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

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Poster prepared for presentation at the Agricultural & Applied Economics Association's 2012 AAEA Annual Meeting, Seattle, Washington, August 12-14, 2012

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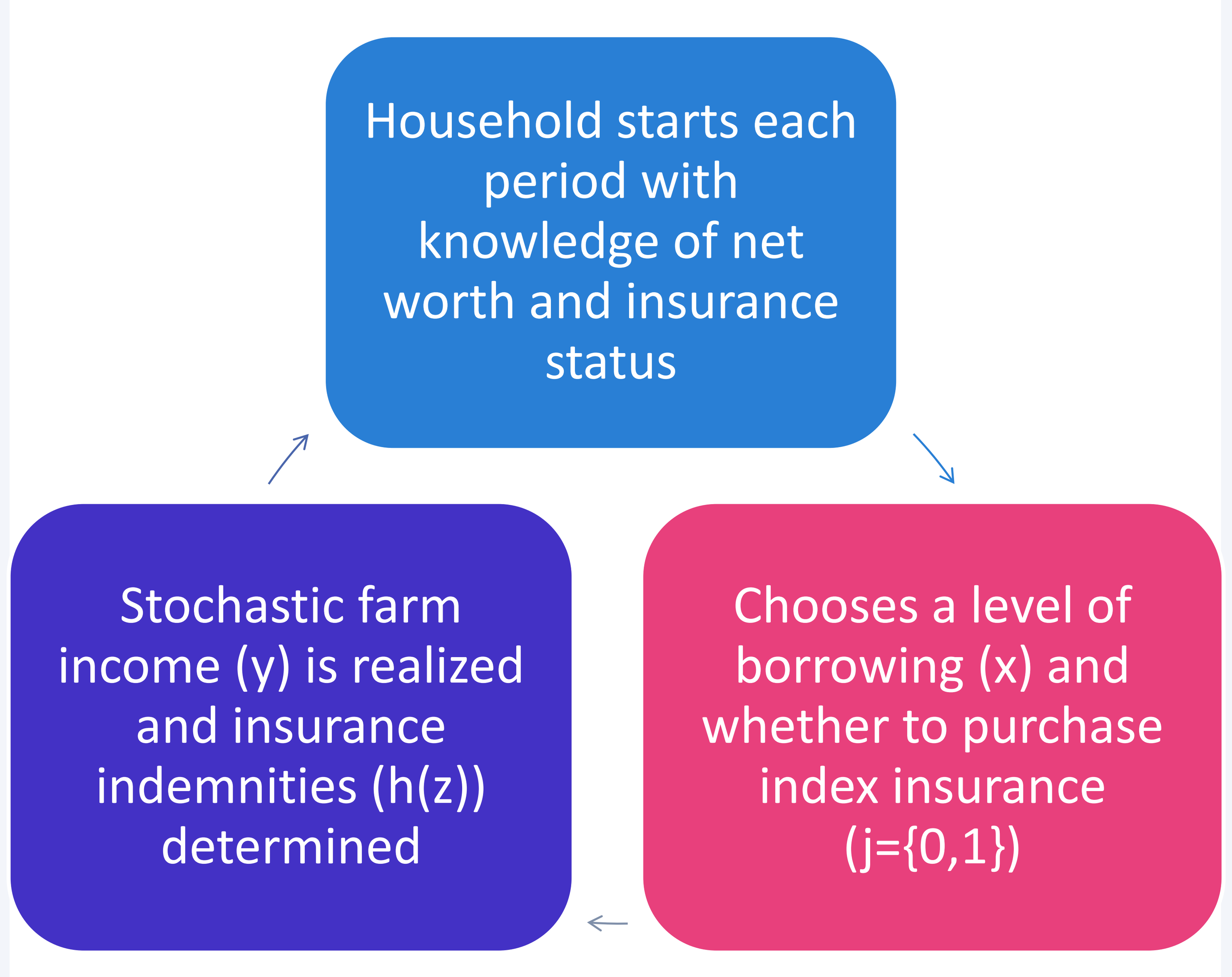
ABSTRACT

