Notes on the Macroeconomics of Microcredit

Andy Newman

EC 721

We've seen that by designing mechanisms that provide incentives for borrowers to reveal information they may have about each other to lenders, microcredit institutions may improve access to credit for those potential borrowers, at least for small projects. In this note we ask how the introduction of a microcredit institution may affect things at the level of a whole economy

1 Basic Setup

- We consider an economy populated by a continuum of risk neutral individuals, each endowed with some wealth a, which is supported on $[0, A]$ for some $A > 0$ according to the c.d.f $F(a)$, which has a strictly positive density; assume that the mean wealth $\bar{a}$ is less than 1 (since F represents a probability measure, the population measure is equal to 1).

- There is limited liability, in the sense that formal contractual relations can impose only restricted punishments on individuals; this limitation on punishment will be the source of the credit market imperfection that microcredit might remedy.

- There are two technologies; these are for simplicity accessible to anyone who can arrange to finance them. Each individual may invest in up to one project that uses either one technology or the other, and again for simplicity we suppose that either way the capital requirement is 1 unit of wealth (since mean wealth is less than 1, capital is scarce, so the economy cannot support everyone investing in a project).

- Call the two technologies *modern* and *traditional*. For now, the only difference between them is that the traditional technology is less productive, yielding an expected return R, while the modern yields μR, where $\mu > 1$.

- In the credit market, lenders compete for borrowers, and will therefore make zero profits in equilibrium. Unlike in the partial equilibrium models we have been looking at so far, the opportunity cost of capital ρ will be endogenous, determined by a market-clearing condition.

2 Credit Market

- The credit market is imperfect due to an enforcement problem that we model using the "running off with the till" setup from the problem set

- Timing: 1) borrower chooses technology; 2) loan contract is signed; 3) loan made and invested; 4) borrower chooses whether to renege; 5) project outcome realized; 6) settlement of loan contract

- Specifically, a loan contract is an agreement for the borrower to deposit a as collateral and repay $r(y)$ when realized project outcome is y in exchange for a loan of 1 and return of $a\rho$ (collateral plus interest) upon repayment; if there is no repayment, borrower loses collateral and may have her total consumption held to 0 with exogenous probability $1 - \pi$

  Here, 0 is the bound on punishment imposed by the "limited liability" constraint

- The lender collects $a\rho$ if the borrower reneges (this is all he gets regardless of whether the borrower is eventually caught); since $a < 1$, (else the borrower doesn't need a lender) the lender will not be willing to lend if he expects the borrower to renege. Instead he requires that $Er(y) \geq \rho$ (competition implies this will be an equality in equilibrium). The borrower in turn gets a payoff of $E(y - r(y)) + a\rho$ if she repays and πEy if she reneges: repayment is more attractive only if $E(y - r(y)) + a\rho \geq \pi Ey$, or (substituting $Er(y) = \rho$ in equilibrium)

$$a \geq 1 - (1 - \pi)\, Ey/\rho \equiv \underline{a}_{Ey,\pi}(\rho) \qquad (1)$$

- Thus only agents with wealth $a \geq \underline{a}_{Ey,\pi}(\rho)$ will be able to borrow. Those who borrow will pay an average gross interest rate of ρ.

Exercise. We assumed that the decision to renege can only be made *before* the project return is realized. Suppose the borrower can decide whether to renege *after* the realization. What if any difference will this make to the previous conclusion?

3 First-best

- The first best case corresponds to a zero escape probability $(\pi = 0)$, in which case the minimum wealth constraint is $a \geq 1 - Ey/\rho$: if the interest rate is low enough that the project has nonnegative expected net present value $(Ey \geq \rho)$, then there is no binding wealth constraint.

- Construct a demand for loans curve. If $\rho > Ey$, no one wants a loan for a technology that yields Ey. Thus of the two technologies, neither will get any investment when $\rho > \mu R$. When $\rho = \mu R$, all agents are indifferent between investing in the modern technology and not investing at all, and so the demand for loans is equal to the unit interval $[0, 1]$ (since anywhere from no one to the entire population, the measure of which is 1, would be content to invest). For any ρ less than μR, each agent strictly prefers investing (in the modern technology) to not, and demands exactly 1 unit of wealth to invest in the modern technology.

