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

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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, Jullien, et al 2008; Gine 2009; Chantarat 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 (Skees and Murphy, 2009)

- 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 temperatures.
- Indemnities are paid in November based on ENSO index, prior to February rainy season.

2.Famine Insurance (Chantarat et al, 2007)

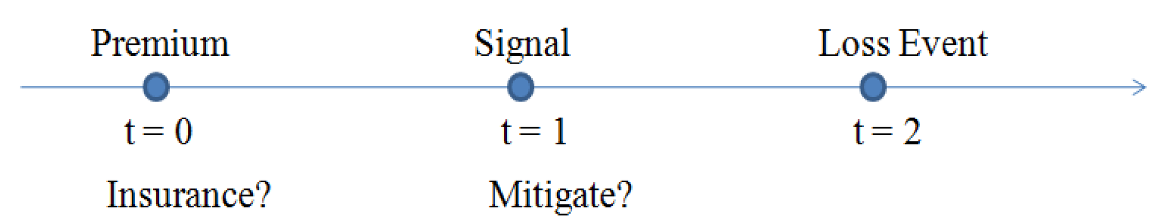
- In Africa, severe droughts lead to famine, but not immediately.
- Relief agencies who purchase drought insurance obtain needed funds before famine begins.

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 the bags of seed they sell.
- If rains fail during first three weeks, insurance provides cash voucher for purchase of new bag of quality seeds.

Methods

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



- 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:

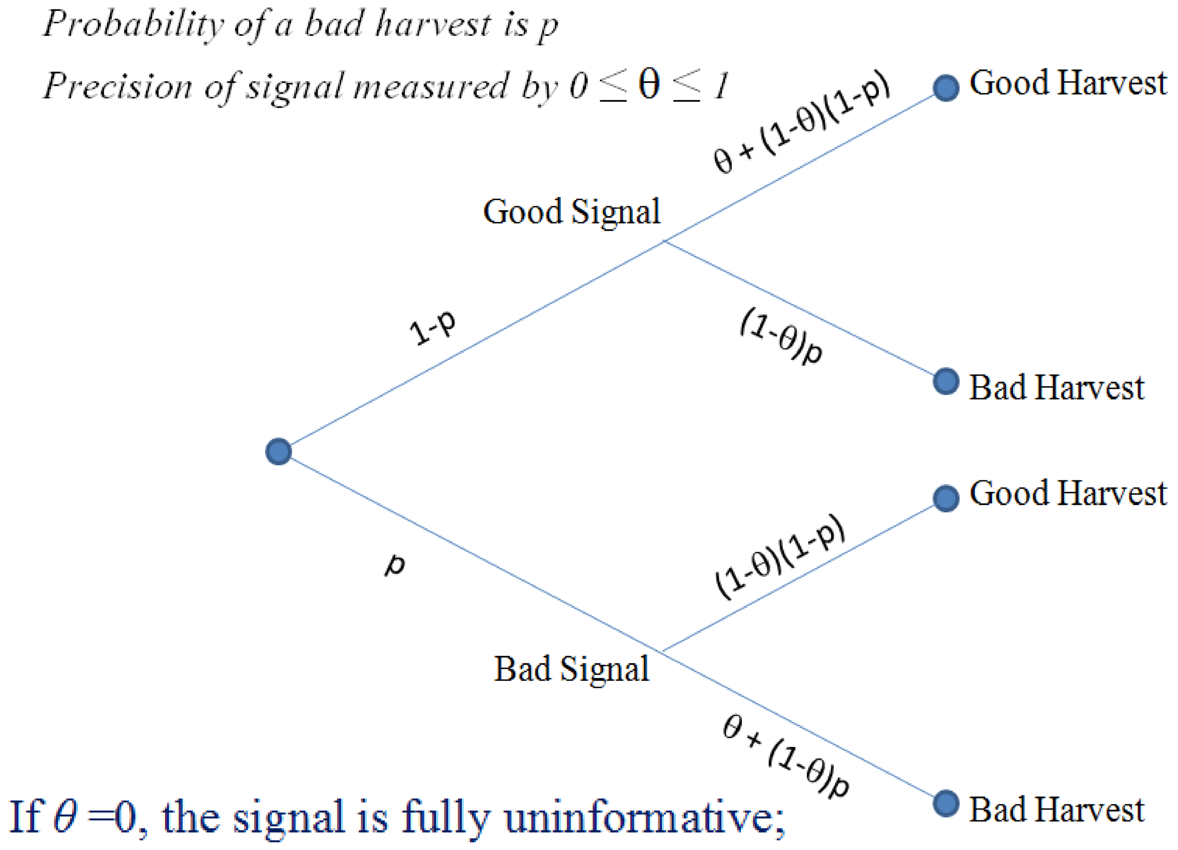
i. No Insurance;
ii. Conventional Index Insurance: indemnifies based on index observed in period 2, after losses incurred;
iii. Mitigation Index Insurance: indemnifies based on index observed in period 1, before losses incurred, in time for mitigation measures to be undertaken.

