FEED THE FUTURE INNOVATION LAB FOR MARKETS, RISK & RESILIENCE

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Climate Change & Vulnerability: Can Index Insurance Meet the Challenge?

Michael R. Carter

University of California-Davis, University of Cape Town & NBER

Director, BASIS Markets, Risk & Resilience Innovation Lab

What is Index or Parametric Insurance?

Impact of Insurance on Coping Strategies in Kenya (Janzen & Carter 2019)

Meal Reduction (Asset Smoothing)

		Threshold Estimates	
	Average	< 9.3 *TLU*	> 9.3 *TLU*
Insurance Impacts	-12%	-49%**	0.4%
Control Means	71%		

Livestock Sales (Consumption Smoothing)

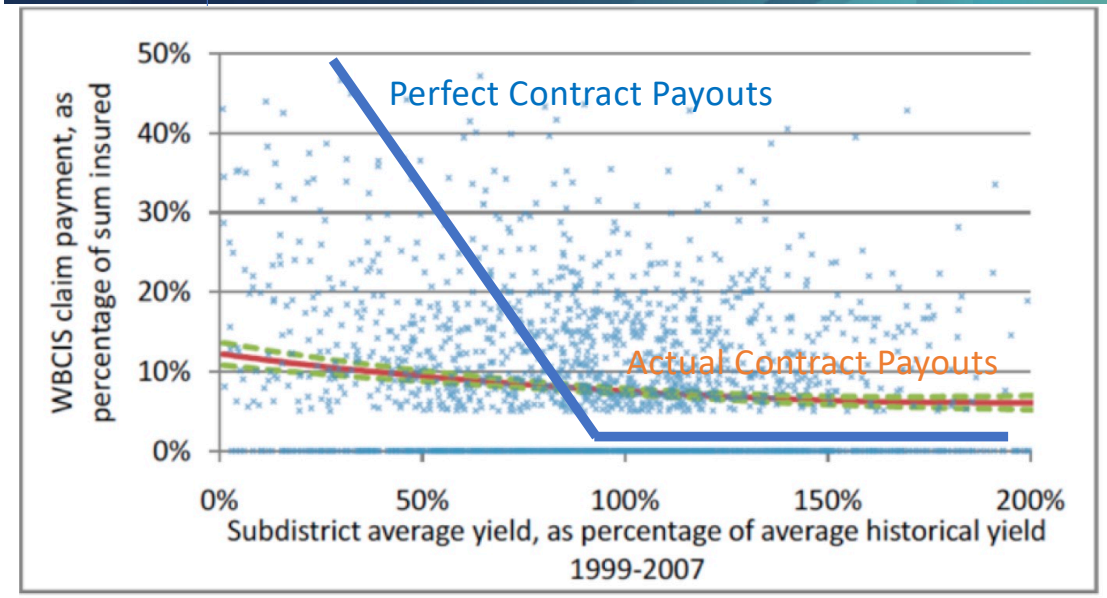
	Average	< 22.4 *TLU*	> 22.4 *TLU*
Insurance Impacts	-61%***	-54%***	-96%***
Control Means	32%		

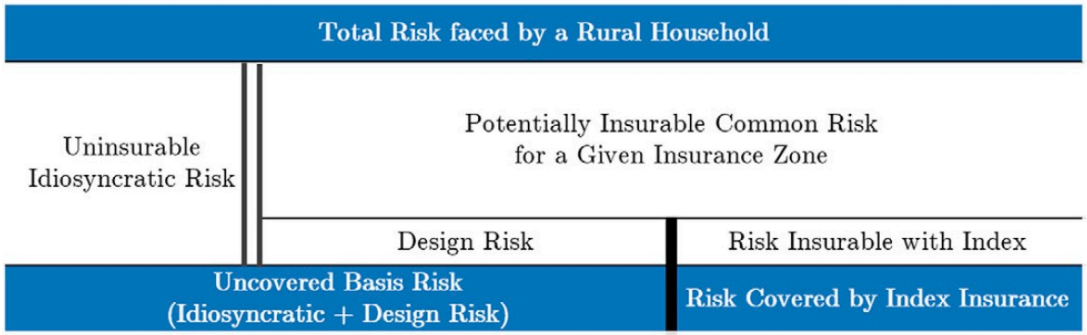
Impact of Cotton Insurance in Mali (Elabed & Carter, 2018)

