more information, visit: `https://www.themix.org/publications/microbanking-bulletin/2010/09/microbanking-bulletin-september-2010-issue-no-20`

[3] Morduch (2000) refers to this polarization as "the microfinance schism" and offers a through discussion of it.

types of altruistic social investors. Rawlsian[4] investors favor the poorest of the poor, while utilitarian investors are not sensitive to the level of poverty and focus on costs as a result. These investors face a repayment amount per dollar offered by a socially motivated MFI with unobservable costs that are increasing in poverty.[5] The two sides play a signaling game, in which investors infer costs and poverty from the MFI's profit status (repayment offer).

I first demonstrate that in the absence of information asymmetry, commercialization is never optimal because the additional funds raised as a result of the higher returns offered to the investors are not worth the higher repayment burden imposed on the borrowers. Consequently, the MFI, regardless of costs, has no incentive to commercialize in a transparent environment. However, under information asymmetry, if the fraction of utilitarian investors is high enough, a low-cost MFI will increase repayment to send a credible signal of low costs that appeals to utilitarian investors. A high-cost MFI cannot afford this signal and chooses not to offer any repayment to investors as in the symmetric information case.

Therefore, I conclude that the combination of the high presence of utilitarian investors and low-cost MFI's efforts to attract more funds in a non-transparent environment drives the commercialization of microfinance. Thus, the presence of for-profits is not a sign of mission drift. The current mix of non-profits and for-profits is a "division" of the microfinance mission: for-profits serve large numbers of the marginal poor by tapping into utilitarian funds, and non-profits take up the more costly task of serving the poorest of the poor. This finding confirms the conjecture quoted at the beginning of this paper by Cull et al. (2009), based on their overview of the literature.

The intuition behind this result requires a more detailed description of the model. A socially motivated MFI and a pool of altruistic social investors play a sequential signaling game. The MFI privately knows whether it serves an extremely poor community (high-cost) or a marginally poor community (low-cost). It moves first and solicits the investors for funds by announcing a repayment amount per dollar. Investors, do not observe the MFI's type but know the distribution, and can infer more information from the repayment offer. They respond to the MFI's offer and decide how much to invest in microfinance. The MFI, in turn, uses the funds to lend to the poor and charges them the repayment promised to investors (financial costs) plus transaction costs that are increasing in poverty. The MFI's objective is to maximize consumer surplus. Each investor's utility is increasing in both private consumption and consumer surplus. A sub-group of them are Rawlsian and only value consumer surplus if the MFI serves an extremely poor community. The rest are utilitarian and value consumer surplus regardless of the poverty level. The distribution of investor types is public information. I solve for the sequential equilibrium and use the Cho and Kreps (1987) intuitive criterion to refine the set of equilibria.

I first analyze a benchmark model where poverty is observable (section 3) to show that the MFI's first best choice is full subsidy (repayment equal to 0). Underlying this finding is

[4]According to the Stanford Encyclopedia of Philosophy, John Rawls argues for fairness as a superior interpretation of justice than the utilitarian view, which understands justice as maximizing the collective happiness. Fore more information, visit: https://plato.stanford.edu/entries/rawls/#JusFaiJusWitLibSoc& https://plato.stanford.edu/entries/bentham/#GreHapPri

[5]This is equal to principal plus interest or the total amount that is to be paid back by the MFI to investors in the future. It is negatively correlated with MFIs' subsidy dependence and thus a measure of commercialization.

the fact that most for-profit MFIs are unable to pay interest rates that can compete with those of conventional financial markets, and some even rely on subsidies of some sort.[6] This is not surprising as the microfinance movement's reason to exist is that conventional banks do not find the poor profitable. Consequently, investors incur an opportunity cost when investing in microfinance by forgoing returns from more lucrative conventional finance. In other words, investing in microfinance is a form of implicit donation out of the future value of investors' wealth with the incentive of helping the poor. The model incorporates this idea as an assumption that the net profit margin of microfinance is lower than conventional finance.[7] To see the effect, consider a given investment amount at zero repayment (full subsidy). If the MFI increases the repayment offer, and the investors want to keep their net giving (forgone future value) constant, they have to increase their investment. However, since the net yield is lower in microfinance, the amount that the MFI has to repay the investors to keep their net giving the same will exceed the extra yield that the added funds create. Therefore, the impact (marginal consumer surplus) of forgone wealth diminishes, which, in turn, reduces investors' giving incentives. Note that, the investment amount might increase but not enough to translate into more net giving.

A simple example would help clarify this point. Say, the conventional market interest rate is 10% over a year. Hence, the future value of a hundred dollars is \$110. If one invests that money in microfinance, the MFI will lend it to the poor at a transaction cost of \$10. A borrower invests the money in a micro-enterprise, that after a year yields \$115. Note that the maximum amount that the MFI can charge the poor borrower is \$115, in which case the investor will receive \$115-\$10=\$105 after costs. Consequently, the investor will be \$5 short of the future value of her money. The five dollars will be her net donation in this case. First, consider the case of zero repayment. The MFI will then only have to charge \$10 to the borrower to cover its costs, leaving him with a surplus of \$115-\$10=\$105. The net donation, in this case, is \$110. Now consider a 55% repayment. In this case, for a \$100 loan, the MFI has to charge the borrower \$55+\$10=\$65 to cover costs and financial obligations, which leaves the borrower with a surplus of \$115-\$65=\$50. Thus, a \$100 investment translates into a donation of \$110-\$55=\$55. In order for the net giving to reach \$110, the investor has to contribute twice as before that is \$200. The consumer surplus, however, will be $2 \times \$50 = \$100$ that is \$5 less than before! This example demonstrates that as repayment increases, the reduction of impact renders forgoing future dollars less attractive to social investors. Of course, since higher repayment reduces the opportunity cost of investing, investments might increase. However, the added funds will not be high enough to outweigh the increase in borrowers' burden due to higher repayment. The result is that no repayment is optimal.

Nonetheless, despite the result form the benchmark model, the reality is that for-profit MFIs hold the lion's share of microfinance investments. In section 4, I introduce the full model with uncertainty to explain what motivates commercialization and why social investors increase funding in response to higher repayment amounts, notwithstanding the added burden

[6]For example, Dieckmann et al. (2007) report that other than a few exceptions, microfinance returns on equity (with an average of around 4%) are not high enough to attract purely profit-oriented investors.

[7]The profit margin of microfinance is equal to the future value of a dollar in the hands of the poor, minus the transaction costs of lending that dollar to the poor.

on poor borrowers. As a first step, I show that increasing repayment offer is less costly for a low-cost MFI (in a marginally poor community) because it has a higher profit margin compared to a high-cost MFI (in an extremely poor community). Thus, a high-cost MFI is more reluctant to commercialize, and a low-cost MFI can use repayment to reveal its type, which is a form of single-crossing property. The opposite, however, is not true. A high-cost MFI cannot separate from the other type, because a low-cost MFI can always mimic the repayment behavior of a high-cost MFI. As a result, the form of equilibrium (separating or pooling) depends on the signaling incentives of a low-cost MFI. That, in turn, depends on the breakdown of Rawlsian and utilitarian preferences in the investor pool.

I find that so long as the fraction of Rawlsian investors is high enough, serving the marginal poor (as opposed to the extremely poor) is not very popular. Thus, in the absence of information asymmetry, a high-cost MFI will receive more funds than a low-cost MFI. Hence, a low-cost MFI has no incentive to expose its type and pools with the other type on the first best repayment of 0. As the fraction of Rawlsian investors drops, the investor pool's preference for tackling extreme poverty diminishes, and so does a low-cost MFI's incentive to pool. Therefore, partially separating equilibria become possible. In such equilibria, a low-cost MFI mixes between pooling with the other type and separating at a higher repayment amount. With a further drop in the fraction of Rawlsian investors, the possibility of fully pooling equilibria diminishes. Once the utilitarian fraction of the investor pool becomes high enough, the order of funding reverses, i.e., investors contribute more when they verify low costs compared to when they observe high costs. Thus, a low-cost MFI has an incentive to offer a positive repayment (commercialization) and signal its type. The single-crossing property described earlier, guarantees that a high-cost MFI is unable to afford this signal and chooses the first best, i.e., zero repayment. As a result, the game reaches a separating equilibrium where the MFI perfectly reveals its type. In summary, as the fraction of utilitarian investors increases from 0 to 1, the equilibrium changes from full pooling on zero repayment to full separation with a low-cost MFI commercializing.

