

**I4–Index Insurance Innovation Initiative
Seed grant proposal**

Title page

Index-based weather insurance for coffee cooperatives in Guatemala

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Abstract

Risk reduction remains a major challenge in increasing productivity and enhancing livelihoods among smallholders in developing countries. Index-based weather insurance offers a new promise for this purpose. Yet, individual uptake has been disappointingly low. We explore in this project the possibility of offering hybrid contracts at the level of coffee cooperatives and individual members in Guatemala and possibly Colombia. Interlinked transactions among members and ownership of collective assets suggest that group insurance can provide benefits in excess of the sum of benefits from individual contracts. Expressions of interest have been received from Fedecocagua in Guatemala and the National Federation of Coffee Growers in Colombia, and private insurance providers have been identified. Extensive prior work in Guatemala gives us a unique data base on which to construct the experiment, including a proposed baseline cooperative survey to be done in the Fall 2010. Randomized control experiments will be used to test the relative merits of group versus individual contracts, to offer a menu of contracts from which cooperatives and individuals can choose, and to explore different ways of promoting use of the product. The seed grant will be used to construct the details of a long term research project with these objectives.

Narrative description

Context and risks

In Guatemala, coffee production is the source of livelihood for hundreds of thousands of poor small farmers organized in producer cooperatives. Exposure to risks is high, with risks originating in prices and weather. These two sources of risk are largely orthogonal. Price risks are due to large fluctuations on the international market with two components: fluctuations that occur within the 18 months of a typical coffee cycle, from production decisions to sales; and fluctuations across years, as experienced in the succession of coffee crises and coffee booms throughout the nineties and early 2000s. With producer cooperatives well integrated into the world market, most use the futures market extensively to protect themselves against intra-annual risk. Use of put-options that do not eliminate upward price opportunities have been argued to be better than the futures market and proposed, but are not yet used (Mohan, 2007).¹ Helping producers hedge against the inter-annual price risk is one of the objectives of the Fair Trade movement with the setting of a price floor. This however has proven to be difficult to implement. So while producer cooperatives in Guatemala are using some instruments of price risk management, they have yet to learn how to use their full potential. Weather risks are due to erratic rainfall (both droughts and floods) and to extreme events (such as Hurricane Mitch in 1998). In Colombia, heavy rains cut coffee production by 30-35% last year. The National Coffee Association of Guatemala estimates that shortage of rain was responsible for reducing production by 28 percent in the same year. It is broadly accepted that these risks are being amplified by the more chaotic weather that climate change models predict. However, due to the unresolved problems of asymmetric information that plague traditional insurance, no instrument exists for cooperatives to insure against weather risks.

Index-based weather insurance offers the possibility of solving a number of these asymmetric information problems. Because it does not require verification of losses, it avoids problems of adverse selection and moral hazard. A properly designed index can address the issue of quality heterogeneity that is so central to coffee profits: poor rainfall affects both yields and quality, and hence both sources of volatility can be covered by one insurance product. And because it has minimal transaction costs, it can help the insurance market reach poor people. As such, index-based insurance could be an effective development tool and has been experimented with in various contexts in developing countries since 2003. However, and so far, despite its theoretical appeal, this product has met with low uptake among intended beneficiaries, particularly small farmers (Carter, 2009)². An option that may be working better for smallholders is group insurance, or hybrid group and individual insurance contracts. Yet, we still have limited theoretical and empirical understanding of the reasons why group insurance may be a more effective approach than individual insurance, and how the product could be designed and marketed. The objective of this research project is to explore this option for coffee cooperatives in Guatemala, and possibly in Colombia as well, and measure the impact it could have on the economic activity and welfare of coffee producers.

¹ Mohan, Sushil. 2007. "Market-based Price-risk Management for Coffee Producers." *Development Policy Review* 25(3): 333-54. Citing Sarris, A. 2002. *Market Based Commodity Price Insurance for Developing Countries. Toward a new Approach*. Washington D.C. International Task Force.