- Since the aggregate supply of wealth $\bar{a}$ is less than 1, the competitive (supply=demand) interest rate is μR. All wealth in the economy is invested in the modern technology. See the figure; Q is the quantity of loans.

- Since the amount of wealth is less than the population, some people simply lend their wealth; however, everyone is indifferent between lending and investing, as the return is the same for both (an agent with a nets $a\mu R$ either way).

4 Second-best

- Suppose now that $\pi > 0$, independent of the technology chosen.

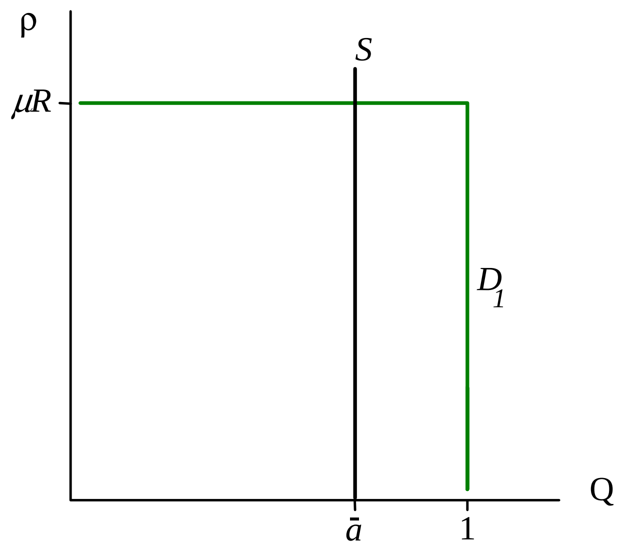

Figure 1: The first-best credit market.

- We construct an "effective demand" curve for loans that incorporates the wealth constraint (1). As before demand is zero if $\rho > \mu R$.

- At $\rho = \mu R$, the only potential demanders of loans are those whose wealth exceeds the minimum $\underline{a}_{\mu R,\pi}(\mu R)$; the measure of such people is $1 - F(\underline{a}_{\mu R,\pi}(\mu R))$; thus demand at $\rho = \mu R$ is $[0, 1 - F(\pi)]$ (since $\underline{a}_{\mu R,\pi}(\mu R) = \pi$).

- As ρ falls, the wealth constraint relaxes (both $\underline{a}_{\mu R,\pi}(\rho)$ and $\underline{a}_{R,\pi}(\rho)$ fall); agents with wealth at or above $\underline{a}_{\mu R,\pi}(\rho)$ strictly prefer investing in the modern technology to investing in the traditional one or not investing; those with wealth below $\underline{a}_{\mu R,\pi}(\rho)$ don't invest, so demand is $1 - F(\underline{a}_{\mu R,\pi}(\rho))$, strictly decreasing in ρ given the assumptions about F. Demand only reaches 1 when $\rho = (1-\pi)\,\mu R$, which is where $\underline{a}_{\mu R,\pi}(\rho) = 0$. Second-best effective demand is labeled D_2 in the figure.

- Notice that the traditional technology is never demanded: either it is not available to a potential borrower (the minimum wealth needed to borrow for the less productive traditional technology is *higher* than that needed for the modern technology: $\underline{a}_{\mu R,\pi}(\rho) < \underline{a}_{R,\pi}(\rho)$, or the borrower prefers the higher yielding modern technology when both are available.

- Equilibrium in the loan market occurs when the supply equals demand, i.e. when

$$\bar{a} = 1 - F(1 - (1-\pi)\,\mu R/\rho) \qquad (2)$$

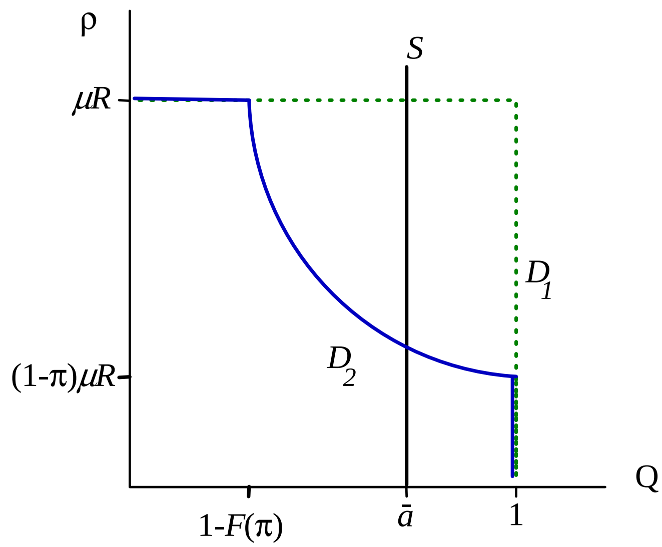

Figure 2: The second-best case.