The two distinguishing features of the model underly this result: 1) the variation of costs with poverty 2) the distinction between Rawlsian and utilitarian investors. The first feature is a reflection of the intrinsic characteristics of extremely poor communities, such as remoteness, low connectivity, weak infrastructure, and small loan sizes, that increase the costs of financial transactions. Thus, even though higher costs mean lower consumer surplus, they are unavoidable in alleviating extreme poverty. The second feature of the model captures the variation in investors' preferences regarding this trade-off, and in turn, determines which MFI type would be favored and receive more funds. Commercialization as a signal of low costs arises as a result of this interaction between investors' preferences and MFI costs and poverty under information asymmetry.

Separation (full or partial) in equilibrium is consistent with the presence and higher market share of for-profits in the microfinance market and the empirical finding that there is a negative correlation between financial independence and serving the poorest of the poor.[8] Therefore, this study suggests that the dominance of the utilitarian view of welfare is the un-

[8] For example, Cull et al. (2016) find that on average commercial institutions make bigger loans (commonly interpreted as wealthier borrowers) and have lower costs compared to non-profits.

derlying explanation. Consequently, the commercialization trend is not necessarily a sign of mission drift. It can alternatively be interpreted as a "mission division" where all investors are socially motivated and intend to improve welfare for the poor but have different approaches to the mission that results in different business models. MFIs that tend to be more commercial (less subsidized) attract more funds from utilitarian investors and expand microfinance while non-profits rely on subsidies to serve the poorest of the poor and make sure no one is left behind. In this picture, both non-profit and for-profit microfinance are indispensable to poverty alleviation. Hence, the microfinance community should neither sideline non-profits in the name of efficiency, nor view for-profits as drifting away from the mission of fighting poverty.

On the policy side, this study urges policymakers to pay closer attention to sources of funding for microfinance programs to ensure that they are compatible with their poverty alleviation goals. The reason is that investors' preferences can affect who benefits from their funds by affecting microfinance business models. Neglecting this point can result in a program missing its intended target. This idea is especially important given the attractiveness of microfinance as a cost-effective tool of poverty alleviation.

Literature: The theoretical literature on microfinance commercialization is rather sparse. In one of the earliest papers in this literature, McIntosh and Wydick (2005) show how competing against for-profit institutions undermines the mission of non-profits by limiting their ability to cross-subsidize poorer borrowers through more profitable wealthier costumers. Later, Ghosh and Van Tassel (2011) argue for the benefits of competition between microfinance institutions for funds, by showing that it causes high-cost institutions to drop out of the market. Karaivanov (2016) focuses on moral hazard and finds that demanding higher interest on social investments incentivizes MFIs to operate more efficiently. In the closest paper to my work, Ghosh and Van Tassel (2013) demonstrate that as the microfinance sector grows, it reaches a point where social investors squeeze high-cost institutions out of the market to induce efficiency, by charging high interest on their funds. I take a few steps further by presenting a richer model, which leads to a result that is more consistent with empirical observations. According to their theory, all microfinance should converge to for-profit once the sector is large enough. However, as explained earlier, both for-profits and non-profits continue to have a strong presence in the market, which is consistent with the findings presented in the current paper.

On the empirical side, studies of commercialization generally point to the social costliness of profits. For example, Cull et al. (2007) conclude that there is evidence of a trade-off between profits and impact as the more profitable institutions perform worse in measures of outreach such as average loan size and the fraction of borrowers that are women. Cull et al. (2011) also find that profit-oriented MFIs are less likely to lend to women or poorer borrowers compared to institutions with lower commercial motives. Of course, there is some empirical evidence like Caudill et al. (2009), who find that lower subsidies correspond to more cost-effectiveness over time and Cull et al. (2016) , who find that on average commercial institutions make bigger loans while having lower costs compared to non-profits. Nevertheless, there is a trade-off between lower costs and outreach. For example, Hudon et al. (2017) use a dataset containing near 500 institutions and find that only 3% of those institutions are truly profitable and at the same time, serve their social goals. The rest face a trade-off between profitability and outreach.

There is also some empirical literature on returns to investment and subsidy dependence in commercial (and non-commercial) microfinance. They generally suggest that microfinance is not very attractive from a profitability viewpoint. For example, Mersland and Strøm (2008) find that the difference between the performance of shareholder-owned MFIs and non-government MFIs is negligible. Cull et al. (2007) look at data from more than 120 microfinance institutions and find that even in their sample that contains the most mature and efficient institutions, there is some reliance on subsidy. A Study by Cull et al. (2016) later confirms this finding by using data from more than 1300 institutions to find that the industry is highly reliant on subsidies that average at $132 per borrower. They also find that most subsidies are indirect in the form of cheap capital or equity grants.

In the following sections, I present the model and the findings. Section 2 describes the model in detail. Section 3 analyzes a benchmark case of full information to find the first best strategy of the MFI. The full model with uncertainty is discussed in section 4. Each subsection of section 4 discusses the game's outcome with a different distribution of preferences in the investor pool. Section 5 concludes.

2 Model Description

2.1 The Poor

Each poor individual i needs a small loan to invest in a project (micro-enterprise, education, health, etc.). The expected outcome of the project is y_i per dollar of investment. The poor do not have the initial capital for the project and do not have access to conventional finance. Their only source of capital is microfinance (if available) and their outside option is normalized to 0. The transaction cost of micro-lending (due to remoteness of location, loan size, etc.) is c_i per dollar.

2.2 Poverty

There are two types of poor communities (villages, slums, or neighborhoods) each with a large set of poor borrowers. One is extremely poor while the other is marginally poor. This distinction is captured by a poverty indicator $p \in \{0,1\}$ where $p = 1$ indicates extreme poverty and $p = 0$-marginal poverty. The average outcome of projects and average transaction cost of lending in a community are functions of this indicator: $Y(p) = E(y_i|p)$ and $C(p) = E(c_i|p)$ respectively. The interest rate in conventional financial markets (the future value of $1) is I_M. Consistent with empirical evidence, I assume that costs of microfinance make it less profitable than conventional banking.[9]

Assumption 1 $\forall p \quad I_M > Y(p) - C(p)$

[9] If this does not hold nothing prevents conventional banks from profitably lending to the poor and there will be no need for microfinance.

Also, consistent with data in Gonzalez (2007) and Husain and Pistelli (2016), I assume that microfinance becomes more costly at extreme poverty. Therefore, the microfinance profit margins are higher when poverty is lower.

Assumption 2 $Y(0) - C(0) > Y(1) - C(1)$

2.3 Microfinance Institution

The MFI is set up in a marginally poor community with probability π an a extremely poor community otherwise. The MFI is privately informed about its type, while the public only knows the distribution of p. The MFI offers a repayment $I \in [0, \bar{I}(p)]$ to raise funds F. Here, $\bar{I}(p) = Y(p) - C(p)$ is the maximum possible interest rate that the MFI can charge the poor. For example $I = 0$ represents pure donations. Alternatively $I > 0$ represents a lower level of subsidy dependence and more commercialization. $I > 1$ represents positive return to investment (accounting profit). The MFI would then lend to borrowers and charge $C(p) + I$ per dollar to cover its operational costs (transaction costs) and financial obligation to the social investor (cost of capital). The MFI's goal is to maximize its social impact.

$$v(F, I, p) = [Y(p) - C(p) - I] \cdot F \tag{1}$$

The term in the brackets represents the average surplus gained by the poor per dollar of loan. This term multiplied by the available funds F is the total consumer surplus from the microfinance activity.

2.4 Social Investors

There is a pool of n altruistic social investors. Each investor i has a large initial wealth of w and chooses to invest funds f_i after observing repayment I. An investor's utility depends on both private consumption and social impact:

$$u_i(f_i, F_{-i}, I, p) = g((w - f_i)I_M + f_i I) + \phi_i(p)(Y(p) - C(p) - I)h(F) \tag{2}$$

$g()$ and $h()$ are increasing and concave, i.e, $g'() > 0$, $g''() < 0$, $h'() > 0$, $h''() < 0$. The first term on the right-hand side represents diminishing utility from future private consumption that is equal to returns from investment in conventional finance and microfinance. The second term represents diminishing utility from the social impact of microfinance activity. $F = \sum_{i=1}^{n} f_i$ is the aggregate funds raised and $F_{-i} = F - f_i$. $\phi_i()$ is the investor's philosophy coefficient and depends on her type. A fraction $\Phi_R \in [0, 1]$ of the population, denoted by set R, are Rawlsian. They are focused on the welfare of the poorest and do not value consumer surplus if the MFI is not located in the poorer community type. For this group and $\phi_i(p) = p$. The $\Phi_U = 1 - \Phi_R$ remaining fraction of investors is denoted by set U. They are utilitarian and value consumer surplus in either community. For this group $\phi_i(p) = 1$. Hence, in summary:

$$\phi_i(p) = \begin{cases} p & \text{if } i \in R \\ 1 & \text{if } i \in U \end{cases}$$

The distribution of types, denoted by $\Phi = (\Phi_U, \Phi_R)$, is publicly observable.

