

A Heterogeneous Agent Model of Credit-Linked Index Insurance and Farm Technology Adoption

**International Agricultural Risk, Finance, and Insurance Conference
Vancouver, Canada
June 16-18, 2013**

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Summary: Lack of protection from downside risk has been posited as one explanation for sluggish technology uptake among subsistence agricultural households in the developing world. Access to credit and insurance is thought to be a stimulant to technology adoption where new methods are riskier but higher yielding on average, or, in the alternative, require sunk costs of investment that can be significant for households that already consume very little when harvests are poor. Despite recent efforts to pilot index-based insurance to smallholder farmers where no formal insurance was previously available, demand for individual-level contracts has been unexceptional at best, even when premiums are highly subsidized. On the flip side, the effect of index insurance on credit supply is ambiguous. In this paper, we employ a dynamic, stochastic, heterogeneous agent model where farm households have access to contingent credit or credit-linked insurance, and may also make dichotomous choices regarding technology and loan repayment in each period. The approach is novel in that insurance is modeled as a meso-level product, where the bank is first indemnified before any payouts are distributed to its borrowing clients. Thus, the model takes into account both supply- and demand-side concerns, and shows the possibilities of a trickle-down effect when index insurance contracts are sold not to individual households, but instead to risk aggregators for whom basis risk is lower. Results show that insurance can have a positive effect on technology uptake, while letting the lender lay first claim on indemnities lowers default rates. Additionally, mandatory credit-insurance bundling results in higher bank profits, which could result in an expansion of credit availability for the rural poor.

Extended Abstract: An extensive risk-coping literature is omnipresent in development economics research, with work focused around the question of whether or not poor households can informally manage risk in the absence of formal financial tools. There has been evidence of

informal risk sharing through reciprocal lending within social networks, resulting in fairly smooth household consumption profiles when controlling for village-level consumption patterns. However, these sorts of risk sharing arrangements, while effective at managing idiosyncratic risk, may be insufficient when a systemic shock lowers the income of all households in a region.

The failure of households to fully insure can result in severe repercussions. In this paper, we focus on the tradeoff between uncertainty of income and higher returns to investment that can cause poor agricultural households to remain in persistent poverty. While interlinked index insurance is only one policy option that has the potential to help these households emerge from a dynamic poverty trap, we employ such a mechanism because it is likely feasible given the stylized facts of agrarian economies in low-income countries: risk-averse households using uninsured credit for consumption rather than investment, credit constraints stemming from systemic risk exposure, a lack of traditional insurance due to high transactions costs, and informal insurance that smoothes consumption fairly well in the face of idiosyncratic shocks.

While the richness of the model presented provides the potential to conduct a number of policy analyses, the motivation of this paper is to address select research questions that will offer inferences on the formulation of development policy that aims to alleviate rural poverty. Namely, this paper will focus on three principal problems:

1. Does the availability of insurance induce subsistence farming households to adopt high-technology methods that provide higher incomes on average?
2. Under what conditions does high-technology adoption result in welfare gains relative to the employment of traditional technology?
3. What types of credit and insurance schemes reduce the incidence of default among rural borrowers and increase bank profitability, so that financial institutions are able to continue lending, expand lending, or lower interest rates on borrowing?

Under certain conditions, we find households with access to interlinked credit-insurance contracts are less likely to default on agricultural production loans and more likely to adopt investment-intensive high-yielding farming practices. In turn, these high-technology households have higher long-run consumption rates than those of traditional technology households. Finally,

although technology adoption is the highest where credit and insurance are separately available to rural households as opposed to being offered as a bundled product, this policy is also the one in which loan default rates are the highest. It is, therefore, important to approach the proceeding policy analysis in a manner that can reconcile the seemingly divergent goals of high technology adoption and low rates of loan default.

A notable difference in the approach in this paper is the way in which indemnity payments are disbursed. In a recent article, Miranda and Gonzalez-Vega (2011) find that mandatory, unsubsidized index insurance for individual farmers can diminish a bank's internal rate of return; this is due to the perverse effects of premium burdens that disincentivize borrowers from repaying loans. However, they do not consider the effects of contingent credit or credit-linked insurance. For the purposes of this paper, contingent credit refers to a loan that is coupled with an index insurance contract that covers the value of the loan upon maturity, the premium for which is deducted from the loan value before it is disbursed. Credit-linked insurance is similar to contingent credit, but the index insurance contract in this case covers the entire portion of a borrower's agricultural income that is determined by systemic factors, not solely the value of the loan. Thus, technology adoption is expected to be greater under the latter contract type.

Under both contracts, any indemnity triggered is first delivered to the bank; the bank then passes the indemnity on to the borrower, net any unpaid portion of his outstanding loan debt. Thus, the flow of indemnity payments prevents one type of strategic default that can occur if indemnities are paid directly to individual farmers. For purposes of comparison, we also run a models where, similar to the principal model, insurance is mandatory for those who wish to borrow, but where the initial claimant is the borrower himself and not the lending institution; where credit, but not insurance, is available; and where credit and insurance are separately available.. This paper thus contributes to the existing literature by laying out a dynamic model that incorporates the benefits of a meso-level index insurance product, but does so with a greater emphasis on demand-side considerations. Results will foster general discussion at the IARFIC meetings, as they hold important insights for development economists and practitioners in the area of agricultural finance and insurance markets in developing countries.