Joint-Liability Credit Linked with Index Insurance—A Dynamic Game Framework

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Selected Poster at the 2017 Agricultural & Applied Economics Association Annual Meeting, Chicago, Illinois, July 30-August 1

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Introduction

- Joint-liability credit, where all members are held jointly liable for the group's collective debt, is believed to lead to lower default rates, compared with individual credit.
- However, experience with joint-liability credit in agricultural lending in developing countries has been unimpressive (Gine & Karlan, 2009; Attanasio et al., 2015).
- One explanation is that the catastrophic weather causes correlation between borrowers' returns and amplifies the incapacity of repayment.
- Index insurance is designed to cover the adverse shocks from catastrophic weather, thus has the potential to improve the sustainability of joint-liability credit.

Research Questions

- How do group and individual credit perform in the presence of systemic risk
- Does the availability of index insurance improve the performance and sustainability of group credit arrangements?
- What types of group credit and insurance schemes best reduce the default rates among smallholder borrowers and increase the expected revenue of lender?

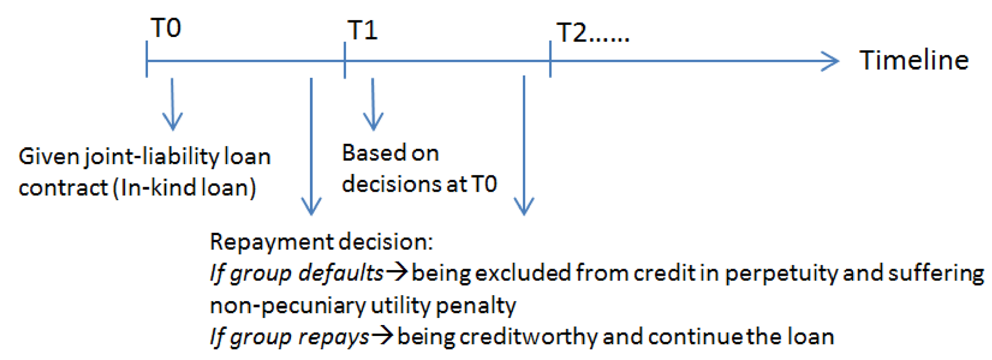
Methodology

We construct a dynamic game model of two borrowers and derive Markov sub-game perfect equilibrium by numerically solving the two borrowers' interrelated Bellman equations using orthogonal polynomial collocation methods.

Model

Two borrowers in the joint-liability group are offered one of three loan contracts

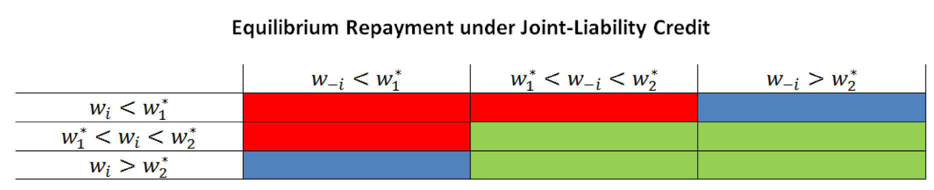
- A conventional joint-liability group loan – no insurance is available
- An insured group loan – bundled with index insurance contract that provides a payout to the farmer in the event of catastrophic weather
- A contingent group loan – linked with insurance contract that provides a payout to the lender to be applied toward the farmers debt obligation



In each period, borrowers make the trade-off between: a) the benefits of repaying their own loan, and possibly the other farmers loan, and b) the alternative of being excluded from access to credit in perpetuity and suffering additional non-pecuniary utility penalty

- Borrowers' goal: maximize present value of current and expected future utility from consumptions
- Lender's goal: receives positive revenue from borrowers

Equilibrium



w_i and w_{-i} are borrowers' returns. w_1^* and w_2^* are wealth thresholds for borrowers to default, repay only their own loan, or repay for the group.

Red areas: The group fails, since both borrowers do not have any incentive to repay their own loan. Green areas: The group succeeds, since both borrowers have the incentive to repay their own loan. Blue areas: The group succeeds, since the borrower with higher initial return has the incentive to help the other repay.

Simulation Results

Simulated Results with Base Parameterization

	without systemic risk		with systemic risk	
	Joint-Liability credit	Individual credit	Joint-Liability credit	Individual credit
Default rate	5.41%	7.40%	6.56%	7.62%
Expected willingness-to-pay	0.3886	0.3737	0.3782	0.3759
Expected revenue	0.3027	0.2963	0.2990	0.2956
Probability of differentiated repay	6.76%		7.77%	
Probability of the same repay	87.84%		85.67%	
Long-run gain of credit compared with autarky	0.7810	0.7200	0.7371	0.7280

Conclusions

- Joint-liability lending results in lower default rate and higher expected revenues relative to individual lending in the presence of systemic risk.
- Also, group credit improves the welfare for borrowers, and more so for low- and mid-income borrowers.
- If index insurance is available, borrowers willingness-to-pay for insured credit and contingent credit is higher than for conventional credit, and the default rate decreases.
- Our sensitivity analysis shows that the optimal interest rate charged by the profit-maximizing lender for joint-liability credit is lower than individual credit and that this optimal interest is further reduced when index insurance is introduced.

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