2.5 Timing and Equilibrium Concept

Timing of the game is as follows:

1. The investors' average philosophy is publicly observed (Φ).
2. The MFI privately observes its type (p).
3. The MFI publicly chooses repayment (I).
4. The investors simultaneously choose how much to invest in MFI (F).
5. The MFI disburses loans and payoffs realize.

In the next two sections, I first consider a full information benchmark (section 3) an then solve for the sequential equilibrium of the full model (section 4). I apply the Cho-Kreps intuitive criterion for equilibrium refinement.

3 Full Information

Consider the benchmark case, in which the MFI's type p is observable to the investors. Once the MFI has offered a repayment I, each investor i chooses her investment (f_i) to maximize her utility:

$$\underset{f_i}{max}\ u_i(f_i, F_{-i}, I, p)$$

An investor's optimal response $f_i(F_{-i}, I, p)$ has to satisfy the corresponding first oder condition derived from the above problem and eq. 2:

$$g'(wI_M - f_i(F_{-i}, I, p)(I_M - I))(I_M - I) \geq \phi_i(p)(Y(p) - C(p) - I)h'(F_{-i} + f_i(F_{-i}, I, p))^{10} \quad (3)$$

Thus the individual best response is:

$$f_i(F_{-i}, I, p) = \left(\frac{1}{I_M - I}\right) max\left\{wI_M - g'^{-1}\left(\frac{\phi_i(p)(Y(p) - C(p) - I)h'(F_{-i} + f_i(F_{-i}, I, p))}{I_M - I}\right), 0\right\} \quad (4)$$

From here, the aggregate best response can be calculated as:

$$F(I, p, \Phi) = n\left(\frac{\Phi_U + p\Phi_R}{I_M - I}\right) max\left\{wI_M - g'^{-1}\left(\frac{(Y(p) - C(p) - I)h'(F(I, p, \Phi))}{I_M - I}\right), 0\right\} \quad (5)$$

Eq. 5 states the investor pool's optimal level of funding in the MFI for a given repayment I. However, it is not immediately clear how this optimal investment varies with changes in repayment amount. In fact, examining eq. 3 reveals that for a given community type p, a repayment increase has two opposing effects: 1) it reduces the marginal cost of investment (the left-hand side) by closing the repayment gap between microfinance and conventional

[10] The inequality is strict only for the case of a corner solution where $f_i(F_{-i}, I, p) = 0$.

finance and 2) it reduces the marginal benefit of investment (the right-hand side) by reducing the consumer surplus per dollar of investment. Since it is not trivial which effect is dominant, it is not easy to determine how aggregate funding responds to changes in repayment amount.

In order to shed some light on the investors' behavior it is best to focus on subsidy instead of funding. The former is the sum of future returns that social investors "forgo" when investing in the MFI who repays bellow the markets rate I_M. A slight rearrangement eq. 5 results in the following:

$$F(I,p,\Phi)(I_M - I) = n\left(\Phi_U + p\Phi_R\right) max\left\{wI_M - g'^{-1}\left(\frac{(Y(p) - C(p) - I)h'(F(I,p,\Phi))}{I_M - I}\right), 0\right\} \tag{6}$$

The left-hand side of the eq. 6 is the investors' "subsidy" or "net giving" to the MFI, which can be shown to be decreasing in repayment I. The first step is to focus on the term $\frac{(Y(p)-C(p)-I)h'(F(I,p,\Phi))}{I_M-I}$ in the right-hand side. This represents the marginal benefit of a unit of net giving (subsidy) which is decreasing in repayment rate I. The intuition is that an increase in repayment reduces both the consumer surplus and the net giving per unit of investment, but since by assumption 1 the latter is always bigger, the ratio of the two terms or the consumer surplus per unit of net giving diminishes.[11] As a result, subsidizing the MFI becomes less attractive as the MFI increases repayment to social investors. Hence, one should expect the total subsidy to be diminishing in repayment rate I, which in turn suggests that a the lowest possible repayment (a pure non-profit) has to be optimal for the MFI.

The above prediction can be formally shown to hold by focusing on the MFI's problem. Anticipating the investors' response (eq. 5), the MFI aims to maximize the social impact by choosing the repayment I:

$$\max_I v(F(I,p,\Phi), I, p)$$

At a first glance, the effect of increasing the repayment seems unclear. On the on hand it has both a direct cost of reducing the consumer surplus per dollar for the MFI and an indirect effect of reducing the marginal benefit of investment for the investors. On the other hand, a repayment increase reduces the marginal cost of investment. Nonetheless, the objective function can be rewritten as the product of total subsidy and the consumer surplus per unit of subsidy:

$$\max_I \left[\frac{Y(p) - C(p) - I}{I_M - I}\right] \cdot F(I,p,\Phi)(I_M - I)$$

Since both terms are decreasing in the repayment amount, the MFI's payoff will also be decreasing in the repayment I. Thus, the optimization problem has a corner solution at 0.

Proposition 1 *If p is observable to the social investors, the MFI's optimal repayment is 0 for both types, i.e. $I^*(1) = I^*(0) = 0$.*[12] *Moreover, let $\overline{\Phi}$ satisfy $F(0,0,\overline{\Phi}) = F(0,1,\overline{\Phi})$. For any Φ such that $\Phi_U > \overline{\Phi}_U$, $F(0,0,\Phi) > F(0,1,\Phi)$ and for any Φ such that $\Phi_U < \overline{\Phi}_U$, $F(0,0,\Phi) < F(0,1,\Phi)$.*

[11] The mathematical proof is given in the appendix as part of the proof of proposition 1.

[12] $I^*(p)$ represents the equilibrium choice of type p under information symmetry that is independent of average investor philosophy Φ.

Proposition 1 reveals that in the absence of information asymmetry and signaling motives, the MFI is reluctant to commercialize. Even though this benchmark model does not apply to today's microfinance market, it can help us with understanding the early days of microfinance when the entire market comprised a handful of non-profits. The small market was more transparent and in-line with the full information benchmark. Moreover, early MFIs were focused on the poorest of the poor, which in the context of this model corresponds to $p = 0$.[13] The resulting equilibrium is that the MFI always optimally chooses a repayment of 0 and has no incentive to further commercialize. Furthermore, it is straightforward to establish that this result is independent of Φ. I, hereon, will refer to this as the first best repayment.

In the next section, I will analyze the full model and demonstrate that under information asymmetry, when the utilitarian fraction of investors (Φ_U) is low enough, both types of MFI pool on the first best repayment. Conversely, when the investors are utilitarian enough, the MFI types separate with an institution in the poorer community type staying at the first best and an institution in the wealthier community type increasing repayment (commercialization).

4 Full Model

Under information asymmetry, once the MFI has offered repayment I, the investors form a belief about the MFI's type (p) from the repayment. Let the investors' belief about the posterior probability of $p = 1$, upon observing I, be denoted as $\eta(I)$. At this point an investor will choose how much to invest (f_i) to maximize her expected utility:

$$\max_{f_i} E_{p\sim\eta(I)} u_i(f_i, F_{-i}, I, p)$$

From the above problem and eq. 2, an investor's optimal response $f_i(F_{-i}, I, \eta)$ has to satisfy the following first oder condition:

$$g'(wI_M - f_i(F_{-i}, I, \eta)(I_M - I))(I_M - I) \geq E_{p\sim\eta}[\phi_i(p)(Y(p) - C(p) - I)h'(F_{-i} + f_i(F_{-i}, I, p))]^{14} \tag{7}$$

From this, the individual best response is:

$$f_i(F_{-i}, I, \eta) = \left(\frac{1}{I_M - I}\right) max\left\{wI_M - g'^{-1}\left(\frac{E_{p\sim\eta}[\phi_i(p)(Y(p) - C(p) - I)h'(F_{-i} + f_i(F_{-i}, I, p))]}{I_M - I}\right), 0\right\} \tag{8}$$

Comparing the above result with eq. 4 implies that each investor's response lies between her best responses under full information with $p = 0$ and $p = 1$ respectively, that is:

$$min(f_i(F_{-i}, I, 0), f_i(F_{-i}, I, 1)) \leq f_i(F_{-i}, I, \eta) \leq max(f_i(F_{-i}, I, 0), f_i(F_{-i}, I, 1))$$

[13] As an exmaple one can refer to the famous case of Grameen bank in its early days. Muhammad Yunus himself was both the source of funding and the manager of the bank. Thus obviously, there was no information asymmetry between the investor and the MFI. Moreover, he targeted the poorest of the poor in rural Bangladesh. (Yunus, 2007)

[14] The inequality is strict only for the case of a corner solution where $f_i(F_{-i}, I, \eta) = 0$.