² Carter, Michael. 2009. "Intelligent Design of Index Insurance for Smallholder Farmers and Pastoralists." In *Innovations in Insuring the Poor*, IFPRI Focus 17, Brief 6.

Focus of the project

Our main interest in this project is to understand the choice of a portfolio of risk management and risk coping instruments by coffee cooperatives and their members and to understand how index-based insurance products can help them improve on what they are currently doing. We are also interested in identifying the reasons why index-based group insurance may be superior to index-based individual insurance, resulting in a higher level of uptake.

It is important to recognize that risk management already exists at the cooperative and individual levels. It includes savings and credit, price insurance, and presumably informal mutual insurance schemes. It is therefore important to scrutinize the linkages that may exist between index-based insurance and the other risk management and/or coping instruments.

Offering the insurance at the cooperative level has clear advantages in terms of direct transaction costs: only one contract, greater expertise of the buyer, sufficient scale to cover the fixed costs associated with insurance of a particular geographical area, and collection of premiums facilitated by presence of the cooperative.

We suspect that on top of that, the group's willingness to pay for the insurance product may be higher than the sum of the individuals' willingness to pay. Trying to understand the channels through which this may occur is our priority. This requires paying attention to the impact of the index-based insurance on pre-existing contractual relationships inside the cooperatives and between the cooperatives and third parties (such as banks or intermediaries along the coffee supply chain). It requires also understanding how index-based insurance might protect collectively owned assets.

Offering group insurance to coffee producer cooperatives is not like offering group insurance to any association of individuals. We shall pay attention to the following specificities of cooperatives:

- They are formal associations of producers.
- They have particular rules to make decisions and share benefits.
- They provide financial services to their members such as credit.
- They have already developed some price insurance strategies to cope with fluctuations

in coffee prices.

As a result of these specificities, the benefits of group contracting are potentially magnified in the case of coffee cooperatives.

Theoretical background

1. Credit and insurance interlinkage for an individual producer

In order to understand correctly the risk management strategies of coffee cooperatives, it is useful to start by analysing how credit and insurance are used at the individual level to smooth consumption. The starting point can be a life-cycle model à la Deaton³. Assume an infinitely lived agent with revenue Y_t in each period. This revenue is a random variable that follows an exogenously given stochastic process. The consumption problem faced by the agent consists in maximizing his expected discounted utility:

$$E_t \left\{ \sum_{j=0}^{+\infty} \delta^j u(C_{t+j}) \right\}, \delta \in]0,1[\quad (1)$$

³ Deaton, A. 1991. "Savings and liquidity constraints." *Econometrica* 59(5): 1221-48.

under the constraints

$$\begin{aligned} A_{t+1} &= R_{t+1}(A_t + Y_t - C_t), \\ \lim_{j \rightarrow +\infty} E_t \frac{A_{t+j}}{\prod_{s=1}^j R_{t+s}} &= 0. \end{aligned} \quad (2)$$

Here A_t denotes the positive or negative amount of savings available in period t , δ is the discount factor, and R_t is the rate of return on savings as well as the interest rate at which the agent can borrow. This formulation assumes perfect credit markets. We can rearrange the constraints (2) in order to get an intertemporal budget constraint. Let us denote

$$H_t = Y_t + E_t \sum_{j=1}^{+\infty} \frac{Y_{t+j}}{\prod_{s=0}^j R_{t+s}} \quad (3)$$

the expected discounted value at time t of present and future income. The intertemporal budget constraint is written

$$C_t + E_t \sum_{j=1}^{+\infty} \frac{C_{t+j}}{\prod_{s=0}^j R_{t+s}} = A_t + H_t. \quad (4)$$

This constraint simply states that at each date t , the actualized expected consumption is equal to the actualized expected revenue. In this setting, the optimal consumption vector of the agent must satisfy the stochastic Euler equation:

$$u'(C_t) = R_{t+1} \delta E_t u'(C_{t+1}). \quad (5)$$

The interest of having some insurance is easily seen in equation (3). When planning consumption, the agent takes into account H_t rather than just Y_t . But because Y_t is a random variable, so is H_t . Hence at dates prior to date t , the agent would like to buy insurance to smooth its expected discounted value of future income in all possible states at date t . The higher the variability in H_t , the higher the desirability of insurance. Without credit constraints, insurance is used to smooth consumption across states of nature, while savings and credit is used to smooth consumption across dates. This simple model suggests that savings and credit is almost sufficient to smooth consumption if shocks on the revenue are small and non-persistent, while insurance becomes necessary if shocks are catastrophic or persistent.

