The macroeconomics of microfinance

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Motivation and research question

- **Microfinance**: Credit targeted toward small scale entrepreneurial activities of the poor who may otherwise lack access to financing.

- During recent years, concerted effort to expand such programs:
  - From 1997-2006, access to microfinance grew by up to 29% a year.
  - In some countries it represents up to 10% of GDP (Bolivia).

- **Research question**: What is the aggregate and distributional impact of microfinance?
  - Most of quantitative analysis on the matter has been done with microevaluations.
  - Macroeconomic effects of microfinance largely unexplored.
Model and validation

- **Model**: Macroeconomic framework of entrepreneurship and financial frictions
  - Agents can be workers or entrepreneurs
  - Agents heterogeneous on productivity and wealth
  - Financial frictions: Collateral constraint
  - Microfinance: Technological innovation that enables intermediaries to receive full repayment on small uncollateralized loans

- **Calibration/validation** of the analysis
  - Calibration to match data on US and India macro aggregates
  - Out of sample validation: How the short run PE predictions compare with the estimates from microevaluations
Results

- Model simulates and quantify the long run effect of microfinance on key macroeconomic measures and distributions

- **In partial equilibrium (PE)**
  - $\Delta$ GDP by 30%
  - TFP declines, $\Delta$ capital and consumption
  - Welfare gains for marginal entrepreneurs and top productive individuals

- **In general equilibrium (GE)**
  - Wages increase
  - Lower entrance of entrepreneurs than in PE
  - TFP increases, consumption increases more than in PE and capital increases less than in PE
  - Welfare gains for marginal entrepreneurs and individuals with low wealth
Model

- Measure N of infinitely-lived individuals heterogeneous in
  - Their wealth \( a \)
  - Their entrepreneurial idea or productivity \( z \)

- Entrepreneurial ideas
  - Drawn from an invariant distribution with cdf \( \mu(z) \)
  - Die at a constant hazard rate of \( 1 - \gamma \)

- Each period individuals choose whether be worker or entrepreneur
  - Choice based on their productivity \( (z) \) and their access to capital
  - Access to capital determined by their wealth through an endogenous collateral constraint

- **Microfinance**: Innovation that guarantees the access to and repayment of uncollateralized credit regardless of entrepreneurs’ wealth or productivity
Preferences, technology and credit markets

- Individual preferences \( U(c) = \mathbb{E} \left[ \sum_i \beta^t u(c_t) \right] , \quad u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma} \)

- Technology \( zf(k, l) = zk^\alpha l^\theta \), with \( \alpha + \theta < 1 \)

- Entrepreneur profit \( \pi(k, l) = zk^\alpha l^\theta - Rk - wl \)

- Credit (capital rental) markets
  - Individuals have access to competitive financial intermediaries, who receive deposits and rent out capital \( k \) at rate \( R \)
  - Capital rental is subject to a collateral constraint

- Entrepreneurs can renege on capital rental contracts:
  - They keep \((1 - \phi) [zf(k, l) - wl + (1 - \delta)k] \) \( 0 \leq \phi \leq 1 \)
  - They lose all financial assets
Credit markets

- $\phi$ captures the extent of frictions in the financial market
- Perfect credit markets $\phi = 1$. No credit or self financing $\phi = 0$
- Rental of capital is quantity restricted by an upper bound $\bar{k}(a, z; \phi)$, which is the largest limit that is consistent with:

$$\max_i \{zf(k, l) - wl - Rk + (1 + r)a\} \geq (1 - \phi) \left[ \max_i \{zf(k, l) - wl + (1 - \delta)k\} \right]$$

- In equilibrium contracts are incentive compatible and hence fulfilled
- Weakly more resources when fulfilling credit obligations than when defaulting

Rental limits $\bar{k}(a, z; \phi)$:
- Increase with the wealth because the punishment for defaulting is larger
- Increase with the entrepreneurial productivity
Microfinance

- **Microfinance**: It relaxes individuals’ capital rental limit as
  \[ k \leq \max \{ \bar{k}(a, z; \phi), a + b^{MF} \} \]