However, this does not automatically extend to the aggregate best response $F(I, \eta, \Phi)$. To see why, consider the case of $\eta = 0$. In this case the marginal benefit of investment for the Rawlsian investors is 0 and eq. 7 holds with inequality. Thus a marginal increase in η will increase their marginal benefit, but will not affect their giving. Nonetheless, for the utilitarian investors, eq. 7 holds with equality and they immediately respond to a marginal increase in η by reducing their investment. As a result, the aggregate funding drops even if the pool of investors is predominantly Rawlsian. Note that this is true so long as there is at least one utilitarian investor in the pool. Therefore, even though for a low enough Φ_U the aggregate investment will eventually increase in η, the change is not monotonic.

Lemma 1 *The aggregate funding is decreasing in belief at $\eta = 0$, i.e. $\frac{\partial F(I,\eta,\Phi)}{\partial \eta}|_{\eta=0} \leq 0$. The inequality is strict for any $\Phi_U > 0$. Moreover, there exists $\underline{\Phi}$ such that $\underline{\Phi}_U < \overline{\Phi}_U$ and satisfies $F(0, 0, \underline{\Phi}) = F(0, \pi, \underline{\Phi})$. Then for any Φ such that $\Phi_U > \underline{\Phi}_U$, $F(0, 0, \Phi) > F(0, \pi, \Phi)$ and for any Φ such that $\Phi_U < \underline{\Phi}_U$, $F(0, 0, \Phi) < F(0, \pi, \Phi)$.*

Lemma 1 reveals that the aggregate best response is non-monotonic in the belief η over the intermediate range of $(\underline{\Phi}_U, \overline{\Phi}_U]$. The intuition is that when the MFI is known to be in a marginally poor community ($\eta = 0$) all the utilitarian investors find it worthwhile to invest. However, when the two types have pooled together ($\eta = \pi$) the investment incentives of the utilitarian investors diminish while the Rawlsian investors still do not find that probability high enough to invest. Thus the overall investment drops. At the other extreme, when the MFI is known to be in an extremely poor community ($\eta = 1$) all the Rawlsian investors find it worthwhile to invest and the aggregate funding goes back up and above the level with $\eta = 0$.

Since investors infer $\eta(I)$ from the repayment, the MFI's problem would be:

$$\max_I v(F(I, \eta(I), \Phi), I, p)$$

One can extend Proposition 1[15] and find that for a given belief held by the investors, the first best for the MFI is to set the repayment equal to 0. Yet, under information asymmetry, an MFI might be able to improve the investors' belief and increase its impact by increasing the repayment. However, by Assumption 2, the marginal consumer surplus of an MFI in the wealthier community ($p = 1$) is higher for a given repayment, i.e. $Y(1) - C(1) - I < Y(0) - C(0) - I$ for any I. Therefore, from eq. 1 it can be shown that a repayment increase is less costly for the MFI when $p = 0$.

Lemma 2 ***(Single Crossing Property)*** *It is less costly for the MFI to increase repayment, when it is in the wealthier community, i.e. for any $I_1 < I_2$ such that $F(I_1, \eta(I_1), \Phi) < F(I_2, \eta(I_2), \Phi)$,*

$$v(F(I_1, \eta(I_1), \Phi), I_1, 1) \leq v(F(I_2, \eta(I_2), \Phi), I_2, 1)$$

implies

$$v(F(I_1, \eta(I_1), \Phi), I_1, 0) < v(F(I_2, \eta(I_2), \Phi), I_2, 0)$$

[15] This is Lemma A-1 in the appendix.

Lemma 2 reveals that only when the MFI is located in the wealthier community it can separate itself form the other type by sending a credible signal (higher repayment). This property suggests that in any equilibrium, if more than one repayment appears on the equilibrium path, higher rates must belong to an MFI that serves a marginally poor community. This is formally stated in the following lemma.

Lemma 3 *In all sequential equilibria, the following hold on the equilibrium path:*

1. *The two types of MFI pool on no more than one repayment, denoted by I_p.*
2. *An MFI in a wealthier community ($p = 0$) chooses at most one other repayment, denoted by I_H.*
3. *An MFI in a poorer community ($p = 1$) chooses at most one other repayment, denoted by I_L.*
4. *The repayments on the equilibrium path satisfy $I_L < I_P < I_H$.*

Lemma 3 proves that not only it is less costly for an MFI in a wealthier community to increase repayments ex ante (Lemma 2) but also posterior probability of extreme poverty is non-increasing in repayment on the equilibrium path. Therefore, it is plausible to expect the investors to hold monotonic off-equilibrium beliefs. In other words, it is counterintuitive for the investors to observe a higher repayment and form a belief that the probability of the MFI being in an extremely poor community is higher. I use this to refine the set of equilibria to monotonic belief equilibria.

Assumption 3 *A monotonic belief equilibrium is an equilibrium where the investor's posterior beliefs satisfy:*

$$I_1 < I_2 \Rightarrow \eta(I_1) \geq \eta(I_2)$$

The exact form of the equilibrium depends on whether an MFI in a marginally poor community has an incentive to separate and reveal its type. That, in turn, depends on which type of MFI would receive better funding from the investor pool, which is determined by the average philosophy Φ. In the next three sections, I show that when the investor pool is more Rawlsian ($\Phi_U \leq \overline{\Phi}_U$), they prefer to contribute more funds to an MFI in a poorer community. Thus, an MFI in the wealthier community is better off mixing with the other type and the game ends in a pooling or partially pooling equilibrium. In contrast, a more utilitarian group ($\Phi_U > \overline{\Phi}_U$) favors an MFI in a wealthier community. Therefore, the two types separate in equilibrium.

4.1 Rawlsian Investor Pool

Consider a purely Rawlsian investor pool ($\Phi_U = 0$). From eq. 5, it can be seen that if the MFI's type were to be revealed, it would only receive funding, if the location was the poorer community type. The intuition is that the marginal benefit of investing in a wealthier community is 0 for all investors as evident in eq. 7. Thus, an MFI in the wealthier community has no incentive to separate. Moreover, by Lemma 2, an MFI in a poorer community cannot send a credible signal to separate itself. Consequently, only fully pooling equilibria are possible. Moreover, under monotonicity of beliefs as explained in Assumption 3, the pooling strategy cannot exceed 0 which is the MFI's first best.[16] The results is that the set of equilibria will be refined to a unique equilibrium. Moreover, by Lemma 1, with any investor pool that is Rawlsian enough ($\Phi_U \leq \underline{\Phi}_U$), the MFI receives more funding under prior belief than when it is known to be in a wealthier community. Hence, the MFI types cannot separate in equilibrium.

Proposition 2 *For all Φ such that $\Phi_U \leq \underline{\Phi}_U$, there is a unique monotonic belief sequential equilibrium. In such equilibrium, the two MFI types pool on zero repayment, i.e., $I^{**}(0, \Phi) = I^{**}(1, \Phi) = 0$.*

Proposition 2 states that if the investor pool is Rawlsian enough, it induces both MFI types to keep to the first best repayment of 0 without any incentive to commercialize. Intuitively, the Rawlsian investor's favorite type is an MFI who serves the core poor. One would expect such MFI to send a credible signal to investors and separate itself form the other type. However, any signal that is affordable for an MFI in an extremely poor community where costs are high, is also affordable for a low-cost MFI in a wealthier community. Therefore, since the latter type has an incentive to pretend to be the favored type, any separation is impossible and the game ends in a pooling equilibrium.