This point needs to be emphasized and may explain much of the difficulty encountered in the attempt to introduce insurance products. Insuring oneself over time for events that are relatively small and frequent can be done through savings and credit. This is because, over many years, the mean value of shocks born by any individual is close to the expected value of these shocks. Whether smoothing is best achieved through savings-credit or insurance of course depends on the relative costs of these two instruments. In the real world insurance is known to have very high loading costs. Hence it is unlikely that an insurance scheme would be preferred to savings and credit. Where insurance is fundamentally needed is to smooth shocks across states of nature, meaning when shocks do not average out across years, but only across individuals. Hence it is for those infrequent and large shocks that insurance is the best instrument, raising difficult issues in implementation (because of needed trust in the insurance company, little opportunity to learn from observations, and erratic intervention by state or NGOs in case of catastrophic events)

How shall we modify this picture in a world with imperfect credit markets? In such a world, it is no longer possible to focus separately on the consumption and production problems of the economic agent: we have to detail where his revenue comes from. Suppose for instance that

$$Y_t = f(I_t, \eta_t), \quad (6)$$

where I_t is investment in production and η_t is a white noise. The investment I_t has to be made at the beginning of period t out of the agent's savings A_t that can be complemented by production credit. When an agent obtains credit from a lender, he can choose to default when time comes to reimburse the loan. Default is an option because of enforcement problems. Suppose for simplicity that there is no way to prevent default in case of a consumption credit. Therefore we must have $A_t \geq 0, \forall t$. In the case of an investment credit in the production technology, it might be easier to enforce repayment because of the existence of some type of collateral. We will follow Banerjee and Duflo (2010)⁴ and assume that default would cost the agent a fraction of the productive investment. In such a situation, it can be shown that the possibility of default constrains what an agent is able to borrow. The choice of investment by the agent will not be the optimal level given the interest rate but will be constrained by the amount of own money he can invest in production:

$$I_t^* = I_t^*(A_t). \quad (7)$$

As a consequence, the revenue Y_t is a (stochastic) function of the savings A_t :

$$Y_t = g(A_t, \eta_t). \quad (8)$$

What does this tell us on the link between credit and insurance?

First, insurance will help the agent obtain credit only to the extent that insurance increases the amount of savings. If the model sketched above is characterized by non-convexities and poverty traps, insurance might reduce the probability of being caught in a trap.

Second, this picture may be too simple and it might be argued that in fact insurance also increases the liability of the borrower because insurance payments can be ceased by the lender in case of default. This is an indirect effect of insurance and an insurance policy offered to the agent might not be the most efficient way to increase liability (for instance an insurance subscribed by the lender might be more efficient).

While insurance has these additional benefits when credit markets are imperfect (this is surely the case in most circumstances, although less for coffee producers organized in cooperatives, at least in Guatemala), this does not seem to be sufficient to reverse our initial potential explanations for the relatively low uptake of individual index-based insurance products and for the complex relations index-based insurance products seem to have with credit.

Because we will have a rich baseline survey on a large sample of cooperatives, conducting this research in Guatemala allows us to leverage this information both by providing a frame and stratification criterion for the insurance research, and by allowing us to investigate heterogeneous treatment effects in more detail.