- **\( b^{MF} \)**: Intra period credit limit of microfinance

  Two choices for the entrepreneur
  - Rent capital from financial intermediary subject to endogenous rental limit
  - Use microfinance to top up his self financed capital, \( a + b^{MF} \)

- \( \bar{K} \) increasing in \( a \) and \( z \) while \( b^{MF} \) is a constant
  - Microfinance will be primarily used by poor, low productivity entrepreneurs
  - Rich/high productive entrepreneurs opportunity set unaffected
Recursive formulation

\[ v(a, z) = \max \{ v^W(a, z), v^E(a, z) \} \]

\[ v^W(a, z) = \max_{c, a' \geq 0} u(c) + \beta \mathbb{E}_{z'} [v_{t+1}(a', z') | z] \]

\[ \text{st } c + a' \leq w + (1 + r)a \]

\[ v^E(a, z) = \max_{c, a', k, l \geq 0} u(c) + \beta \mathbb{E}_{z'} [v_{t+1}(a', z') | z] \]

\[ \text{st } c + a' \leq zf(k, l) - Rk - wl + (1 + r)a \]

\[ k \leq \max \{ \bar{k}(a, z; \phi), a + b^{MF} \} \]
Calibration

- Two stages:
  - Technological and preference parameters so that the $\phi=1$ equilibrium of the model economy matches US
  - Re calibrate $\phi$ and $\eta$ using data from India

$$\mu(z) = 1 - z^{-\eta}$$

<table>
<thead>
<tr>
<th>Target Moments</th>
<th>US Data</th>
<th>Model</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 10-percentile employment share</td>
<td>0.69</td>
<td>0.69</td>
<td>$\eta = 4.84$</td>
</tr>
<tr>
<td>Top 5-percentile earnings share</td>
<td>0.30</td>
<td>0.30</td>
<td>$\alpha + \theta = 0.79$</td>
</tr>
<tr>
<td>Establishment exit rate</td>
<td>0.10</td>
<td>0.10</td>
<td>$\gamma = 0.89$</td>
</tr>
<tr>
<td>Interest rate</td>
<td>0.04</td>
<td>0.04</td>
<td>$\beta = 0.92$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target Moments</th>
<th>Indian Data</th>
<th>Model</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 10-percentile employment share</td>
<td>0.58</td>
<td>0.58</td>
<td>$\eta = 5.56$</td>
</tr>
<tr>
<td>External finance to GDP ratio</td>
<td>0.34</td>
<td>0.34</td>
<td>$\phi = 0.08$</td>
</tr>
</tbody>
</table>
Occupational choice with microfinance

Relative poor/unproductive individuals choose to be workers
Relative rich/productive individuals choose to be entrepreneurs
Shaded area represents those who switch with microfinance in PE
  Mostly poor individuals with marginal entrepreneurial productivity
  Wealthy not affected by microfinance
Short run PE and microfinance

- △ income because many workers switch to entrepreneurs

- Negative effect of microfinance on TFP
  - Microfinance improve capital allocation at the intensive margin
  - Massive entry of marginal entrepreneurs (extensive margin), lower average productivity
Short run PE and microfinance

- Comparison of short run PE and India/Thailand experiments is relevant
  - Scale of the programs is small relative to the country’s economy
  - Microevaluations done after one year of experiments
  - Both experiments study entrepreneurship, investment, consumption

- Microevaluation as out of sample evidence on model’s validity
  - Over predicts impact on investment and entrepreneurship
  - Underpredicts impacts of consumption

<table>
<thead>
<tr>
<th></th>
<th>Microevaluation</th>
<th>Short-Run PE Model Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>India</td>
<td>Thailand</td>
</tr>
<tr>
<td>Max loan size to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>per-capita expenditures</td>
<td>1-2</td>
<td>1</td>
</tr>
<tr>
<td>Microcredit relative to</td>
<td>0.44</td>
<td>0.33</td>
</tr>
<tr>
<td>total credit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment</td>
<td>+16-128%</td>
<td>+35%†</td>
</tr>
<tr>
<td>Consumption</td>
<td>+16%†</td>
<td>+15%</td>
</tr>
</tbody>
</table>