	Cotton Production			Grain Crops
	Area (ha)	Inputs ('000 CFA)	Harvest (kg)	Area (ha)
Impact of Insurance (IV)	1.3**	98**	945	0.6
Mean of Control Group	2.5	223	2567	3.6

- *Index or Parametric Insurance* does not require direct measurement & verification of individual losses, but instead pays off based on an index that:
  - Cannot be influenced by the insured party
  - Related to, but not identical to, losses actually experienced
  - Opens the door to insuring low wealth & remote households & businesses
- Evidence that micro index insurance offered to individuals:
  - *Reduces households' reliance on Costly Coping Strategies* in response to weather shocks
  - *Crowds in Investment* (Resilience-plus)
  - These behavioral responses raise the intriguing possibility that the public sector can social protection money by spending some public funds on index insurance that triggers payments in the event of a climatic shock.
- *Sovereign index insurance*, which issues government budget support when climate shocks increase government fiscal obligations, *may* also generate economic gains

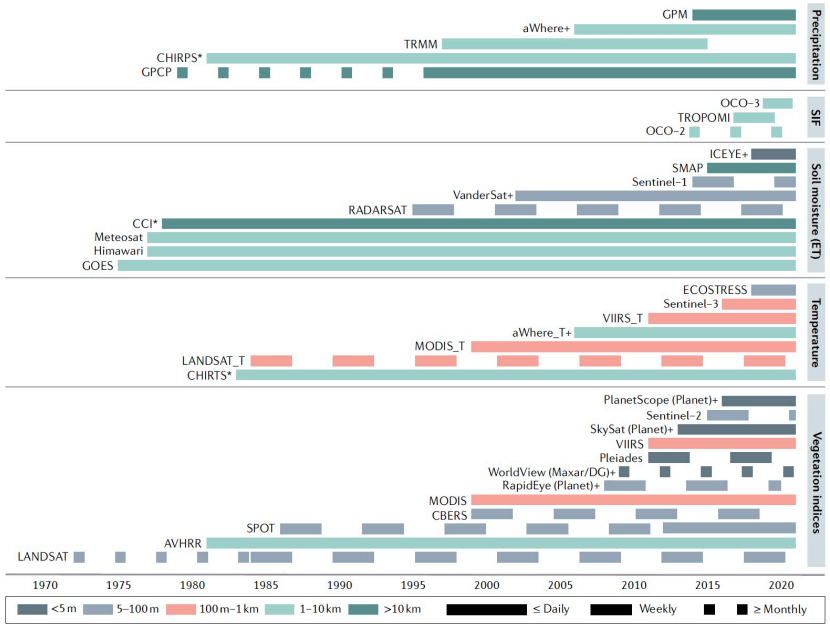