2. Group-level insurance

Proposing the index-based insurance contract at the group level, such as a coffee cooperative, can be seen as a potential solution to the low uptake problem. From the insurer's point of view, there are some obvious advantages to group contracts such as the reduction in underwriting costs or the scaling up necessary to recover the fixed costs. For instance, working with farmers' cooperatives has been experimented by Nyala Insurance S.C. in Ethiopia. As E. Meherette, Nyala's deputy CEO, explains: "Nyala has found that farmers' unions serve as

⁴ Banerjee, A., and E. Duflo. 2010. "Giving credit where credit is due." *Working paper*, MIT.

effective delivery channels for the weather insurance products. By working with cooperative unions, Nyala insures all farmers who belong to the cooperative under the same contract. The cooperative is responsible for both paying the premium and distributing potential payouts to each insured farmer, reducing transaction costs for Nyala.”⁵ A careful analysis might also suggest advantages on the demand side, i.e., reasons why demand at the group level might be higher than demand at the individual level.

Contrary to group lending, group insurance in the case of index-based products is unlikely to improve the functioning of the insurance contract itself: index-based insurance is already designed to minimize adverse selection and moral hazard. But the benefits of index-based group insurance can come from the interlinking of formal and informal insurances. This argument originates with Attanasio and Rios-Rull (2000)⁶ and has been developed by Clarke and Dercon (2009)⁷. To summarize the argument, when there is a risk that formal insurance crowds out informal mutual insurance that exists among some group members, it can be useful to propose formal insurance at the group level. Doing so internalizes the potential externalities that being insured creates on the other group members.

In the mutual insurance crowding out argument described above, group insurance may be preferred to individual insurance because of the impact the insurance contract may have on another contractual relationship that existed at the group level such as an informal mutual insurance contract. This is reminiscent of the logic for interlinked contracts proposed by Bardhan (1980)⁸ and Braverman and Stiglitz (1982)⁹ who argue that landlords link financial contracts to labor contracts in order to alleviate the moral hazard problems that arise in the latter. Here, when weather insurance is controlled by the group, it can allow a better functioning of the other contractual deals between the group and each individual. This would not be possible if weather insurance were controlled by the individuals. But the interlinked contracts argument should not be restricted to the impact of weather insurance on informal mutual insurance. It can be extended to the impact of weather insurance on any kind of contractual relationship among group members. Coffee cooperatives for instance face extensive free-riding problems: because of their profit sharing rules, members have an incentive to bypass the cooperative and sell coffee through other channels when the price follows an increasing trend. Letting the cooperative control weather insurance may alleviate this moral hazard problem and facilitate the functioning of the long term contractual relationship between the cooperative and each of its members.

Weather insurance may also have an impact on contractual agreements that exist between the group and third-parties. In this case, the argument in favour of group contracts relies on collectively owned assets. When assets are owned by a group, offering coverage at the individual level is likely to lead to under-coverage, a tragedy of the commons outcome. When the group’s capacity to take collective decisions is sub-optimal, offering the coverage to the group may solve

⁵ E. Meherette. 2009. “Providing weather index and indemnity insurance in Ethiopia.” In *Innovations in Insuring the Poor*, IFPRI Focus.

⁶ Attanasio, O., and J. Rios-Rull. 2000. “Consumption smoothing in island economies: Can public insurance reduce welfare?” *European Economic Review* 44(7): 1225-58.

⁷ Clarke, D., and S. Dercon. 2009. “Insurance, credit, and safety nets for the poor in a world of risk.” *DESA working paper #81*.

⁸ Bardhan, P. 1980. “Interlocking factor markets and agrarian development: A review of issues.” *Oxford Economic Papers* 32(1): 82-98.

⁹ Braverman, A., and J. Stiglitz. 1982. “Sharecropping and the interlinking of agrarian markets.” *American Economic Review* 72(4): 695-715.

the problem. Sales contracts signed by the cooperative, credit contracts for which the cooperative provides the collateral, and also infrastructures and capital shared by the cooperative members are all collectively owned assets for which the demand for insurance coverage at the cooperative level may be higher than the demand for coverage at the individual level.

Generic issues and I4 priorities

There are a number of unresolved generic issues that will be addressed through the project that are interest to I4.