Equilibrium always exists under our assumptions.

- As in the first best, only the modern technology is used, and the level of investment ($\bar{a}$) is the same as well. The equilibrium interest rate is weakly lower, strictly so whenever $\bar{a} > 1 - F(\pi)$, as in the figure.

- National income is the same as in the first best in this model, although when $\rho < \mu R$, it has been redistributed in favor of net borrowers.

5 The Dark Side of Microcredit

- Microcredit has typically been used to finance "traditional" technologies, e.g. weaving, or retail service. There are at least two reasons for this. One is that the traditional technologies are accessible (even apart from financing problems) with minimal training while the modern ones (software production) are not. (We could model this by allowing the capital requirement to differ across the two technologies: part of the capital needed to operate the modern technology is then human capital, which may also need to be financed.)

- But another possible reason is that the traditional technologies are easier to monitor, particularly in group lending settings. So suppose a microcredit institution enters that makes lending for the traditional but not the modern technology more feasible than it was before

- Model this by assuming two different values of π_m and π_t, with $\pi_m > \pi_t$: the modern technology has a higher escape probability then the traditional one. (We abstract from the details of how exactly this is achieved, e.g. through the mechanism of joint liability contracts.) Of course, since the modern technology still has the higher expected return, we might still have $\underline{a}_{\mu R,\pi_m}(\rho) < \underline{a}_{R,\pi_t}(\rho)$, in which case the analysis is essentially unchanged

- The interesting case occurs when $\underline{a}_{\mu R,\pi_m}(\rho) > \underline{a}_{R,\pi_t}(\rho)$, i.e. $\mu(1-\pi_m) < 1-\pi_t$. That is the enforcement probability is sufficiently low for the modern technology that the expected resources available to flow back to a lender are smaller, despite the higher productivity, for the modern technology than the traditional one.

- Possible reasons for this might be purely technological, but could also have to do with the physical location in which the two technologies are carried out:

if one has to move from a village to a city to operate the modern technology, fellow villagers will no longer be available for peer monitoring. Or to operate the modern technology one may have to specialize in certain tasks that fewer peers understand. Either way, the informational advantage that makes joint liability contracting effective may be lost when the modern technology is adopted.

- Constructing the effective demand curve.
  - To facilitate comparison with what has gone on before, let $\pi_m = \pi$ (the same value as before) and suppose $\pi_t = 0$: this puts $\underline{a}_{R,\pi_t}(\rho) = 0$. The microcredit institution works so well that *everyone* is now a potential borrower for the traditional technology.
  - Demand is zero for $\rho > \mu R$; at $\rho = \mu R$, only modern technology attracts investment, and demand is $[0, 1 - F(\pi)]$, as before

- For $\mu R > \rho > R$, the demand is the same as it was before microcredit, since the traditional technology is not attractive at this interest rate

- When $\rho = R$, the borrowers with $a \geq \underline{a}_{\mu R, \pi_m}(\rho)$ strictly prefer the modern technology, but now everyone with wealth less than $\underline{a}_{\mu R, \pi_m}(\rho)$ finds traditional investment (barely) profitable. Demand for loans is $[1 - F(\underline{a}_{\mu R, \pi_m}(\rho), 1]$.

- Demand now remains at 1 for all $\rho < R$.

• Overall, the *effective demand for loans increases* as a result of the improved monitoring. See D_M in the figure.

• Suppose first the $\bar{a}$ is less than $1 - F((1 - \pi)\,\mu)$. Then the interest rate that clears the market in the absence of microcredit already exceeds R, and nothing changes (only the part of the demand curve that lies below R has changed).