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



FORMAL MODEL

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:

$$V(s) = Max\{V_0(s), V_1(s)\}, \text{ where}$$

$$V_0(s) = \text{Max}_{0\le x\le b}\{u(s+x) + \delta E_{\tilde{y}} V(\tilde{y} - (1+r)x)\}$$

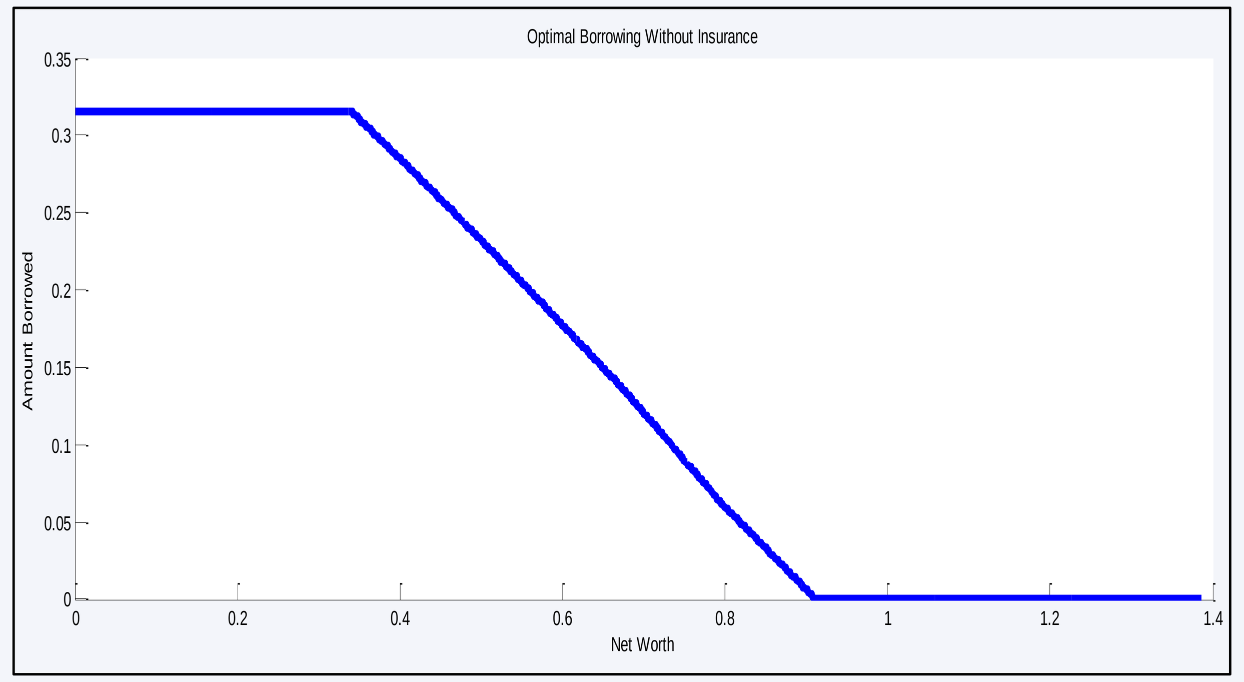
$$V_1(s) = \text{Max}_{0\le x\le b}\left\{\begin{matrix} u(s+x-\pi) \\ +\delta E_{\tilde{y},\tilde{z}} V(\tilde{y} - g(x) + h(\tilde{z})) \end{matrix}\right\}$$