Comparison of Short-Run PE Model Prediction with Microevaluations.
Long run impacts in PE. Asset accumulation dynamics

- 30% larger effect on output and capital in the long run
- Marginal entrepreneurs eventually overcome the collateral constraint
- Further entrance by entrepreneurs
- Economy wealthier as a whole, there are more unproductive entrepreneurs, lower TFP

![Graph showing long-run PE and microfinance impacts](image-url)
Long run GE and microfinance

- Unlike in PE, markets should clear

- △ TFP, ▽ capital, output cte

- **Higher interest rate**: Microfinance increases demand for capital, but depresses demand for aggregate saving

- **Higher wage**: Microfinance reduces supply of workers and increases demand for workers through better selection into entrepreneurship
Effects on TFP

- Positive effect of microfinance on TFP in GE
- Unlike in PE, **in GE the extensive margin actually contributes to the TFP gains**
- Microfinance increases fraction of entrepreneurs, but less than in PE
  - In GE the prices of production factors rise with microfinance
  - Opportunity cost of becoming entrepreneur rises
  - Wage deters the entry of more marginal entrepreneurs
  - The average productivity of active entrepreneurs actually increases

Decomposition of the Impact of Microfinance in General Equilibrium
Effects on Capital accumulation

- Reasons to save
  - Entrepreneurs derive collateral services from their wealth
  - Entrepreneurs save for the periods in which they will not be as talented
  - Workers do not have any reason to save

  **Effects of increasing** $b^{MF}$

1. Saving rate of top entrepreneurial productivity decreases
   - Higher wage and capital rate imply lower profits, which in turn mean lower returns to saving for talented but poor entrepreneurs
   - Future earnings by top productivity individuals are expected to fall by less

2. Promotes the entry of marginal entrepreneurs
   - Higher saving rates than workers, but much smaller than top 5%.
   - Income share of those with lower saving rates increase with $b^{MF}$.
   - Aggregate saving rate: Income weighted average of individual saving rates
Distribution of welfare gains

- **Welfare impact:** Fraction of consumption an individual is willing to give up every period in order to have access to $b^{MF} = 1.5w(0)$
  - By productivity: Marginal entrepreneurs gain the most
  - By wealth: Microfinance benefits the poor

- **PE:** Least talented individuals only slightly affected, and the most talented individuals would be the most benefited. Results reversed in GE
Five Extensions

1. Small open economy
2. Microfinance as subsidized capital
3. Labor market opportunity shock
   - Self employment tend to be higher in less developed countries
   - Individuals also draw l=1 with prob χ, zero otherwise
   - If l=0, forced to entrepreneurship. Z and l equally persistent and independent
   - Results: Lower aggregate capital, lower increases of output and wage than benchmark
   - Low productive forced entrepreneurs gain the most
4. Consumption loans
   - Microfinance is used to smooth consumption also
   - $a' \geq -b^{MF}$
   - Further depress capital accumulation
   - Output and wages lower than in benchmark
5. Large scale sectors
Concluding remarks

- General equilibrium considerations of microfinance are quantitatively and qualitatively important

- Increase in wages in general equilibrium has a strong redistributive effect
  - This leads to a substantially smaller aggregate capital stock in contrast to the predictions of PE
  - Reinforces the positive effect of microfinance on low productive low wealth individuals

- This paper points to the large potential gains from trade between micro and macro development literature
A stationary competitive equilibrium is composed of: an invariant distribution of wealth and entrepreneurial productivity with joint cumulative distribution function $G(a,z)$ and the marginal cumulative distribution function of $z$ denoted by $\mu(z)$; individual decision rules on consumption, asset accumulation, occupation, labor input, and capital input, $c(a,z)$, $a'(a,z)$, $o(a,z)$, $l(a,z)$, $k(a,z)$; rental limits $\bar{k}(a,z;\phi)$ and prices $R$, $r$ such that