Indemnity Structure	t =1	t = 2
No Insurance	——	——
Conventional Index Insurance	——	Indemnity
Mitigation Index Insurance	Indemnity	——

Information Structure (Conditional Probabilities)

Probability of a bad harvest is p

Precision of signal measured by $0 \leq \theta \leq 1$



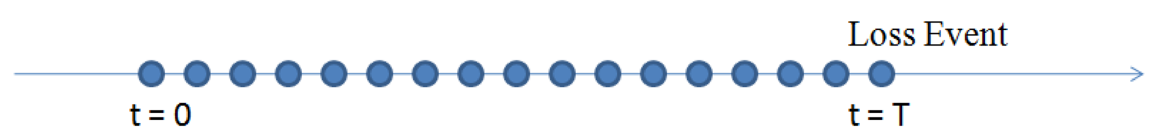
If θ =0, the signal is fully uninformative;

If θ =1, the signal is fully informative.

Loss Structure	Do not Mitigate	Mitigate
Good Harvest	1	1
Bad Harvest	1-*L*	1- (1-φ)L

Here, *L* denotes the loss;
φ indicates the effectiveness of the mitigation measures.
If φ=1, mitigation is fully effective at eliminating the loss;
If φ=0, mitigation is fully ineffective at reducing the loss.

➢We then turn to a multi-period dynamic stochastic model with a more refined treatment of time and explore how the relative benefits of mitigation index insurance vary with the point in time at which the indemnities are paid.



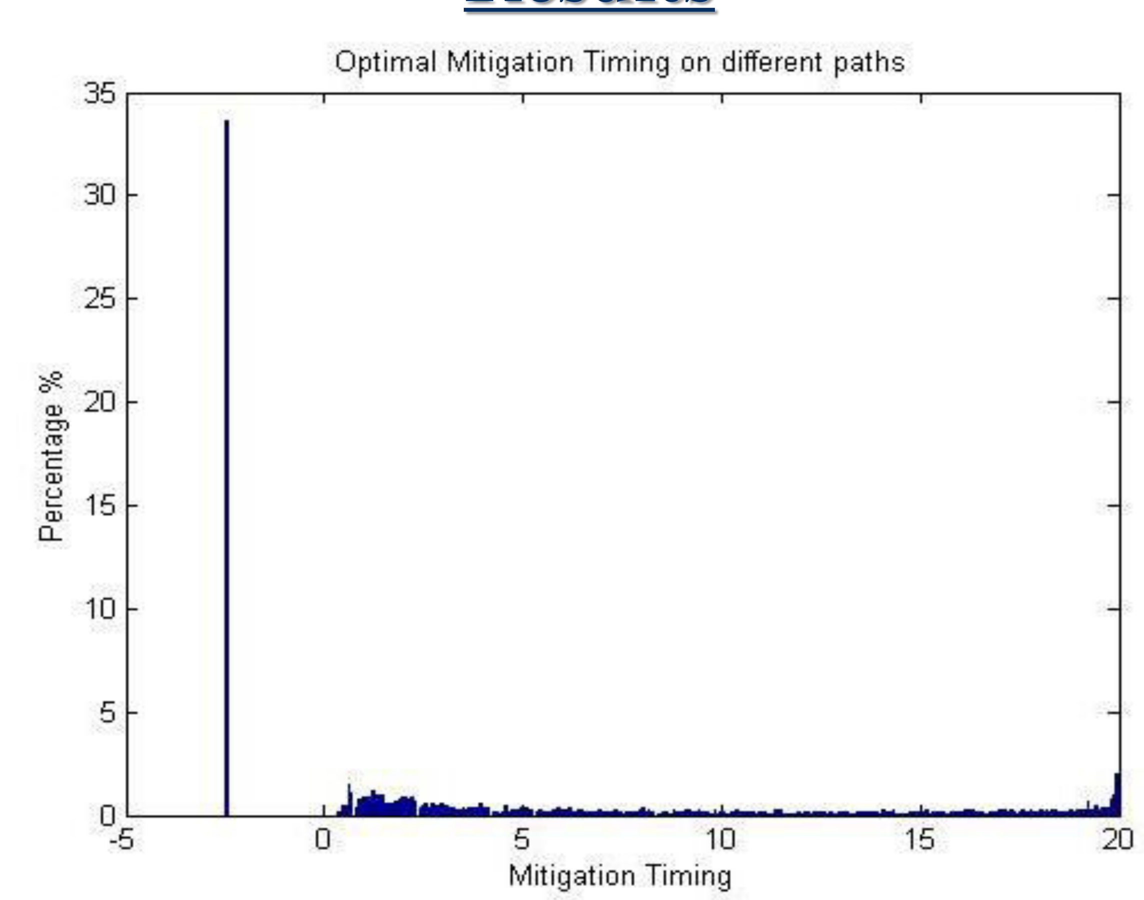
Information ↑
Losses at a future date can be predicted with greater precision as time passes.