The Achilles Heal of Index Insurance

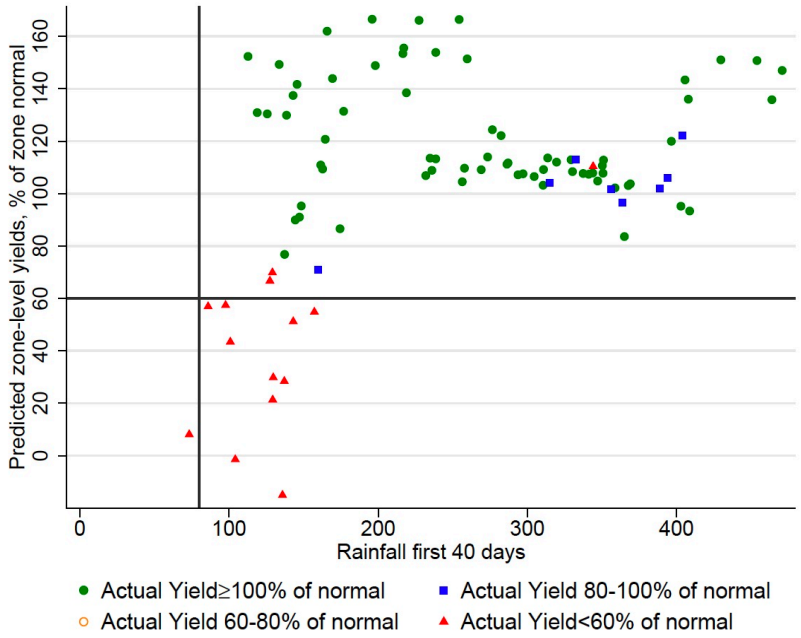




- The greatest strength of index insurance (losses do not have to be verified) is also its greatest weakness (the index may fail to trigger payment when losses occur)
- The worst thing can befall a household (severe loss) becomes worse if the contract fails to pay (severe loss plus premium paid)
- Failure prone index insurance can function more as a lottery ticket than insurance (no one has yet to claim that solve rural poverty by selling the poor lottery tickets!)
- Decompose the sources of contract failure for household index insurance into
  - Idiosyncratic risk
  - Design Risk

Increasing the Reliability of Index Insurance



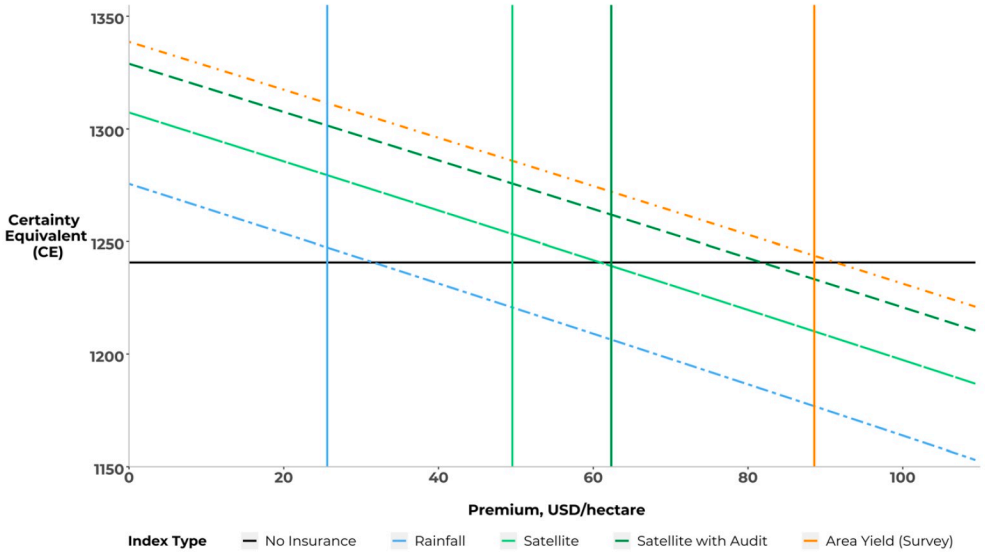


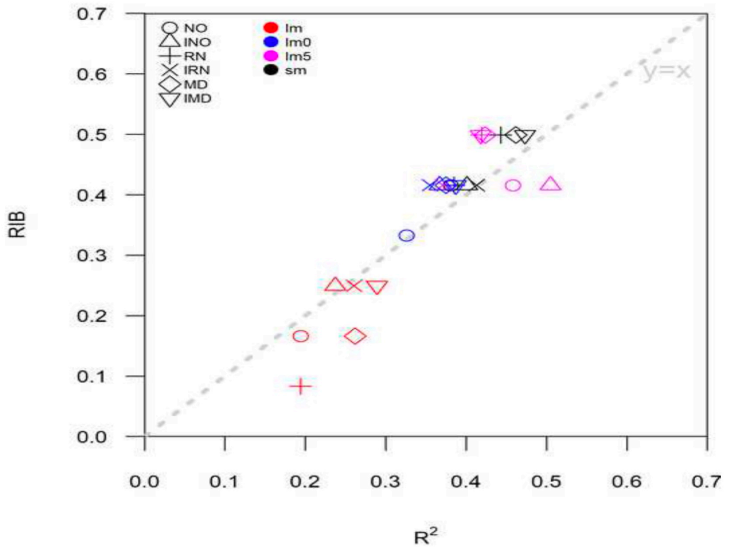
- *Rapid advances in satellite-based remote sensing*
  - *Spatial & temporal resolution*
  - *New sensors and measures*
  - *Flexible machine learning & other tools to better predict losses from given data*
- *Contractual innovations*
  - *Fail-safe terrestrial crop cut audits*
  - *Picture-based or drone-based audits*