1. Individuals policy function solve their problem
2. Financial intermediaries make zero profit $R = r + \delta$
3. Rental limits are the most generous limits satisfying $\bar{k}(a,z;\phi) \leq k^u(z)$
4. Capital, labor and good markets clear
5. The joint distribution of wealth and entrepreneurial productivity is a fixed point of the equilibrium mapping
Stationary competitive equilibrium 2

4. Capital, labor and good markets clear

\[
\frac{K}{N} \equiv \int k(a, z) G(da, dz) = \int aG(da, dz) \quad \text{Capital}
\]

\[
\int l(a, z) G(da, dz) = \int_{o(a,z)=W} G(da, dz) \quad \text{Labor}
\]

\[
\int c(a, z) G(da, dz) + \delta \frac{K}{M} = \int_{o(a,z)=E} \left[zk(a, z)^{\alpha} l(a, z)^{\theta}\right] G(da, dz) \quad \text{Goods}
\]

5. The joint distribution of wealth and entrepreneurial productivity is a fixed point of the equilibrium mapping

\[
G(a, z) = \gamma \int_{(\tilde{a}, \tilde{z}) | \tilde{z} \leq z, a'(\tilde{a}, \tilde{z}) \leq a} G(d\tilde{a}, d\tilde{z}) + (1 - \gamma)\mu(z) \int_{(\tilde{a}, \tilde{z}) | a'(\tilde{a}, \tilde{z}) \leq a} G(d\tilde{a}, d\tilde{z})
\]
Experiments

- **Urban Indian** Spandana study, Babarjee et al (2009)
  - Randomized expansion of MFI branches across different neighborhoods in Hyderabad
  - Surveys conducted 18 months later after loans have been disbursed
  - Loan ranged 1, 2 times annual per capita expenditures (12000 rupees)
  - Treated areas had 8% higher probability of having access to microcredit

- **Thai** million Baht Village Fund, Kaboski and Townsend (2011)
  - Government transfer of 1 million bath of seed money to each selected rural village to open banks
  - Loans were roughly equal to the annual expenditures per capita
  - Same transfers to all villages: Magnitude of the per capita intervention is exogenous wrt relevant variables
# Experiments

<table>
<thead>
<tr>
<th>Country</th>
<th>Fraction of Borrowers</th>
<th>MF Loans to GDP</th>
<th>Average Loan Size</th>
<th>Per-capita Income</th>
<th>Total Credit to GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>0.13</td>
<td>0.028</td>
<td>112</td>
<td>547</td>
<td>0.37</td>
</tr>
<tr>
<td>Mongolia</td>
<td>0.13</td>
<td>0.129</td>
<td>1,393</td>
<td>1,410</td>
<td>0.62</td>
</tr>
<tr>
<td>Peru</td>
<td>0.11</td>
<td>0.041</td>
<td>1,590</td>
<td>4,658</td>
<td>0.21</td>
</tr>
<tr>
<td>Bolivia</td>
<td>0.09</td>
<td>0.107</td>
<td>1,926</td>
<td>1,776</td>
<td>0.31</td>
</tr>
<tr>
<td>Vietnam</td>
<td>0.09</td>
<td>0.044</td>
<td>510</td>
<td>1,024</td>
<td>1.06</td>
</tr>
<tr>
<td>Kenya</td>
<td>0.04</td>
<td>0.036</td>
<td>744</td>
<td>803</td>
<td>0.20</td>
</tr>
<tr>
<td>India</td>
<td>0.02</td>
<td>0.003</td>
<td>146</td>
<td>1,154</td>
<td>0.53</td>
</tr>
<tr>
<td>Mean</td>
<td>0.02</td>
<td>0.004</td>
<td>655</td>
<td>3,192</td>
<td>0.50</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.03</td>
<td>0.020</td>
<td>3,192</td>
<td>3,071</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Microfinance Facts from the MIX Data