Making index insurance work: A review of recent progress

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Ample evidence that conventional insurance does not work for low wealth rural households (Ecuador).

Evidence that index insurance can work:

- **Before the Drought**
  - 20-30% increase in investment when insured (Ghana, India, Mali)

- **After the Drought**
  - Significant reductions in costly coping strategies (Kenya)
The Problem,

- But uptake of index insurance is often low:
  - Low quality (failure-prone)
  - High price
  - Lack of trust in providers
  - Lack of information on a complex, novel technology (learning difficult)
  - Cash constraints to purchase
  - Behaviorally oddities (ambiguity aversion)
- Index insurance remains work in progress
Progress toward Meeting Potential

- Our goal is to look forward & specifically focus on advances that might solve these problems
  - Ground-truthing & technological advances to create high-quality insurance indices
  - Safe Minimum Standards for index insurance quality to help create a viable market
  - Interlinked & meso-level insurance to overcome low uptake issues
  - [Contract design informed by behavioral economics]
  - [Smarter Subsidies that lower insurance costs & help make the market]
  - [Apply lessons from the microcredit revolution on outreach to low wealth clients]

- Alain will present alternatives to index insurance (stress resistant seed technologies; savings & credit instruments). These may be substitutes for insurance, but perhaps also complements as we can discuss later.
Disappointed (angry) farmers & what are sometimes called “Basis Risk Events” have punctuated the importance of designing contracts that protect farmers.

Sources of uninsured risk are two:

- **Design risk** occurs when an insurance index is poorly correlated with average losses in the insurance zone covered by the index; and,
- **Idiosyncratic risk** occurs when the individual’s losses differ from the average losses in her insurance zone.
Design risk can be minimized by improved contract design
Idiosyncratic risk can be minimized by downscaling contract (subject to moral hazard constraints)
Examine a recently implemented contract in Tanzania & Mozambique to illustrate design and implementation of a high quality contract
Ongoing project in Tanzania and Mozambique is exploring the complementarity between index insurance and drought tolerant (DT) maize seeds that offer some protection against mid-season drought.

Goal was to design a contract that offered protection against:
- Early season rainfall deficit; and,
- End of season yield deficit

To this end, we collected current and retrospective maize yield data that would allow us to design a quality contract based on two satellite indices:
- Estimated rainfall data to detect early season drought
- NDVI (a bio-mass or “greenness” index) to measure yield deficit

Measure each of these at the level of “contract zones, which comprise roughly 3 villages
Early season rainfall deficit trigger:
- 5x5 kilometer (25 square kilometer) resolution
- Data at 10-day (dekad) frequency
- Use data to estimate planting date and then detect early season drought
- Contract triggers payment if estimated rainfall below 90 mm over the first 40 days of the growing season
Index Design

- Yield shortfall trigger based on Normalized Difference Vegetation Index (NDVI)
  - Measures biomass growth over the maize growing season
  - Data available on 250 m x 250 m grid (6 hectares) since 2002
  - Crop masking used to discard pixels that are not maize
  - Contract Triggers if predicted yields are less than 65% of their long-term average

- Optimized statistical model explains 80% of zone variation in yields (still some design risk)

- Scope for improvement with downscaling & ultra-high resolution data from Planet Labs (3mx3m)
Index Design: NDVI
Overall Contract Performance

![Graph showing predicted zone-level yields, % of zone normal vs. rainfall first 40 days. Different symbols represent different yield categories: actual yield ≥ 100% of norm, actual yield between 80–100% of norm, actual yield between 60–80% of norm, and actual yield <60% of norm.]
An on-farm audit can occur if farmers experience yield losses that are not predicted by the satellite data:

- Farmers are notified 100 days after planting if insurance payout will occur in advance of harvest;
- Farmers may then call for an audit if they believe the insurance did not properly cover their losses

Audit triggered if at least 50% of farmers complain

Camera-based audit is conducted by a team trained by CIMMYT crop officers from the Ministry of Agriculture
### Example Pricing Table

#### Price of Insurance Contract (PRELIMINARY)

<table>
<thead>
<tr>
<th>Contract Element</th>
<th>1 Acre (8 Kg of Seeds)</th>
<th>Per 2 kg Bag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall Deficit (5%* $16)</td>
<td>$0.80</td>
<td>$0.20</td>
</tr>
<tr>
<td>Yield Shortfall (16%* $16)</td>
<td>$2.56</td>
<td>$0.64</td>
</tr>
<tr>
<td>Audit Rule</td>
<td>$1.15</td>
<td>$0.29</td>
</tr>
<tr>
<td><strong>Total Pure Premium</strong></td>
<td><strong>$4.51</strong></td>
<td><strong>$1.13</strong></td>
</tr>
</tbody>
</table>

- **Market Price Assuming 25% Mark-up**

<table>
<thead>
<tr>
<th></th>
<th>1 Acre (8 Kg of Seeds)</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Market Price</strong></td>
<td><strong>$5.63</strong></td>
<td><strong>$1.41</strong></td>
</tr>
</tbody>
</table>
A quality index insurance contract is one that:
- Adequately protect farmers against income fluctuations; and,
- Can achieve the objectives we seek in offering insurance to developing country farmers (the before & after the drought effects summarized above)

Like hybrid maize seeds, quality of index insurance:
- Is a hidden trait (that is, the farmer can look at the contract paper & tell if it will protect her)
- Costly to develop and supply

Unlike hybrid seeds:
- No defined & enforced quality standards (akin to germination & yield tests for seeds)
- Takes many years for farmers to discern quality

Given these characteristics, economic theory suggests unregulated market can reach a junk equilibrium with low quality insurance and low demand
SMS for Index Insurance

- Using the data collected for contract design, standard economic concepts allow definition of a “Safe Minimum Standard” for index insurance quality.