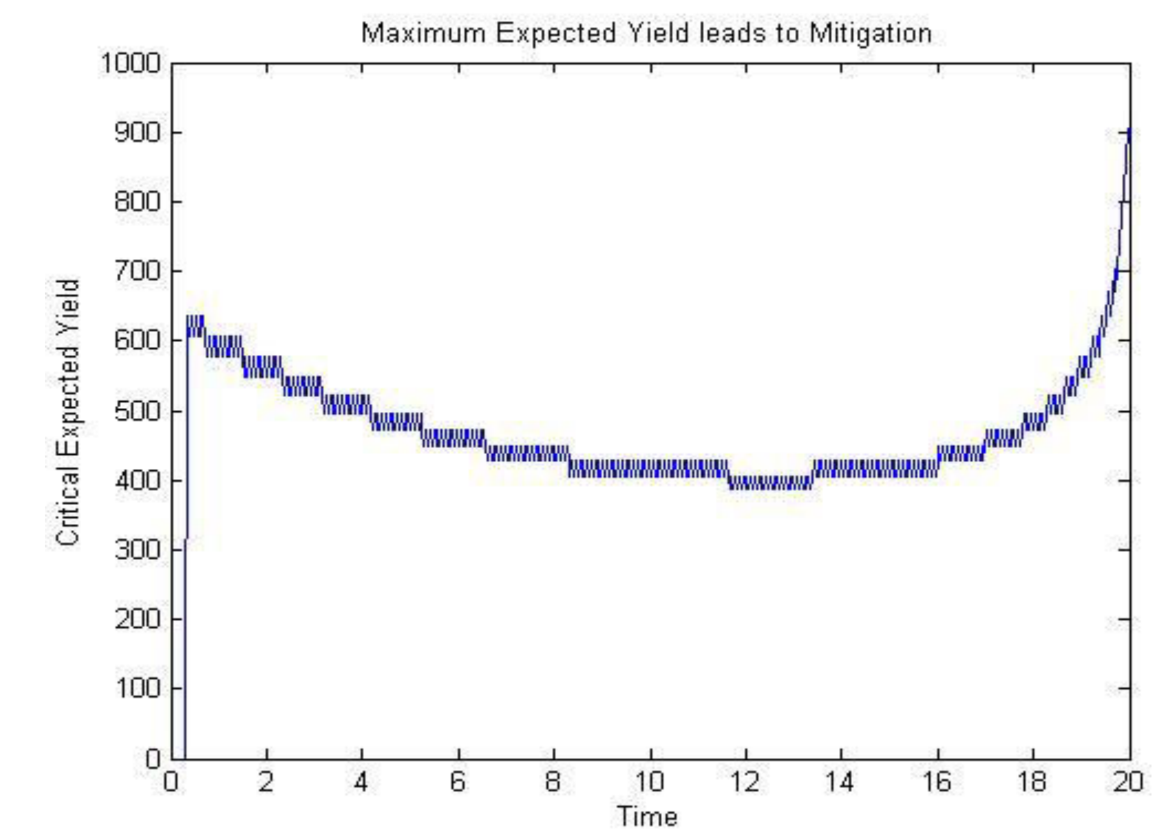
Mitigation ↓
Opportunities to reduce losses at a future date diminish as time passes.

Tradeoff
The longer one waits to mitigate, the less cost effective it becomes, but the better informed one is about its benefits.

➢ We use binomial option pricing model (BOPM) to approximate the information structure, and numerically solve and simulate the model.

Results





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 rises;
- cost of mitigation rises;
- endowment falls.

➢ Higher precision of signal;
Increasing mitigation cost
→ Less and later mitigation

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