Defining & Measuring Quality for Micro Index Insurance

- Like hybrid maize seeds, quality of index insurance Is a hidden trait (that is, the farmer cannot look at the contract paper & tell if it will protect her)
- High quality is more costly to develop and supply high quality than low quality
- Unlike certified hybrid seeds:
  - No defined & enforced quality standards (akin to germination & yield tests for seeds)
  - Takes many years for farmers to discern quality (even harder than for maize seeds)
- Low quality market equilibrium without certification: the bad drives out the good
- So how can we defined quality?
  - Standard microeconomic concepts can be used to define the value of insurance as the difference in family expected well-being (utility) with insurance contract J versus their well-being without: $\mathrm{IB}^{\mathrm{j}} = \mathrm{EU}^{\mathrm{J}} - \mathrm{EU}^{\mathrm{N}}$
  - While somewhat obtuse to non-economists, this expression reduces to a weighted average of sensible elements
  - If $\mathrm{IB}^{\mathrm{J}} < 0$, then contract J fails a minimum quality standard as it is expected to make people worse off with than without insurance.
  - More on certifying quality in a moment

Defining & Measuring Quality for Micro Index Insurance





- Using data on rice farmers in Tanzania, this diagram illustrates using this quality metric
  - For example, a first generation rainfall contract fails to pass the test
  - Simple satellite-based predicted yield barely passes
  - The strongest contract is a satellite contract with fail-safe audit rule.

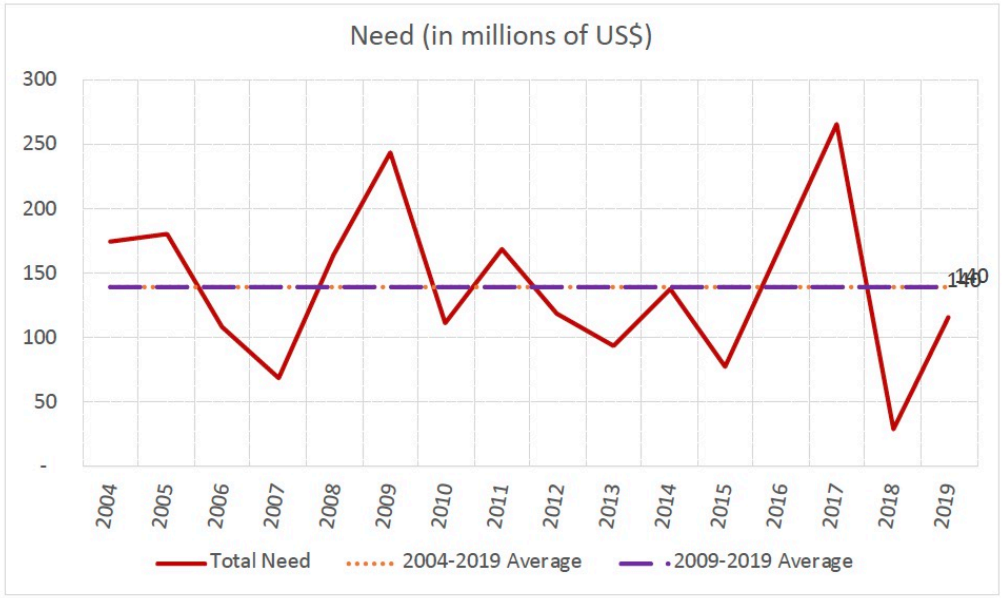
- These quality concepts can also be used to design contracts, in preference to predictive skill metrics often used by remote sensing scientists
- Can define the relative insurance benefit for index contract J as $\mathrm{RIB}^{\mathrm{J}} = {}^{\mathrm{RIB}^{\mathrm{J}}}/_{\mathrm{RIB}^{\mathrm{P}}}$, where IB^{P} is the insurance benefit of a perfect contract with zero design risk
- Using data on livestock mortality, can see the difference between predictive skill and RIB measure

