Intelligent Design of Index Insurance for Smallholder Farmers and Pastoralists

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Despite their compelling logic, index insurance contracts that transfer risk from smallholder farmers and pastoralists have met with sometimes indifferent demand and low uptake by the intended beneficiaries. Yet the evidence that risk plays an important role in creating and perpetuating rural poverty is mounting and demands further efforts to solve this problem. This brief focuses on ways to solve this demand problem by designing index insurance contracts more intelligently.

Elements of an index insurance contract

An index insurance contract has four elements:

1. a signal with a knowable probability distribution that is related to the assets or income that the contract is meant to insure (rainfall levels or average crop yields in a locality are possible signals);
2. a mapping system that connects the signal to an index whose value will determine indemnity payments under the contract;
3. a payoff structure that defines the relationship between the index and indemnity payments; and,
4. basis risk, which is the risk that an index will not perfectly cover all the losses that any particular individual might experience.

Identifying an acceptable signal (such as rainfall) should be just the first stage in designing an index insurance contract. Too often, however, an untransformed signal is converted into a simple linear insurance index. Predictably, such contracts poorly cover the actual risks and losses faced by small-scale farmers and pastoralists. A poorly designed contract, or one that is disconnected from the losses faced by the putatively insured, can actually reduce average farmer income and increase its variance. The challenge is to more intelligently design contracts from a demand-side perspective so that the index contract offers the best coverage possible for the insured party.

Design contracts using livelihood data

The first step in designing a demand-driven contract is to see if a weather or other signal can be used to predict the individual losses that the contract is designed to insure. For example, designers of an index-based livestock insurance contract for northern Kenyan pastoral households used a range of statistical regression techniques to analyze household and local-level data. They found that a rangeland groundcover signal best explained individual losses of livelihood. This kind of statistical analysis is the best way to ground truth a contract and assure that it provides the best insurance protection possible (that is, it minimizes uncovered basis risk), enhancing the demand-worthiness of the contract.

In addition, regression analysis translates a signal, which may be measured in exotic units unfamiliar to farmers, into the livelihood units that make sense to them. In the northern Kenya example, regression analysis translated readings from an infrared spectrometer into a measure of predicted herd mortality, something already well understood by pastoralists.

Choose index signal using demand-side considerations

Many signals besides weather are available for index contracts. Index insurance should rely on the signal (or signals) that offer the best contract from a demand-side perspective. Livelihood data can be used to design the best contract for each possible signal. The contracts, or hybrid combinations of them, can then be compared to see which one offers the best value to the beneficiary population, taking into account the predictive power of the signal as well as the cost of obtaining it.

Among index insurance contracts for West African grain farmers, the most promising contract proved to be one based on the Normalized Difference Vegetation Index, or NDVI—a remotely sensed, satellite-based measure of vegetation density. Every 10 days NDVI is measured and provided freely at a resolution of 8 kilometers by 8 kilometers (km)—equivalent to having a separate weather station or an area yield survey for each 8-km square. The values for the NDVI were compared with average village grain yields and rainfall. The three measures moved in tandem, but careful analysis showed that the power of the NDVI to predict individual household grain production was equivalent to an area yield contract implemented at a village level and was superior to the village rainfall gauge. Given that village-level area yield contracts would be extremely costly to implement (requiring an annual yield survey for every village where an insured farmer lives), the NDVI signal is the preferred basis for an area yield contract in this context.

This result should not be generalized. A design analysis for cotton farmers in Mali showed that NDVI was inferior in its predictive power to a district area yield index that is freely available from the cotton parastatal. What is generalizable is the need to test the predictive power of candidate insurance indexes against actual livelihood data.

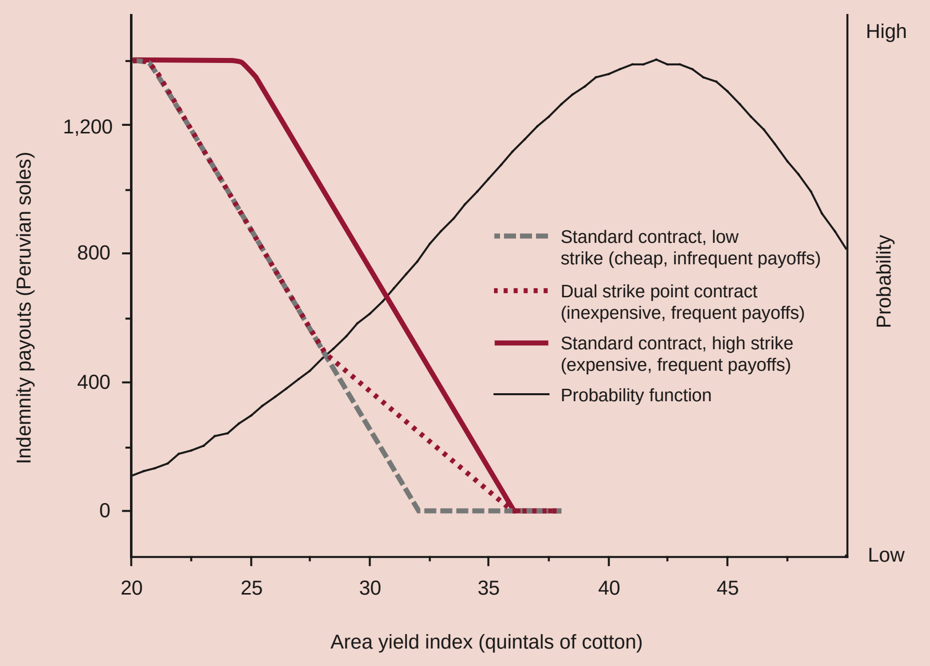
Indemnity structures that mediate between contract price and trustworthiness