- Two things reduce the quality of an index insurance contract:
  - The probability that an insurance failure happens
  - The “value” of money when failure happens (money worth more when need it most)

- Standard economic theory can aggregate these two elements into a single a ’reservation’ price measure defined as the maximum amount an individual could pay for a contract without making herself worse off.

- The Safe Minimum Standard is thus:
  - Market Price < Reservation Price for a moderately risk averse farmer
  - If the market price exceeds the reservation price, then the individual would be better off having no insurance and keeping the premium money (even if subsidized)
Example of SMS analysis from a fail-safe contract designed for rice farmers in Tanzania

Industry not yet pushing for such standards

A first step might be for donors to demand that projects they fund meet the SMS
Low insurance demand by individual farmers has encouraged the development of interlinked & meso-level products:

- An interlinked contract is one in which insurance is bundled with another service, such as an agricultural loan through a bank or an agricultural value chain (e.g., required as a condition of a loan) and the creditor has first claims on insurance payoffs to cover debts.

- A meso product is where the insurance is purchase directly by the bank (or other meso-level institution) as portfolio protection.
Important to emphasize two things about interlinked & meso-level insurance:

- Index quality remains paramount as large design risk (common risk that is NOT covered adequately by the contract) will sink even a meso-level contract
- If a goal of insurance is to enable farmers to prudentially invest more in their agriculture, knowledge, understanding and protection under the meso-contract remain important
An interlinked contract is one in which the creditor has first claim on insurance payouts to cover farmers’ debt obligations.

Interlinkage makes most sense in environments where loans are undercollateralized.

When loans are undercollateralized, lender bears drought and other risk.

Often the case in value chain finance where a standing crop partially collateralizes the loan.

Let’s look at results from a theoretical analysis (Carter et al.)
Interlinkage & Collateral

- In low collateral environments, standalone insurance contracts will have minimal impact on investment profitable activities
- Requiring standalone insurance can reduce investment!
- Interlinked insurance interlinked can crowd in investment if:
  - The loan market is competitive and the lender reduces interest rates on interlinked loans
  - Farmer knows that she is only liable for residual loan liability not covered by insurance payouts
- Note also that even interlinked insurance will have zero impacts if contract quality and, or total risk are low
Mixed experience with interlinked credit:

- High insurance uptake (30-70%) in value chain/loan programs in Kenya (sugar cane) and Mali (cotton), with significant investment impacts in Mali
- Minimal uptake in Ethiopia (grain crops) and Burkina Faso (cotton), largely because of complex implementation problems
- In Ghana, presence of interlinkage increased loan approval rates for male farmers (a supply-side effect), and yet for at least women farmers, insurance demand higher when insurance payments went directly to them (non-interlinked) rather than to the lender
In Conclusion

- Problems of risk & resilience more powerful than ever
- Time to neither praise nor bury index insurance
- Technological frontier is exciting, but we need more attention to the designing contracts for quality
- Governments & donors can support the development and implementation of quality standards
- Can also promote portfolio thinking which flexibly that combines financial and agronomic risk management technologies in flexible ways that evolve over time for individuals
Thank You!

M.R. Carter
Making Index Insurance Work
As SMS diagram shows, even quality index insurance cannot meet the SMS if price is marked up by much more than 40% of “actuarially fair price”

While US crop insurance is marked up by ~27% (and then subsidized), not unusual in our projects to see mark-ups well above 50%

Reasons behind these mark-up levels can be disputed, but clearly has some basis in concerns about data quality (sparse data problem) and climate change (unstable probability distributions)

One interpretation is that these factors result in an uncertainty loading or mark-up
What is clear is that demand for, and impacts of, index insurance will be minimal at this price.

Been some tendency to simply to subsidize a highly marked-up price (the original GIIF program run by IFC).

A smarter subsidy might be for a public entity to carry some of the “tail risk” (about which there is uncertainty) so that the overall price comes down.

A just announced GIIF program takes some first steps in this direction.

Also, can use subsidies to help make the market by providing a catastrophic level of protection.

Still much to be done to improve the use of subsidies so that index insurance can have its desired effects & promote resilience.
Learn from the Microfinance Revolution

- **Main lessons from microfinance:**
  - Microcredit increasingly customized to client circumstances:
  - Flexible collateral arrangements:
  - crops, warehouse receipts, assets purchased
  - Account for seasonal distribution of farmer income
  - Role of nudges and social incentives (joint liability)

- **Lessons for index insurance:**
  - Promote Village Insurance Savings Accounts (Nepal): dedicated savings for health and weather index insurance
  - Pay premium at time of delivery of product: part of contract with buyer of crop (used in cotton, dairy & sugar value chains/contract farming schemes)
  - Include index insurance premium in price of inputs (Syngenta)