4.2 Utilitarian Investor Pool

At the other extreme, consider a purely utilitarian pool of investors ($\Phi_U = 1$). In this case, the marginal benefit of investing in an MFI (the right-hand side of eq. 7) is solely dependent on costs and thus higher for a low-cost MFI. Therefore, the utilitarian investors' preferred type is an MFI in the wealthier community which gives it an incentive to separate form the other type. Lemma 2 guarantees that a credible signal of low-cost is possible and separating equilibrium exists. Moreover, the intuitive criterion and monotonicity of beliefs limit the set of equilibria to the least costly separating (Riley) equilibrium. Furthermore, this result can be extended to any pool of investors that is utilitarian enough ($\Phi_U > \overline{\Phi}_U$) such that an MFI in a marginally poor community receives more funding. Over this range, such MFI has an incentive to separate from an MFI in an extremely poor community.

Proposition 3 ***(Mission Devision Equilibrium)*** *For all Φ such that $\Phi_U > \overline{\Phi}_U$, Riley separating equilibrium is the unique monotonic belief sequential equilibrium that satisfies Cho-Kreps intuitive criterion. The MFI in the extremely poor community ($p = 1$) chooses the first best repayment of 0 while the MFI in the marginally poor community ($p = 0$) chooses a strictly higher repayment and raises more funds, i.e. $I^{**}(0, \Phi) > I^{**}(1, \Phi) = 0$ and $F(I^{**}(0, \Phi), 0, \Phi) > F(I^{**}(1, \Phi), 1, \Phi)$.*

Proposition 3 describes the "mission devision" equilibrium in microfinance. An MFI that is located in a wealthier community and serves the marginal poor, offers a higher repayment to signal lower costs and raise more funds. This is consistent with the higher average loan size and bigger market share of the commercial MFIs observed in data. In contrast, an MFI that is located in a poorer community and serves the core poor cannot afford the more commercial

[16] This is Lemma A-2 in the appendix.

model of the other type and thus, offers a zero repayment that corresponds to a non-profit model.

4.3 Semi-Rawlsian Investor Pool

What happens if the pool of investors includes a significant fraction of both Rawlsian and utilitarian types? More accurately what will the equilibrium look like if $\underline{\Phi}_U < \Phi_U \leq \overline{\Phi}_U$. In this case, on the one hand, by Proposition 1, an MFI in a marginally poor community receives less funding when exposed than when it is believed to be in an extremely poor community. Therefore, as in the Rawlsian case, it has an incentive to pool with the other type and a fully separating equilibrium does not occur. However, on the other hand, by Lemma 1, it raises more funds when exposed than when it is fully pooling with the other type of MFI. Thus, a partial separation from the pool is desirable. This results in a partially separating equilibrium, where an MFI in a marginally poor community mixes between pooling with the other type and a higher repayment that separates it from the pool.

Proposition 4 *For all Φ such that $\underline{\Phi}_U < \Phi_U \leq \overline{\Phi}_U$, in any monotonic belief sequential equilibrium that satisfies Cho-Kreps intuitive criterion, an MFI in an extremely poor community ($p = 1$) chooses one repayment $I^{**}(1, \Phi) \geq 0$ for sure. The strategy of an MFI in a marginally poor community ($p = 0$) is pooling with the other type at $I^{**}(1, \Phi)$ with probability $\gamma \in (0, 1]$ and separating from the pool at a higher repayment $I^{**}(0, \Phi) > I^{**}(1, \Phi)$ with probability $1 - \gamma$. Moreover, a partially separating equilibrium ($\gamma < 1$) always exists.*

Proposition 4 states the interesting feature of the equilibria over this interim range. Even though a fully pooling equilibrium cannot be ruled out entirely, partial separation is always possible. In other words, separation incentives of an MFI in a marginally poor community strengthen with the increase in utilitarianism.

Interestingly, the monotonic belief sequential equilibria are not unique in this case, even after imposing Cho-Kreps intuitive criterion. In fact, as the fraction of utilitarian investors increases, it becomes possible for the strategy of an MFI in an extremely poor community to be a strictly positive repayment, i.e. $I^{**}(1, \Phi) > 0$. This is in contrast to the cases of utilitarian and Rawlsian investor pools, where such MFI always chooses $I^{**}(1, \Phi) = 0$. Such equilibria require off-equilibrium beliefs at low repayments that are "worse" than the pooling distribution to prevent downward deviation. Moreover, since $\Phi_U \leq \overline{\Phi}_U$, by Proposition 1, low poverty ($\eta = 0$) raises less funds and is a "worse" belief compared to high poverty ($\eta = 1$). Thus, at a first glance, it seems as such equilibria can only be maintained by violating Assumption 3. In other words, one might expect that any increase in η upon downward deviation, as required by belief monotonicity, will result into a "better" belief than the pooling distribution and provides a deviation incentive. Yet, interestingly, this is not always the case, since funding does not monotonically change with the probability of extreme poverty. In fact, while by Proposition 1, $\Phi_U < \overline{\Phi}_U$ implies $F(I^*(0), 0, \Phi) < F(I^*(1), 1, \Phi)$, by Lemma 1, $\Phi_U > \underline{\Phi}_U$ implies that $F(I^*(0), 0, \Phi) > F(I^*(0), \pi, \Phi)$. Consequently, there may exist posterior distributions that put higher probability on extreme poverty, but raise less funds than the pooling distribution. Such posterior distributions, as off-equilibrium beliefs, do not violate Assumption 3 and prevent downward deviation, which gives raise to equilibria where the two types of MFI (partially) pool on a positive repayment.

5 Conclusion

According to this analysis, despite a trade-off existing between repayments and social impact, positive returns in microfinance are not necessarily driven by pure profit motives. In fact, under symmetric information or when the social investors have a Rawlsian view of welfare, an MFI has no incentive to offer high repayments. It is a combination of information asymmetry and the utilitarian view of welfare on the investor side that prompts signaling by positive repayments. In such an environment, an MFI that serves a marginally poor community uses a more commercial model than an MFI in an extremely poor community. The former MFI type has lower costs due to a wealthier clientele and signals that through a positive repayment to social investors to raise more funds. The latter type, however, operates closer to a charity model, because it cannot afford high repayments due to high costs.

The conclusion is that deferent business models in microfinance can be a result of differences in the poverty level of the consumers and the welfare goals of social investors. The two types of microfinance divide the mission and tackle different levels of poverty, making both indispensable to poverty alleviation. Moreover, the investors' welfare philosophy can have a significant impact on the type of poor customers that benefit most from microfinance activities. Therefore, development policymakers need to pay due attention to the funding sources of microfinance.

Appendix

Proof of Proposition 1

Part 1: the aggregate funding from eq. 5 can be rewritten as $F(I,p,\Phi) = n\left(\frac{\Phi_U + p\Phi_R}{I_M - I}\right)\left(wI_M - g'^{-1}(X)\right)$ where $X = \frac{(Y(p)-C(p)-I)h'(F(I,p,\Phi))}{I_M - I}$. Thus the marginal funding is:

$$\frac{\partial F(I,p,\Phi)}{\partial I} = \frac{F(I,p,\Phi)}{I_M - I} + n\left(\frac{\Phi_U + p\Phi_R}{I_M - I}\right)\left(-g'^{-1\prime}(X)\frac{\partial X}{\partial I}\right) \tag{A-1}$$

It is straight forward that if $\frac{\partial F(I,p,\Phi)}{\partial I} < 0$ then $\frac{\partial X}{\partial I} < 0$. Also if $\frac{\partial F(I,p,\Phi)}{\partial I} \geq 0$ then:

$$\frac{\partial X}{\partial I} = \frac{(Y(p)-C(p)-I)h''(F(I,p,\Phi))\frac{\partial F(I,p,\Phi)}{\partial I}(I_M - I) + (Y(p)-C(p)-I_M)h'(F(I,p,\Phi))}{(I_M - I)^2} < 0 \tag{A-2}$$

Moreover the MFI's payoff is $v(F(I,p,\Phi),I,p) = n(Y(p)-C(p)-I)\left(\frac{\Phi_U + p\Phi_R}{I_M - I}\right)\left(wI_M - g'^{-1}(X)\right)$ thus the marginal effect of repayment I is:

$$\frac{\partial v(F(I,p,\Phi),I,p)}{\partial I} = n\left(\frac{\Phi_U + p\Phi_R}{I_M - I}\right)\left[\left(\frac{Y(p)-C(p)-I_M}{I_M - I}\right)(wI_M - g'^{-1}(X)) - (Y(p)-C(p)-I)g'^{-1\prime}(X)\frac{\partial X}{\partial I}\right] \tag{A-3}$$

which by eq. A-2 implies $\frac{\partial v(F(I,p,\Phi),I,p)}{\partial I} < 0$. Thus, the MFI's problem has a corner solution at $I^* = 0$. This completes the first part of the theorem.