The indemnity structure of an index contract defines the payoffs that accrue to farmers based on the realized value of the index. This indemnity structure needs to be designed to protect the insured against the catastrophic losses that create and sustain poverty, but too generous a payout structure results in an unaffordable contract.

Often these two considerations result in a payoff structure like that illustrated by the tiny dashed line in Figure 1. Taken from an actual index insurance product for cotton farmers in Peru, this indemnity structure begins to pay off when yields fall below 32 quintals per hectare and protects the farmer against the catastrophic risk of default and land loss. But this contract would be expected to pay off at most one to two times every 10 years. Adoption of this product would require significant trust on the part of farmers, who would on average have to pay premiums for quite a few years before seeing the payoffs that would generate confidence in the trustworthiness of the contract.

One response to this trust problem would simply be to raise the "strike point," or payoff point, to, say, a yield of 36 quintals per hectare. This contract would pay off much more frequently, but its price would be unaffordably high—more than double that of the low-strike-point contract. A solution to this trade-off between price and trustworthiness is a nonlinear payoff structure (shown by the solid line in Figure 1). Indemnity payments begin at a high strike point to induce confidence, but to keep the price down, these initial, trust-inducing payments are low. As the yield index falls further, the rate of payment increases so that the catastrophic protection is the same as the original, low-price contract. The cost of this nonlinear, hybrid contract is about US$5 more per hectare. The contract need appear no more or less complex to the farmer than a conventional linear contract.

Figure 1—Dual strike-point contract



Source: Author's calculations.

Effective education for the never-before insured

No matter how well designed, index insurance can reduce risk only if there is sustained and informed demand for it. Effective demand for insurance may be weak, however, among a population never before insured. Insurance is an intangible good that offers stochastic benefits: sometimes insurance delivers an indemnity payment and sometimes it does not. If farmers misunderstand or underestimate the value of a well-designed insurance contract, there will be little demand for the contract and little impact on farmer behavior. Conversely, if farmers overestimate the value of the insurance (especially index insurance, which offers only incomplete coverage of losses), then they are likely to be disappointed by the insurance and fail to continue to purchase it over time. Thus, without training for potential buyers in financial literacy, it is unlikely that index insurance contracts will solve the problem of agricultural risk.

Recent advances in teaching financial literacy to populations with modest formal education include comic book–like educational materials. For index insurance in particular, simulation games have been designed to allow farmers to experiment with the actual contract they will have an opportunity to purchase. Although much remains to be learned about how to create the knowledge needed to underwrite demand for these products, initial experience with these games in Ethiopia, Kenya, and Peru is promising.

More generally, insurance providers are still in the early stages of learning how best to design and deliver index insurance. There will surely be additional errors in contractual design and implementation, but the time for additional thought and work is now. ■

For further reading: For more information on the Kenya project, see www.ilri.org/livestockinsurance; for more on the Peru project, see http://www.basis.wisc.edu/projects_ama/Area_Based_Yield_Insurance_Peru.html; see also A. Pratt, M. R. Carter, U. Hess, P. Suarez, and M. Velez, "Making Index Insurance Attractive to Farmers," *Mitigation and Adaptation Strategies for Global Change* 14, no. 8 (2009): 737–53; C. B. Barrett, B. J. Barnett, M. R. Carter, S. Chantarat, J. W. Hansen, A. G. Mude, D. Osgood, J. R. Skees, C. G. Turvey, and M. N. Ward, *Poverty Traps and Climate and Weather Risk: Limitations and Opportunities of Index-based Risk Financing*, IRI Technical Report 07-03 (Palisades, N.Y., U.S.A.: International Research Institute for Climate and Society [IRI], 2007); M. R. Carter, C. B. Barrett, S. Boucher, S. Chantarat, F. Galarza, J. McPeak, A. Mude, and C. Trivelli, *Insuring the Never-before Insured: Explaining Index Insurance through Financial Education Games*, BASIS Brief No. 2008-07 (Madison, Wis., U.S.A.: University of Wisconsin, 2008); and T. Lybbert, C. B. Barrett, S. Boucher, M. R. Carter, P. Chantarat, F. Galarza, J. McPeak, and A. Mude, "Dynamic Field Experiments in Development Economics: Risk Valuation in Morocco, Kenya, and Peru," *Agricultural and Resource Economics Review* (forthcoming).

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