Only the Rich Need Apply? A Dynamic Model of Index-Based Insurance Choice

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ABSTRACT

I present a dynamic expected utility model to explain farmers’ borrowing decisions and observed low demand for agricultural index insurance. Results indicate that, in the absence of insurance, only low- and medium-wealth households access credit for farming and consumption. Once insurance contracts become available, however, cases exist in which borrowing initially declines with wealth until a critical wealth level is reached, after which wealthier households take out loans in order to purchase insurance. Implications of simulations suggest that index-based products may not be tailored for the ultra-poor, who must borrow the maximum amount simply to meet consumption needs. As such, researchers piloting index-based insurance programs must seriously consider the effects of liquidity constraints on contract uptake.

MOTIVATION AND OBJECTIVES

- Index insurance has been promoted as a tool to reduce poverty among low-income households by allowing them to take on higher-risk, higher-return agricultural activities.
- However, several pilots and randomized controlled trials have been plagued by low uptake and less-than-expected impact results.
- This paper explores one possible cause of low household-level demand: liquidity constraints.
- The use of a dynamic model that numerically solves a household’s Bellman equation through collocation methods provides insights that cannot be captured in a static setting.

THE MODEL: HOUSEHOLD DYNAMICS

Household starts each period with knowledge of net worth and insurance status

- Stochastic farm income (V) and insurance indemnities (H(j)) determined
- Chooses a level of borrowing (x) and whether to purchase index insurance (j={0,1})

OPTIMAL BORROWING WITH OPTION TO INSURE

In the model, a farm household chooses its level of borrowing and makes a discrete choice to purchase insurance to maximize the present value of current and expected future utility of consumption. Its optimization can be represented by the Bellman equation:

\[ V(s) = \max \{V_0(s), V_1(s)\} \]

\[ V_0(s) = \max_{x, j} \left\{ (s + x) + h(j), \frac{1}{1+r} \left[ \max_{x, j} \left\{ (s + x) + h(j) \right\} \right] \right\} \]

\[ V_1(s) = \max_{x, j} \left\{ (s + x) + h(j), \frac{1}{1+r} \left[ \max_{x, j} \left\{ (s + x) + h(j) \right\} \right] \right\} \]

WHAT IS INDEX INSURANCE?

- Payouts are not based on actual losses. Instead, they depend on the measure of an index that is closely related to farm-level losses.
- A good index should be:
  - Exogenous to the policy holder (no moral hazard)
  - Highly correlated with policy holder’s losses
- All policy holders of the same contract face the same risk (no adverse selection).
- Examples of indices:
  - Rainfall
  - Area yields
  - Regional livestock mortality rates
  - Satellite-based vegetation measures
  - Sea-surface temperature (ENSO)

RESULTS – INDEX INSURANCE

Figure 2: Decision Rule for Borrowing with Possibility of Index Insurance Purchase

- For most values of net worth, a household with access to insurance displays the same borrowing patterns as one without an insurance option.
- Borrowing patterns diverge at a higher net worth (just under 1.0), where wealthy households borrow modestly (x = 0.05) to purchase insurance.
- Borrowing declines with net worth; a household switches back from borrowing to not borrowing if s > 1.10, but still purchases insurance.

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A list of references, as well as a description of parameters and the values used for simulations, is available upon request. E-mail correspondence should be sent to Farrin.2@osu.edu.