Part 2: at $p = 1$ funding is independent of Φ and has to satisfy:

$$F(I,1,\Phi) = \left(\frac{n}{I_M - I}\right)\left(wI_M - g'^{-1}\left(\frac{(Y(1) - C(1) - I)h'(F(I,1,\Phi))}{I_M - I}\right)\right)$$

At $p = 0$ funding satisfies:

$$F(I,0,\Phi) = \left(\frac{n\Phi_U}{I_M - I}\right)\left(wI_M - g'^{-1}\left(\frac{(Y(0) - C(0) - I)h'(F(I,0,\Phi))}{I_M - I}\right)\right)$$

Comparing the two and noting that both $h'()$ and $g'^{-1}()$ are decreasing functions reveals that for any I and any Φ, $F(I,0,(0,1)) = 0 < F(I,1,\Phi) < F(I,0,(1,0))$. Therefore, there exist $\overline{\Phi}_U$ such that $F(0,0,\overline{\Phi}) = F(0,1,\overline{\Phi})$. Moreover, since both $h'()$ and $g'^{-1}()$ are decreasing functions, $F(I,0,\Phi)$ is increasing in Φ_U for any I. This completes the proof. ■

Proof of Lemma 1

Part 1: the aggregate best response can be calculated as:

$$F(I,\eta,\Phi) = \left(\frac{\Phi_R n}{I_M - I}\right) max\left\{wI_M - g'^{-1}\left(\eta X_1\right),0\right\} + \left(\frac{\Phi_U n}{I_M - I}\right) max\left\{wI_M - g'^{-1}\left((1-\eta)X_0 + \eta X_1\right),0\right\} \tag{A-4}$$

where $X_0 = \frac{(Y(0)-C(0)-I)h'(F(I,\eta,\Phi))}{I_M - I}$ and $X_1 = \frac{(Y(1)-C(1)-I)h'(F(I,\eta,\Phi))}{I_M - I}$. Consider $\bar{\eta}$ such that for $\Phi_U = 0$, $wI_M - g'^{-1}(\bar{\eta}X_1) = 0$. Since $F(I,\eta,\Phi)$ is increasing in Φ_U , it is straightforward that for any $\Phi_U > 0$, $wI_M - g'^{-1}(\bar{\eta}X_1) < 0$. Therefore, for any $\eta \in [0,\bar{\eta}]$ eq. A-4 simplifies to: $F(I,\eta,\Phi) = \left(\frac{\Phi_U n}{I_M - I}\right)\left(wI_M - g'^{-1}\left((1-\eta)X_0 + \eta X_1\right)\right)$. As a result:

$$\frac{\partial F(I,\eta,\Phi)}{\partial \eta} = \frac{\left(\frac{\Phi_U n}{I_M - I}\right)\left(-g'^{-1'}\left((1-\eta)X_0 + \eta X_1\right)\right)\left(\frac{(Y(1)-C(1)-Y(0)+C(0))h'(F(I,\eta,\Phi))}{I_M - I}\right)}{1 - \left(\frac{\Phi_U n}{I_M - I}\right)\left(-g'^{-1'}\left((1-\eta)X_0 + \eta X_1\right)\right)\left(\frac{[(1-\eta)(Y(0)-C(0)-I)+\eta(Y(1)-C(1)-I)]h''(F(I,\eta,\Phi))}{I_M - I}\right)} \leq 0$$

and the inequality is strict for any $\Phi_U > 0$. This completes the proof of the first part.

Part 2: I will consider two cases separately.

Case 1: $\pi \leq \bar{\eta}$

From part 1, for all $\eta \leq \bar{\eta}$, at $\Phi_U = 0$: $F(I,\eta,\Phi) = 0$ and $\frac{\partial F(I,\eta,\Phi)}{\partial \eta} = 0$. Therefore it is straightforward that if $\pi \leq \bar{\eta}$, then $\underline{\Phi}_U = 0$ satisfies $F(0,0,\underline{\Phi}) = F(0,\pi,\underline{\Phi})$. Moreover, since by part 1, for any $\eta \leq \bar{\eta}$ at any $\Phi_U > 0$, $\frac{\partial F(I,\eta,\Phi)}{\partial \eta} < 0$, then for any $\Phi_U > \underline{\Phi}_U = 0$, $F(0,0,\Phi) > F(0,\pi,\Phi)$.

Case 2: $\pi > \bar{\eta}$

By part 1, for any $\Phi_U > 0$, $\frac{\partial F(I,\eta,\Phi)}{\partial \eta} < 0$ at any $\eta \leq \bar{\eta}$. As a result for any $\Phi_U \leq \overline{\Phi}_U$, since by Proposition 1, $F(0,0,\Phi) \leq F(0,1,\Phi)$, there exists $\eta_0(\Phi) \in (\bar{\eta}, 1]$ such that it solves $F(0,0,\Phi) = F(0,\eta_0(\Phi),\Phi)$. It is also straightforward that $\eta_0(\overline{\Phi}) = 1$. Moreover, from previous case $lim_{\Phi_u=0}\eta_0(\Phi) \rightarrow \bar{\eta}$. Therefore, for any $\pi \in (\bar{\eta}, 1)$ there exist $\underline{\Phi}$ such that $\underline{\Phi}_U < \overline{\Phi}_U$ and satisfies $\eta_0(\underline{\Phi}) = \pi$. Then for any Φ such that $\Phi_U > \underline{\Phi}_U$, $F(0,0,\Phi) > F(0,\pi,\Phi)$ and for any Φ such that $\Phi_U < \underline{\Phi}_U$, $F(0,0,\Phi) < F(0,\pi,\Phi)$. ■

Lemma A-1 *For any given posterior belief (η) MFI's payoff is decreasing in repayment, i.e.* $\frac{\partial v(F(I,\eta,\phi),I,p)}{\partial I} < 0$.

Proof

Consider the aggregate best response as given by eq. A-4. There are two possible cases.

Case 1: If $wI_M \geq g'^{-1}(X_1)$ then since $g'^{-1}()$ is positive and decreasing:

$$\frac{\partial F(I,\eta,\Phi)}{\partial I} = \left(\frac{\Phi_R n}{(I_M - I)^2}\right)\left(wI_M - g'^{-1}(X_1)\right) - \left(\frac{\Phi_R n}{I_M - I}\right) g'^{-1\prime}(X_1)\left(\frac{\partial X_1}{\partial I}\right)$$
$$+ \left(\frac{\Phi_U n}{(I_M - I)^2}\right)\left(wI_M - g'^{-1}(X_0 + X_1)\right) - \left(\frac{\Phi_U n}{I_M - I}\right) g'^{-1\prime}(X_0 + X_1)\left(\frac{\partial X_0}{\partial I} + \frac{\partial X_1}{\partial I}\right) \quad \text{(A-5)}$$

It is straight forward that if $\frac{\partial F(I,\eta,\Phi)}{\partial I} < 0$ then $\frac{\partial X_p}{\partial I} < 0$ for all p. Also if $\frac{\partial F(I,p,\Phi)}{\partial I} \geq 0$ then:

$$\frac{\partial X_p}{\partial I} = \eta_p \times \frac{(Y(p) - C(p) - I)h''(F(I,\eta,\Phi))\frac{\partial F(I,\eta,\Phi)}{\partial I}(I_M - I) + (Y(p) - C(p) - I_M)h'(F(I,\eta,\Phi))}{(I_M - I)^2} < 0 \quad \text{(A-6)}$$

The MFI's payoff is $v(F(I,\eta,\Phi),I,p) = (Y(p) - C(p) - I)F(I,\eta,\Phi)$. Thus from eq. A-4 the marginal effect of repayment I is:

$$\frac{\partial v(F(I,\eta,\phi),I,p)}{\partial I} = -F(I,\eta,\Phi) + (Y(p) - C(p) - I)\frac{\partial F(I,p,\phi)}{\partial I}$$
$$= \left(\frac{\Phi_R n}{I_M - I}\right)\left[\left(\frac{Y(p) - C(p) - I_M}{I_M - I}\right)\left(wI_M - g'^{-1}(X_1)\right) - (Y(p) - C(p) - I)g'^{-1\prime}(X_1)\left(\frac{\partial X_1}{\partial I}\right)\right] +$$
$$\left(\frac{\Phi_U n}{I_M - I}\right)\left[\left(\frac{Y(p) - C(p) - I_M}{I_M - I}\right)\left(wI_M - g'^{-1}(X_0 + X_1)\right) - (Y(p) - C(p) - I)g'^{-1\prime}(X_0 + X_1)\left(\frac{\partial X_0}{\partial I} + \frac{\partial X_1}{\partial I}\right)\right]$$

which by eq. A-6 implies $\frac{\partial v(F(I,\eta,\phi),I,p)}{\partial I} < 0$.

