Mitigation Index Insurance for Developing Countries:  
Insure the Loss or Insure the Signal?

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Selected Poster prepared for presentation at the  
2015 Agricultural & Applied Economics Association and Western Agricultural Economics  
Association Joint Annual Meeting, San Francisco, CA, July 26-28

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Introduction

Risk Management in developing countries

The livelihoods of the rural poor in the developing world depend, directly or indirectly, on agriculture. The economic lives of such individuals are typically characterized by exposure to profound weather-related perils such as droughts, floods, and windstorms, and by lack access to formal insurance and financial services that forces them to employ risk-avoidance, risk-diversification, and informal risk-sharing practices that are either costly or offer inadequate risk protection (Coate and Ravallion 1993; Townsend, 1994; Ligon, Thomas, et al., 2002; Dubois, Julienn, et al. 2008; Gine 2009; Chantarar et al. 2007).

Traditional Insurance: indemnifies demonstrable losses, Index Insurance: indemnifies based on a weather variable that is correlated with losses.

Objectives

We explore alternate timing for index insurance payouts. In particular, we explore the potential benefits of what we call “mitigation index insurance” in which the payouts of the insurance contract arrive before losses are incurred, in time to be used to take measures to mitigate, that is, reduce eventual losses.

Applications of Mitigation Index Insurance

1. El Niño-Southern Oscillation (ENSO) business interruption insurance

   - Severe El Niños produce torrential rains and devastating floods in Peru. Onset of El Niños can be detected months in advance based on sea-surface temperature.
   - Indemnities are paid in November based on ENSO index, prior to February rainy season.

2. Famine Insurance

   - Chantarar et al., 2007
     - In Africa, severe droughts lead to famine, but not immediately.
     - Relief agencies who purchase drought insurance obtain needed funds before famine begins.

3. Replanting Guarantee Insurance

   - Poor rainfall during germination reduces crop yields. Farmers can replant, but lack money for quality seeds.
   - In 2014, in Tanzania, Acre Africa launched rainfall index insurance contract that is bundled by seed companies into vouchers for purchase of new bag of quality seeds.

Methods

We use a stylized three-period, discrete choice, stochastic dynamic optimization model:

<table>
<thead>
<tr>
<th>Loss Event</th>
<th>Do Not Mitigate</th>
<th>Mitigate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premium</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Signal</td>
<td>1-1</td>
<td>1-φ</td>
</tr>
<tr>
<td>Loss</td>
<td>0</td>
<td>1-φ</td>
</tr>
</tbody>
</table>

- insurance is purchased in period 0;
- a signal correlated with losses emerges in period 1;
- given the signal, mitigation measures may be taken in period 1;
- and losses, if any, are realized in period 2.

Conventional vs. Mitigation Index Insurance

We assess the relative values of mitigation index insurance and conventional index insurance by deriving the individuals expected ex-ante welfare under three insurance scenarios:

i. No Insurance;
ii. Conventional Index Insurance: indemnifies based on index observed in period 2, after losses incurred;
iii. Mitigation Index Insurance: indemnifies based on index observed in period 1, before losses incurred, in time to be used for mitigation measures to be undertaken.

<table>
<thead>
<tr>
<th>Indemnity Structure</th>
<th>t=1</th>
<th>t=2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional Index Insurance</td>
<td></td>
<td>Indemnity Index Insurance</td>
</tr>
</tbody>
</table>

Information Structure (Conditional Probabilities)

- Probability of a bad harvest is \( p \)
- Precision of signal measured by \( \theta = \theta_1 \leq 1 \)
- Good Harvest
- Bad Harvest
- If \( \theta = 0 \), the signal is fully uninformative;
- If \( \theta = 1 \), the signal is fully informative.

Conclusions

- Mitigation index insurance encourages people to undertake mitigation while conventional index insurance discourages them from doing so.
- Value of mitigation index insurance rises as:
  - precision of signal;
  - cost of mitigation rises;
  - endowment falls.
- Higher precision of signal:
  - Increasing mitigation cost
  - Less and later mitigation

Bibliography