Insights from Behavioral Economics on Index Insurance

Michael Carter

Professor, Agricultural & Resource Economics
University of California, Davis
Director, BASIS Collaborative Research Support Program

I^4 Index Insurance Innovation Initiative
Technical Committee Meeting
Washington, D.C. 12 May 2011
Introduction: The Puzzle of Index Insurance

• Standard Index Insurance Contract
  – Linear Payout as fall below strike point
    • Expect demand from risk averse agents under expected utility theory even for this partial insurance
    • Miranda’s classic mean-variance treatment
  – Gine’s non-linear payouts
    • \( \rightarrow \) more better demand

• Despite this strong theoretical expectation, we know that demand often seems tepid—but why?
Figure 1—Dual strike-point contract

Source: Author’s calculations.
Introduction: The Puzzle of Index Insurance

• Maintaining expected utility perspective, look for explanations & solutions:
  – Basis risk and poor design (but even partial insurance is valuable)
  – Contracts priced over actuarially fair—suddenly basis risk becomes more important.
    • GIIF as solution?
    • Interlinkage as solution?
  – Liquidity constraints (but solutions)
  – Trust (Alain’s observations; Gine et al. on India)
    – Understanding (probabilities; complexity)
• Is it possible that we are wrong in our fundamental approach about the behavioral principles that guide demand?
• Expected utility theory in general has been heavily questioned by behavioral experiments
• Let’s look at a few elements of that critique and consider what it might mean for design of index insurance contracts and how we might test the veracity of these alternative designs
Behavioral Paradox 1

• A volunteer from the audience—thank you, Lena!

• Problem 1
  • I give Lena $10
  • Lena, you must choose which of the following lotteries you want to play:
    – Lottery A: Heads you get $10, Tails you get 0
    – Lottery B: Heads you get $5 and Tails you get $5
  • Lena, your choice, please …

• Problem 2
  • I given Lena $20
  • Lena, you must choose which of the following lotteries you want to play:
    – Lottery A': Heads you loose $10, Tails you loose 0
    – Lottery B': Heads you loose $5 and Tails you loose $5
  • Lena, your choice, please …
Behavioral Paradox 2

• A volunteer from the audience—thank you, Nora!

• **Problem 1**
  • Nora, you must choose which of the following lotteries you want to play:
    – *Lottery A*: Certainty of receiving 100 million.
    – *Lottery B*: 10% chance of 500 million; 89% chance of 100 million; 1% chance of nothing.
  
• Nora, your choice, please ...

• **Problem 2**
  • Nora, you must choose which of the following lotteries you want to play:
    – *Lottery A’*: 11% chance of 100 million; 89% chance of nothing.
    – *Lottery B’*: 10% chance of 500 million; 90% chance of nothing.

• Nora, your choice, please ....
Behavioral Paradox 1, Results

• Typical play in these games reveals “preference reversals,” from the perspective of conventional expected utility theory:
  – In Lena’s game, most people Choose B in problem 1 and A’ in problem 2
  – In Nora’s game, most people choose A in problem 1 and B’ in problem 2

• The preference reversal observed in Lena’s game signals that people respond differently to the ‘same situation’ depending on whether framed as a gain and or a loss:
  – Suggests that people do not perfectly integrate their assets as we typically assume in modeling behavior in the face of risk (& insurance demand)
  – A budgeting effect, or separate mental accounts
  – Loss aversion is not the same as risk aversion (in gains)
Behavioral Paradox 2, Results

- The reversal in Nora’s game illustrates Allais’ Paradox—people are not indifferent to the removal of a common consequence (89% chance of getting $100 million)
  - Violates ‘independence’ axiom of expected utility theory
  - May suggest S-shaped probability weighting scheme
  - Or, a distinctive preference for certainty [more later]
Before turning to the meaning of these behavioral findings for index insurance, let’s look at one more standard behavioral finding.

- Standard Risk aversion lottery
- Ambiguity Aversion lottery
- Standard finding
**Implications for Index Insurance**

- Consider the following expected utility representation of well-being with and without an actuarially fair index insurance:

\[
V^I = \iiint u(y(\theta, \varepsilon) - K + W - \pi + \rho(\theta))\phi(\theta, \varepsilon)d\theta d\varepsilon
\]

\[
V^N = \iiint u(y(\theta, \varepsilon) - K + W)\phi(\theta, \varepsilon)d\theta d\varepsilon
\]

where \( E(\rho(\theta)) = \pi \)

- Note the following:
  - Asset integration (not matter if do or do not include for \(-K+W\) for relative rankings
  - That is gains and losses treated the same
  - Objective probabilities (no probability decision weights)
  - Some things are certain (\( \pi \)), other things are not (\( \rho \)), yet all evaluated with the same expected utility framework

- Finally, note that from the farmer’s perspective, index insurance is ambiguous
  - Conditional on having a loss (\( y(\theta, \varepsilon) < \bar{y} \)), unclear if the farmer will get a payout (\( \bar{y}(\theta) < \bar{y}^* \))
Behavioral Economics-informed Alternative Approaches

• Cumulative prospect Theory (Kahneman & Tversky)
  – Losses versus gains
  – Risk-seeking over losses versus risk averse over gains
  – Low deductible preference
  – Peculiar probability weights

• Certain and uncertain utility (Andreoni & Sprenger)
  – Losses versus gains (generalize)
  – Ambiguity
  – Preference for certainty
Behavioral Economics-informed Alternative Approaches

- Cumulative prospect Theory:

\[
U(\tilde{x}) = \sum_{x_{\text{min}}}^{0} w^-(p)\ v^-(x^-) + \sum_{0}^{x_{\text{max}}} w^+(p)\ v^+(x^+)
\]
Behavioral Economics-informed Alternative Approaches

- Certain and uncertain utility (Andreoni & Sprenger)

\[
W(X, L) = \begin{cases} 
  v(x_j) & \text{if } L \in \mathcal{L}_D \\
  \sum_{i=1}^{S} p_{N_i} \times u(x_i) & \text{if } L \in \mathcal{L}_N
\end{cases}
\]
Contract Design under Non-expected Utility

• Alternatives
  – Gains versus losses
  – Probabilistic-seeming premium
  – Deductibles

• Exploratory Mechanisms
  – Standard risk, loss and ambiguity lotteries
    • Test for alternative theories
  – Framed alternative contracts to reveal preferences
    • Losses versus gains
    • Different premium structures
    • Deductibles