Case 2: If $wI_M < g'^{-1}(X_1)$ then only utilitarian invesotors invest thus:

$$\frac{\partial F(I,\eta,\Phi)}{\partial I} = \left(\frac{\Phi_U n}{(I_M - I)^2}\right)\left(wI_M - g'^{-1}(X_0 + X_1)\right) - \left(\frac{\Phi_U n}{I_M - I}\right) g'^{-1\prime}(X_0 + X_1)\left(\frac{\partial X_0}{\partial I} + \frac{\partial X_1}{\partial I}\right)$$

The solution is analogous to case 1. ■

Proof of Lemma 2

From eq. 1 $v(F(I_1, \eta(I_1), \Phi), I_1, 1) \leq v(F(I_2, \eta(I_2), \Phi), I_2, 1)$ can be written as:

$$(Y(1) - C(1) - I_1)F(I_1, \eta(I_1), \Phi) \leq (Y(1) - C(1) - I_2)F(I_2, \eta(I_2), \Phi) \qquad \text{(A-7)}$$

Since $F(I_1, \eta(I_1), \Phi) < F(I_2, \eta(I_2), \Phi)$ and by Assumption 2, $Y(1) - C(1) < Y(0) - C(0)$, eq. A-7 implies:

$$(Y(0) - C(0) - I_1)F(I_1, \eta(I_1), \Phi) < (Y(0) - C(0) - I_2)F(I_2, \eta(I_2), \Phi)$$

which completes the proof. ■

Proof of Lemma 3

Part 1: Assume by the means of contradiction that both types of MFI offer two repayments $I_1 < I_2$ with positive probability. Thus, it must be true that an MFI with $p = 1$ is indifferent between these two strategies, i.e. $v(F(I_1, \eta(I_1), \Phi), I_1, 1) = v(F(I_2, \eta(I_2), \Phi), I_2, 1)$. By Lemma 2, this implies $v(F(I_1, \eta(I_1), \Phi), I_1, 0) < v(F(I_2, \eta(I_2), \Phi), I_2, 0)$ which contradicts MFI with $p = 0$ mixing the two strategies I_1 and I_2.

Parts 2 and 3: Assume by the means of contradiction that an MFI of type p chooses two repayments with positive probability $I_1 \neq I_P$ and $I_2 \neq I_P$ such that $I_1 < I_2$. By part 1, the other MFI type will not choose either of these two with positive probability. Therefore, consistent posterior belief has to be $\eta(I_1) = \eta(I_2) = p$. By Proposition 1, $v(F(I_1, p, \Phi), I_1, p) > v(F(I_2, p, \Phi), I_2, p)$ which contradicts the MFI mixing the two strategies I_1 and I_2.

There are two possible cases for part 4:

- Case 1: If the equilibrium is (partially) pooling then I_P is on the equilibrium path. Assume by the means of contradiction that on the equilibrium path $I_H < I_P$. Thus, an MFI with $p = 0$ is indifferent between these two repayments, i.e. $v(F(I_H, \eta(I_H), \Phi), I_H, 0) = v(F(I_P, \eta(I_P), \Phi), I_P, 0)$. However, since by Lemma 2 this implies $v(F(I_H, \eta(I_H), \Phi), I_H, 1) > v(F(I_P, \eta(I_P), \Phi), I_P, 1)$, an MFI with $p = 1$ has an incentive to deviate. Hence, $I_H > I_P$ and by a symmetric argument, $I_L < I_P$.

- Case 2: If the equilibrium is separating then I_P is not on the equilibrium path. Assume by the means of contradiction that on the equilibrium path $I_H < I_L$. Thus, an MFI with $p = 1$ (weakly) prefers I_L over I_H, i.e. $v(F(I_H, \eta(I_H), \Phi), I_H, 1) \leq v(F(I_L, \eta(I_L), \Phi), I_L, 1)$. However, since by Lemma 2 this implies $v(F(I_H, \eta(I_H), \Phi), I_H, 0) < v(F(I_L, \eta(I_L), \Phi), I_L, 0)$, an MFI with $p = 0$ has an incentive to deviate. Hence, $I_H > I_L$.

This completes the proof. ■

Lemma A-2 *In all monotonic belief sequential equilibria, an MFI in an extremely poor community always chooses a repayment of 0 when it is not pooling with an MFI in a marginally poor community. That is $I_L = 0$ if it is on the equilibrium path.*

Proof Assume by the means of contradiction that $I_L > 0$, then consistent belief is $\eta(I_L) = 1$. Monotonicity of beliefs thus requires, $\eta(0) = 1$. But this gives an MFI in an extremely poor community an incentive to deviate, since by Proposition 1 $I^*(1) = 0$ and $v(F(I^*(1), 1, \Phi), I^*(1), 1) > v(F(I_L, 1, \Phi), I_L, 1)$. ∎

Proof of Proposition 2

Step 1: I will prove that an MFI in an extremely poor community will not unilaterally choose any repayment with positive probability. By the means of contradiction if it does, by Lemmas 3 and A-2 it is $I_L = 0$, which implies $\eta(0) = 1$. In this case for any strategy $I > 0$ that an MFI in a marginally poor community chooses with positive probability, by Lemma A-1 $v(F(I, \eta(I), \Phi), I, 0) < v(F(0, \eta(I), \Phi), 0, 0)$. However, since $\Phi_U \leq \underline{\Phi}_U$, $v(F(0, \eta(I), \Phi), 0, 0) < v(F(0, \eta(0), \Phi), 0, 0)$. Thus an MFI in a marginally poor community has an incentive to deviate.

Step 2: I will prove that the two MFI types will not pool on any positive repayment. By the means of contradiction if they do, by Lemma 3 it has to be a unique repayment $I_P > 0$. Then, for both types (any $p \in \{0, 1\}$), by Lemma A-1 $v(F(I_P, \eta(I_P), \Phi), I_P, p) < v(F(0, \eta(I_P), \Phi), 0, p)$. Moreover, by step 1 only an MFI in a marginally poor community might partially separate, which implies $\eta(I_P) \geq \pi$. Additionally, monotonicity of beliefs requires $\eta(0) \geq \eta(I_P) \geq \pi$. However, since $\Phi_U \leq \underline{\Phi}_U$ it must be true that $v(F(0, \eta(I_P), \Phi), 0, p) \leq v(F(0, \eta(0), \Phi), 0, p)$. Thus both MFI types have an incentive to deviate.

Step 3: I will prove that an MFI in a marginally poor community will not unilaterally choose any repayment with positive probability. By the means of contradiction if it does, by Lemma 3 it has to be a unique repayment $I_H > 0$, which implies $\eta(I_H) = 0$. Moreover, by Lemma A-1 $v(F(I_H, \eta(I_H), \Phi), I_H, 0) < v(F(0, \eta(I_H), \Phi), 0, 0)$. Additionally, by step 1 and 2, the two types partially pool on $I_P = 0$, which implies $\eta(0) > \pi$. However, $\Phi_U \leq \underline{\Phi}_U$ implies $v(F(0, \eta(I_H), \Phi), 0, 0) < v(F(0, \eta(0), \Phi), 0, 0)$. Thus an MFI in a marginally poor community has an incentive to deviate.