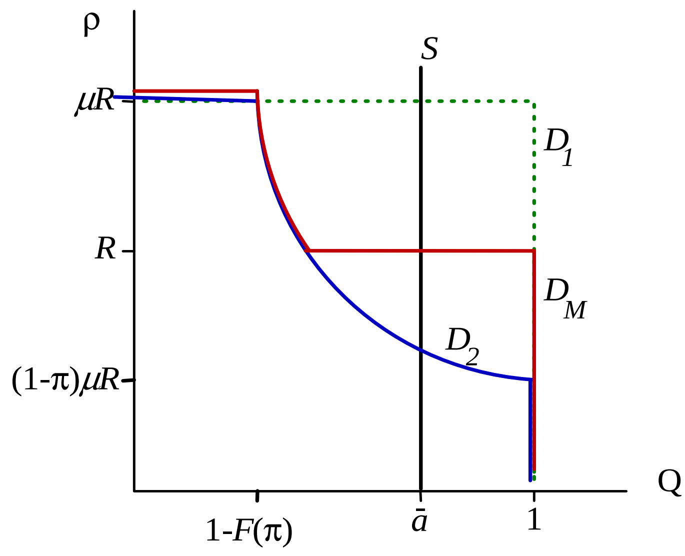

Figure 3: The effect of microcredit.

- In the other case, the equilibrium ρ *increases* (to R in this case).
  - There is positive investment in the traditional technology ($\bar{a} - 1 + F((1-\pi)\mu)$ units, to be precise)
  - Investment in the modern technology is reduced by the same amount (some people are rationed out of investment in modern by the higher interest rate, which raise the minimum borrowing wealth)

– *National income falls* by $(\mu - 1) R$ $(\bar{a} - 1 + F((1 - \pi) \mu)$

– Strictly speaking, the model is indeterminate in saying who invests in the traditional technology, but if we relaxed the assumption that $\pi_t = 0$ but is still small, then the very poorest will not be the ones investing.

– We can identify several other groups (defined by wealth intervals)

  * 1. The very poor do benefit from the increased interest rate

  * 2. Those who invest in traditional technology who before were not investing also benefit (they could still lend, but choose not to, and lending is more attractive than it was)

  * 3. Those who are rationed out of the modern but still invest in the traditional lose, as they generate smaller outputs and pay more for their loans

    - ∗ 4. All net borrowers still investing in the modern technology are also harmed
    - ∗ 5. The very wealthy (those who can self-finance) benefit: they are net lenders.
  - Note that it is entirely possible that group (2) (new investors) may be very small: all the traditional technology investment might come from group (3)

- In short, microcredit may be at best ineffective and at worst counterproductive to lifting the economy as a whole, though it can serve to redistribute income in favor of the poor and the very rich.

- In practice, it is doubtful that the very poor earn close to a competitive return on what little wealth they do have, and some of their benefits may in practice be inflated away by increased prices for goods they don't produce (hard to show in a one-good model!).

6 Extensions

- The model suggests that if capital is very scarce (the economy is overall very poor), microcredit may have little net effect; when it is somewhat richer, the effects may be to do more aggregate harm than good. Now, before you go out and clamour for shutting down Grameen Bank (who in fact have been pretty good about encouraging microenterprises that use modern technologies), a disclaimer: the point here is to get you to think about how microcredit, which may look good in the small, might not be so effective in the large. The principle can be applied to many situations besides microcredit, and ought to be kept in mind in both theoretical and (especially, perhaps) empirical work.

- The conclusions are based on some strong assumptions, and it is worth thinking about relaxing them. Here are a couple of suggestions

- We assumed inelastic wealth supply. This makes sense if wealth is in the form of land, but might not for financial forms of wealth. If wealth is sufficiently positively elastic with respect to ρ, the conclusions may change.

  Exercise. Experiment with a few graphs. If you prefer explicit calculation (always good for checking your graphs are right!), assuming $A = 1$ and F is uniform probably keeps the algebra to a minimum. It's also instructive to compare first-best to second-best as well as the latter to microcredit in the different scenarios.

  - Empirically, saving is often not very interest elastic (offsetting income and substitution effects). But it is pretty income elastic. So a policy that increases national income will also increase wealth, and vice versa. This calls for a dynamic analysis beyond the scope of these notes. Stay tuned.

- Greater realism, which is necessary for "serious" policy evaluation, likely would entail relaxing the equal-capital-for-both-technologies assumption.

  Exercise. How does the analysis change if it is assumed that the traditional technology also has a lower capital requirement than the modern one?