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 – NO INSURANCE

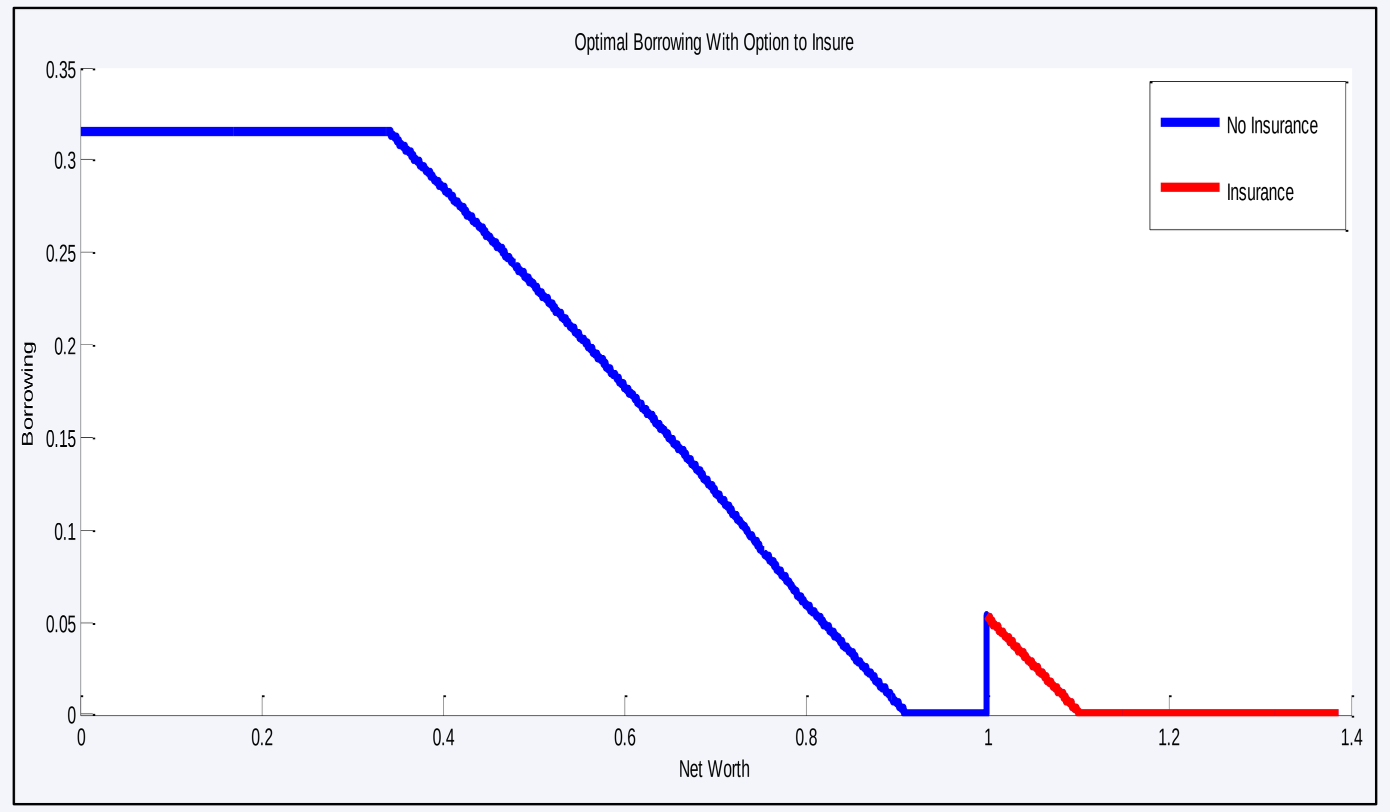
Figure 1: Decision Rule for Borrowing without Insurance



- Households with low net worth borrow the maximum.
- At a critical net worth (s = 0.34), borrowing declines.
- At a second critical net worth value (s = 0.91), a household stops borrowing completely.

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.

ACKNOWLEDGEMENTS AND CONTACT

I would like to give special thanks to my faculty advisor, Dr. Mario J. Miranda, Anderson's Professor of Finance and Risk Management at The Ohio State University, for providing invaluable comments during our many discussions of this paper. Simulations were run using the CompEcon toolbox for MATLAB, which was developed by Dr. Miranda and Dr. Paul L. Fackler. I also received helpful critiques from two anonymous faculty reviewers from my department at Ohio State. Any errors are solely my own.

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.