Step 4: By steps 1 to 3 and Lemma 3, the only remaining monotonic belief sequential equilibrium is fully pooling on zero repayment, which implies $\eta(0) = \pi$. Consider the off equilibrium belief that for all $I > 0$, $\eta(I) = \pi$. This is a monotonic belief structure. Moreover, by Lemma A-1 neither type has an incentive to deviate. Thus, such equilibrium exists and is the unique (in strategies) monotonic belief sequential equilibrium of the game. ∎

Proof of Proposition 3

Step 1: I will prove that the two MFI types will not pool on any repayment. By the means of contradiction, if they do, by Lemma 3 it has to be a unique repayment I_P and the posterior belief will be $\eta(I_P) \in (0, 1)$. Moreover, $\Phi_U > \overline{\Phi}_U$ implies that $F(I_P, 0, \Phi) > F(I_P, 1, \Phi)$ which in turn gives $F(I_P, 0, \Phi) > F(I_P, \eta(I_P), \Phi)$. Additionally, the payoff of an MFI in an extremely poor community is 0 at $\bar{I}(1)$, i.e., $v(F(\bar{I}(1), 0, \Phi), \bar{I}(1), 1) = 0$. Therefore, there always exists a repayment $I_D \in (I_P, \bar{I}(1))$ such that $v(F(I_D, 0, \Phi), I_D, 1) = v(F(I_P, \eta(I_P), \Phi), I_P, 1)$. Then, by Lemma 2 $v(F(I_D, 0, \Phi), I_D, 0) > v(F(I_P, \eta(I_P), \Phi), I_P, 0)$. This provides an MFI in a marginally poor community with an incentive to deviate since the equilibrium belief is $\eta(I_D) = 0$. The reason is that since by Lemma A-1 an MFI's payoff is decreasing in repayment for a given belief, any $I \geq I_D$ is equilibrium dominated for an MFI with $p = 1$ and the intuitive criterion imposes the belief $\eta(I_D) = 0$.

Step 2: The separating equilibrium is unique because by Lemma A-2 in any separating equilibrium the two MFI types will choose repayments that satisfy $I^{**}(0, \Phi) > I^{**}(1, \Phi) = 0$. Moreover, by Lemma A-1 an MFI's payoff is decreasing in repayment for a given belief, therefore, an MFI in a marginally poor community will choose the least costly signal that satisfies:

$$v(F(I^{**}(0, \Phi), 0, \Phi), I^{**}(0, \Phi), 1) = v(F(0, 1, \Phi), 0, 1)$$

It is straightforward that such equilibrium can be supported by the following beliefs:

$$\eta(I) = \begin{cases} 1 & \text{if } I < I^{**}(0, \Phi) \\ 0 & \text{if } I \geq I^{**}(0, \Phi) \end{cases}$$

and that an MFI in a marginally poor community raises more funds: $F(I^{**}(0, \Phi), 0, \Phi) > F(I^{**}(1, \Phi), 1, \Phi)$. ■

Proof of Proposition 4

Step 1: I will prove that an MFI in an extremely poor community will not unilaterally choose any repayment with positive probability. By the means of contradiction if it does, by Lemmas 3 and A-2 it can only by a repayment of $I_L = 0$, which implies $\eta(0) = 1$. Moreover, for any strategy $I > 0$ that an MFI in a marginally poor community chooses with positive probability, by Lemma A-1 $v(F(I, \eta(I), \Phi), I, 0) < v(F(0, \eta(I), \Phi), 0, 0)$. Additionally, since $\Phi_U \leq \overline{\Phi}_U$, $v(F(0, \eta(I), \Phi), 0, 0) < v(F(0, \eta(0), \Phi), 0, 0)$. Thus, an MFI in a marginally poor community has an incentive to deviate. As a result, by Lemma 3, an equilibrium can only entail an MFI in an extremely poor community choosing a repayment $I_P \geq 0$ and an MFI in a marginally poor community fully or partially pooling with it. In the latter case, by Lemma 3, it will mix between I_P with some probability $\gamma \in (0, 1)$ and one other repayment $I_H > I_P$ with probability $1 - \gamma$. Furthermore, $\gamma = 1$ corresponds to full pooling.

Step 2: I will construct a partially separating equilibrium as described in step 1 such that the two MFI types partially pool at $I_p = 0$. Since $\underline{\Phi}_U < \Phi_U \leq \overline{\Phi}_U$, by Proposition 1 and Lemma 1, $F(0, \pi, \Phi) < F(0, 0, \Phi) \leq F(0, 1, \Phi)$. Hence, there exists $\eta^* > \pi$ such that $F(0, \eta^*, \Phi) = F(0, 0, \Phi)$. There also exists $\varepsilon > 0$ such that $\eta^* - \varepsilon > \pi$ and $F(0, \eta^* - \varepsilon, \Phi) < F(0, 0, \Phi)$. Moreover, since $F(\bar{I}(0), 0, \Phi) = 0$, there exists $I_H \in (0, \bar{I}(0))$ such that $v(F(I_H, 0, \Phi), I_H, 0) = v(F(0, \eta^* - \varepsilon, \Phi), 0, 0)$. Additionally, since $\eta^* - \varepsilon > \pi$, there exists $\gamma^* = \frac{\pi(1-\eta^*+\varepsilon)}{(\eta^*-\varepsilon)(1-\pi)} \in (0, 1)$ and if an MFI in a marginally poor community pools with the other type at $I_P = 0$ with probability γ^*, then the posterior belief in the pool is $\eta(I_P) = \eta^* - \varepsilon$. As a result, $v(F(I_H, 0, \Phi), I_H, 0) = v(F(0, \eta(0), \Phi), 0, 0)$ and by Lemma A-1, under the following beliefs:

$$\eta(I) = \begin{cases} \eta^* - \varepsilon & \text{if } I < I_H \\ 0 & \text{if } I \geq I_H \end{cases}$$

an MFI in a marginally poor community will not have an incentive to deviate from a mixed strategy of choosing $I_P = 0$ with probability γ^* and I_H otherwise. Furthermore, by Lemma 2 $v(F(I_H, 0, \Phi), I_H, 1) < v(F(0, \eta(0), \Phi), 0, 1)$ and thus by Lemma A-1, an MFI in an extremely poor community will not have an incentive to deviate from choosing $I_P = 0$. This completes the proof. ■

References

Caudill, Steven B, Daniel M Gropper, and Valentina Hartarska, "Which microfinance institutions are becoming more cost effective with time? Evidence from a mixture model," *Journal of Money, Credit and Banking*, 2009, *41* (4), 651–672.

Cho, In-Koo and David M Kreps, "Signaling games and stable equilibria," *The Quarterly Journal of Economics*, 1987, *102* (2), 179–221.

Cull, Robert, Asli Demirgüç-Kunt, and Jonathan Morduch, "Financial performance and outreach: A global analysis of leading microbanks," *The Economic Journal*, 2007, *117* (517).

_ , _ , and _ , "Microfinance Meets the Market," *Journal of Economic Perspectives*, 2009, *23* (1), 167–92.

_ , _ , and _ , "Does regulatory supervision curtail microfinance profitability and outreach?," *World Development*, 2011, *39* (6), 949–965.

_ , _ , and _ , "The microfinance business model: enduring subsidy and modest profit," 2016.

Dieckmann, Raimar, Bernhard Speyer, Martina Ebling, and Norbert Walter, "Microfinance: An emerging investment opportunity," *Deutsche Bank Research. Current Issues. Frankfurt*, 2007.

Ghosh, Suman and Eric Van Tassel, "Microfinance and competition for external funding," *Economics Letters*, 2011, *112* (2), 168–170.

_ and _ , "Funding microfinance under asymmetric information," *Journal of Development Economics*, 2013, *101*, 8–15.

Gonzalez, Adrian, "Efficiency drivers of microfinance institutions (MFIs): The case of operating costs," 2007.

Hudon, Marek, Marc Labie, Patrick Reichert et al., "What is a fair profit for social enterprise? Insights from microfinance," Technical Report, ULB–Universite Libre de Bruxelles 2017.

Husain, Meraj and Micol Pistelli, "Where Good Intentions Meet Good Business Practice: A correlation analysis of social, operational and financial performance in microfinance," 2016.

Karaivanov, Alexander, "Non-grant Microfinance, Incentives, and Efficiency," Technical Report, Working Paper, Simon Fraser University 2016.

McIntosh, Craig and Bruce Wydick, "Competition and microfinance," *Journal of development economics*, 2005, *78* (2), 271–298.

Mersland, Roy and Reidar Øystein Strøm, "Performance and trade-offs in Microfinance OrganisationsDoes ownership matter?," *Journal of International Development*, 2008, *20* (5), 598–612.

Morduch, Jonathan, "The microfinance schism," *World development*, 2000, *28* (4), 617–629.

Yunus, Muhammad, *Banker to the poor: Micro-lending and the battle against world poverty*, PublicAffairs, 2007.