1. *Portfolio of instruments.* To avoid errors of narrow bracketing in managing risk, index-based insurance should be seen not in isolation but as an element of a portfolio of risk management and risk coping instruments. Instruments to be optimally combined with insurance include investment in improved resilience of coffee plantations, put options to hedge on futures and Fair Trade markets, saving and credit management, and income diversification. The cooperative survey will give us information on the nature and importance of shocks to which cooperative members are exposed, on instruments used to manage and cope with these shocks, and on the potential role of index insurance as an element of risk management.

2. *Political economy of collective action and quality of cooperation.* There are important political economy issues in offering an insurance contract at the cooperative level. They include decisions on how the burden of payments of insurance premiums should be distributed, and on how payouts to the cooperative will be distributed internally (formula-based independent of damages, or based on assessment of individual damages).

Cooperative behavior can be highly effective, but also plagued by free-riding, in particular as members default on contract obligations. Differential quality of cooperation across cooperatives depends on structural characteristics of the group (ability to monitor and enforce rules) and on the quality of leadership. Uptake and use of insurance products will be contingent on differential qualities of cooperation across cooperatives.

Using experience in other areas of collective action, we propose to show how the introduction of alternative decision mechanisms for setting rules for sharing cost and benefits can improve their enforcement and, by the same token, the uptake of insurance. This will typically be done with Randomized Control Trials on alternatives.

3. *Quantity and quality effects of weather shocks.* Weather shocks affect both coffee yields and coffee quality. Lack of rains affects yields while excess of rains affects quality. Relating insurance costs to expected benefits for producers depends on these two effects that largely remain to be established.

4. *Hybrid insurance contracts.* Experience in other contexts (rice insurance in China for example) has shown that the demand for insurance both on the extensive and the intensive margins varies a lot across producers. This is to be expected when considering the overall household strategies and opportunities for diversification in sources of income. In particular, some producers will want to insure production costs while others will want to insure household income, resulting in different needs (including no need) for index-based insurance. One way to accommodate this heterogeneity is to offer a menu of contracts. We could also consider offering a mix of contracts at the cooperative level and at the individual level, such as for example a

minimum coverage for all producers at the cooperative level and additional contracts with higher coverage for individuals that choose to.

5. *Recurrent and extreme events.* Clear distinction must be made between insuring for catastrophic risks and for recurrent risks. The relative roles of saving/credit vs. insurance, and of group vs. individual insurance, for these two types of risks need to be clearly established.

Private sector partnerships-Institutional background

We have received expressions of interest to explore introduction of cooperative-level index-based weather insurance products from two partners:

(1) Fedecocagua in Guatemala, Gerardo de León, Director

This is the institutional partner we have been working with on the analysis of Fair Trade under Basis. It is a federation of 120 cooperatives that exports 30% of Guatemala's coffee. Fedecocagua has shared with us access to 15 years of administrative data. We are planning a survey of its member cooperatives in the Summer-Fall 2010 that will also serve as the baseline for the proposed index-based insurance project. In offering an insurance product to the cooperatives, we will collaborate with RUTA, Miguel Gomez director, based in Costa Rica with operations in all Central America. RUTA has already taken initial steps to introduce an index-based insurance to coffee cooperatives in Guatemala and Nicaragua. The institutional partners are FIDES (Federacion Interamericana de Empresas de Seguros), AMIS (Asociación Mexicana de Instituciones de Seguros), the Inter-American Development Bank, CIAT, GTZ, and Munich Re.

(2) The National Federation of Coffee Growers of Colombia, Juan Lucas Restrepo, Manager

Colombia just introduced new legislation (*Diario Oficial* January 29, 2010) to subsidize privately provided index-based insurance that covers coffee and cooperatives. Working with the Federation (that sells under the Juan Valdez brand) is a significant opportunity given its importance for smallholder coffee producers, most of whom are organized in cooperatives. The Federation has half a million members. It owns its own insurance company, the "*Compañía Agrícola de Seguros*" that covers production risk and could now provide index-based coverage. The Federation also owns its own bank, the *Banco Cafetero*, that has become the third largest bank in the country. Initial discussions about index-based weather insurance have been held between the Federation and MAPFRE from Spain. While we will work first with Fedecocagua in Guatemala, we will also explore collaboration with the Colombian Federation.