Quality Index Insurance Certification (QUIIC)

- Using these coherent standards, we thus have a metric that can be used to provide a coherent measure of index insurance quality.
- So how can we solve the problem
- In collaboration with the NASA-affiliated remote sensing group in Nairobi, the Regional Centre for Mapping of Resources for Development, the Markets, Risk and Resilience Innovation Lab is working with public and private sector partners to develop a voluntary certification mark of index insurance quality
- See numerous examples of voluntary certification standards when the consumer cannot easily discern the quality of a commodity (e.g., fair trade; the ISO series; etc.) where the private
- First certifications underway; Still need to test the business case for voluntary certification
- Hope that donors and governments that support or subsidize index insurance will require the standard in order to catalyze the market for individual insurance contacts that can help the vulnerable manage climate change

Quality Standards for Sovereign Index Insurance Contracts

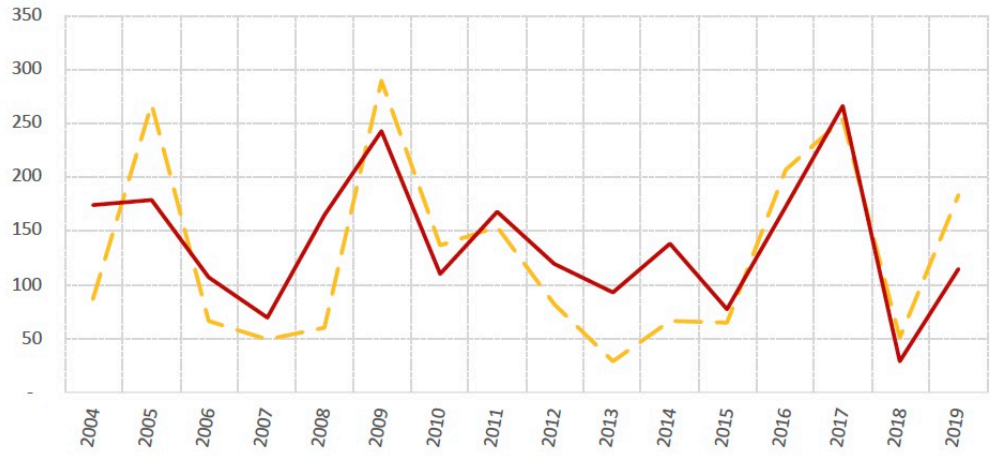
Figure 2: NDMA (Estimated) Costs of Full Social Protection in Ke



- Similar to micro level index insurance contacts, sovereign index insurance contracts are a novel technology that has had its share of failures
- While standard microeconomic concepts suggest ways to measure quality for micro contracts, when is a sovereign contract sufficiently reliable that a government would be better off purchasing index insurance for budget support than simply going it alone with its own resources?
- Recent work (Carter, Sugastti & Fava, 2021) suggests two approaches:
  - *Approach 1*: Assuming that the government has a binding social protection obligation (e.g., it must issue cash transfers to all households below the poverty line in any given period), choose insurance or no insurance (go-it-alone) based on the approach that minimizes the economic cost of meeting this obligation
  - *Approach 2*: Assuming that the government has a fixed social protection budget, choose the financing modality that maximizes the expected economic well-being of the country's vulnerable population
- Let's look briefly at approach 1 and a case study of a potential sovereign index insurance contract to help Kenya manage its social protection obligation to the vulnerable population located in its arid and semi-arid lands

Quality Standards for Sovereign Index Insurance Contracts

- How costly is the go-it-alone policy?
  - To gain purchase on this problem, assume that the large fluctuations in required social protection spending are buffered by the government's discretionary public investment account
  - Macroeconometric studies find that decreases in the level of public investment and increases in the instability of public investment both decrease national economic growth
  - Using these estimates, we can thus calculate the cost (in terms of foregone GDP) of the go-it-alone strategy
- What about sovereign insurance?
  - Perfect insurance that provided exactly the public funds needed to close the poverty gap for all poor households would stabilize public investment expenditure (growth promoting), but because of insurance mark-ups, would reduce the level of pubic investment spending
  - Using estimates from the literature the net result is that perfect insurance offers a substantial GDP gain relative to the go-it-alone strategy and the public finance instability it creates: Vver the 2009-2019 period, paying for the binding social protection obligation using the pay-as-you-go public finance model would have cost the Kenyan economy $US 436 million, whereas perfect insurance would have reduced that cost to only $US 28 million
- But what about *imperfect* index insurance?



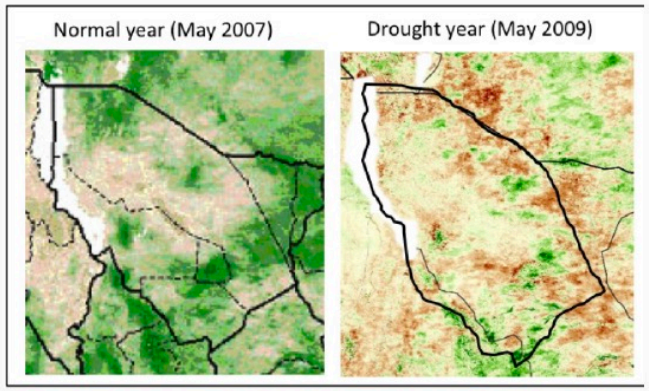
Is Sovereign Index Insurance worth it?

(c) Long Rains, $\rho = 2.5$

Markup	0%			10%			20%		
	SW	IP	Headcount	SW	IP	Headcount	SW	IP	Headcount
No social protection	1.67	1.49	1,804,097	1.67	1.49	1,804,097	1.67	1.49	1,804,097
Pay as you go	1.84	1.82	1,224,588	1.84	1.82	1,224,588	1.84	1.82	1,224,588
Index insurance	1.87	1.80	822,769	1.86	1.79	920,488	1.86	1.77	1,571,006
Perfect insurance	1.90	-	0	1.88	1.86	1,804,097	1.87	1.83	1,804,097

- Repeating the same exercise for a well-designed, current generation sovereign index insurance contract, we find that the GDP costs of meeting the binding social protection obligation is about 6-times higher than perfect insurance, but still less than half the foregone-GDP cost of the Pay-as-You-Go policy
- The same index contract also passes the public finance quality test using Approach 2 (but just barely)
- The point of course is that we need to look carefully at the quality of index insurance when applied to sovereign risk management
- As with micro index insurance, the quality metric can answer the question whether the contract is good enough to purchase
- It can also be used to discipline the contract design process, providing a way to select between alternative indices based on how close they can get to reaching the cost savings of a perfect insurance contract

In Conclusion



- While there is justifiable excitement about the potential for index insurance to enhance social protection & reduce food insecurity in the fact of climate change, index insurance remains a work in progress
- The greatest strength of index insurance (the fact that losses do not have to be verified for each individual) is also its greatest weakness (the index fails to accurately measure individual losses)
- This is a non-trivial issue as illustrated by the occasional spectacular and highly publicized failures of both micro and sovereign index insurance
- The technological frontier in remote sensing and in the analysis of remote sensing data is, however advancing rapidly
- We need, however, clear concepts of quality, and minimum quality standards to protect both individuals and governments
- With those standards in hand, we can then design for quality an help make a market that can use this tool to help meet the challenge of climate change

Further Reading

Benami, Elinor, Zhenong Jin, Michael R. Carter, Aniruddha Ghosh, Robert J. Hijmans, Andrew Hobbs, Benson Kenduiywo, and David B. Lobell. 2020. “Uniting Remote Sensing, Crop Modeling, and Economics for Agricultural Risk Management.” *Nature Reviews Earth and Environment*

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