Insuring against the weather: Integrating generic weather index products with group-based savings and loans

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Abstract

This research considers the following question: how can generic weather index products be designed and combined with network-based savings, gifts and loans to insure some of the basis risk inherent in these products? The research will focus on developing simple, flexible and inclusive index insurance products, and learning how to link them with savings or credit to reduce the impact of basis risk inherent in any index product. This research will thus also provide some understanding on how linking insurance and credit can strengthen credit markets in rural areas. The work will build on multiple years of panel data collected in Bangladesh and Ethiopia that has characterised the risks of rural households, their coping strategies and the impact of risk on welfare and investment. It will also build on the significant research work undertaken on mutual insurance societies in Ethiopia and microfinance groups in Ethiopia and Bangladesh. The research will use non-parametric techniques to assess the relationship between index variables and yield, and will use experimental economics to assess determinants of demand, the interlinking of insurance, credit and savings and ultimately, the impact of insurance provision.

Narrative

1. Introduction

Households in underdeveloped economies face significant uncertainty with regards to future consumption. This uncertainty is in many instances closely connected to unexpected shocks in households' agricultural production. Since well organized insurance markets can mitigate the adverse consequences that are brought about by undesirable shocks, there has been a sustained effort to provide affordable insurance products for these households. Recent developments in index-based weather insurance have provided new insurance possibilities for smallholder farmers by solving problems of adverse selection and moral hazard and remaining relatively inexpensive. While index-insurance offers much potential, there is still work to be done in perfecting its design – in particular in reducing basis risk, improving understanding and reducing costs of provision. As such, whilst provision of index insurance on a small scale has been observed in a number of countries including Ethiopia (Gine and Yang 2007, Cole et al 2009, Hess and Hazell 2009, Meherette 2009), it has not yet been brought to scale.

With the purchase of any index product (however well designed) a farmer will face some basis risk that is uninsured by the policy. This basis risk poses a challenge to index insurance that should not be underestimated: it has a significant welfare cost to the farmer, and it can result in low insurance demand and little behavioural change when insurance is purchased (Carter 2009). Finding other means by which to reduce the basis risk farmers hold is extremely important, especially if this risk is high in the interest of designing products that are simple and flexible enough to meet farmer needs. Considering better how to integrate index-insurance with other mechanisms that farmers currently use to mitigate the adverse impacts of risk may help in minimising this basis risk. In particular by considering how to integrate index insurance with the group-based savings, gifts and loans that are used by farmers to manage idiosyncratic shocks (Clarke and Dercon 2009).

This research will focus on how to develop simple, flexible and inclusive index insurance products, and how to provide them to risk-sharing, savings and credit groups as a means to reduce basis risk. The second stage of the research will examine how to link insurance to savings and how to link insurance to credit. Linking insurance to savings and credit not only makes households more robust to shocks, it also has the potential to improve the functioning of the credit market, and the savings behaviour of households.

2. Bangladesh and Ethiopia: The need for weather insurance

The proposed research will take place in Bangladesh and Ethiopia and will be targeted to smallholder households. These two countries are proposed because: (i) panel-data on yields, production practices and welfare has been collected for many years, (ii) weather risk poses a significant risk to welfare—in Bangladesh this is flood risk, in Ethiopia it is drought or frost risk, (iii) index data is available, (iv) somewhat formalized groups exist, and (v) research and insurance partnerships have been or can be established. In future work we would like to test these research ideas in an area of Mozambique where IFPRI has collected three rounds of panel data and where drought risk is a major risk to farmer welfare, and groups are less formalized.

Natural disasters have been a recurring of life in Bangladesh. Floods are the second most frequent natural disaster after storms and cause the greatest loss- in terms of number of people affected as well as economic damage. Bangladesh has faced 46 floods of varying intensities in the last twenty years with a total death toll of over 5000 and over a 100 million affected. Bangladesh has faced 46 floods of varying intensities in the last twenty years with a total death toll of over 5000 and over a 100 million people affected. Panel data collected for 957 households between 1996 and 2007 found that 13 percent of these households were affected by floods between 1996 and 2007 (Quisumbing 2007). Floods were the most prevalent shock after dowry and illness. In qualitative work done in these villages, floods were cited as the main cause of impoverishment over the last ten years by 25 percent of the focus groups (Davis 2007). The two other main factors named were dowry and illness and injury within the household.

Skoufias and Quisumbing (2005) examine the extent to which households are able to insure their consumption from specific economic shocks. Results indicated the importance of community-based insurance mechanism as underlying risk sharing. Flood shocks that affect communities at large render these informal insurance mechanisms ineffective and therefore can have impacts that are much worse than those caused by idiosyncratic shocks.

This project would fund development of a simple flood index insurance product that pays out on the basis of water levels recorded at points in the river. The insurance would be available to all those living in the flood plain for which that point is a good measure of flood damage. This project would fund the conceptualisation of the product, research on its delivery through savings and microfinance groups and linking this product to savings and credit.

The biggest source of risk to household welfare in rural areas of Ethiopia is weather risk (Dercon, Hoddinott and Woldehanna 2005). Almost half of rural households in Ethiopia were affected by drought in a five year period from 1999 to 2004, and drought had a significant impact on the welfare of these households. The consumption levels of those reporting a serious drought were found to be 16 percent lower than those of the families not affected, and the impact of drought was found to have long-term welfare consequences: those who had suffered the most in the 1984-85 famine were still experiencing lower growth rates in consumption in the 1990s compared to those who had not faced serious problems in the famine. In some highland locations, frost risk is the major weather risk faced.

Pilot work has been undertaken in Ethiopia to assess how generic insurance products will be understood and purchased by rural farmers. Future work is planned to assess how providing insurance through traditional risk-sharing groups (iddirs) can mitigate some aspects of basis risk thereby increasing take-up. Were this project funded this work would be expanded to include: (i) non-parametric analysis of the distributional relationship of rainfall and yield data in Ethiopia over time, (ii) research on how to provide insurance through savings and microfinance groups—in the north of Ethiopia iddirs do not exist, and yet northern Ethiopia is one of the most drought-prone regions in the country, and would benefit from the provision of weather insurance—and (iii) analysis of how to link insurance and savings products, and insurance and credit.

3. Contract design

In the following three subsections we discuss the preliminary strategy and priorities that will guide development of the insurance contract, the delivery mechanism and the interlinking of insurance, savings and credit. In the final subsection we discuss how the proposed contract will advance I4 research priorities in developing livelihood focused contract design (priority 2), and in explicitly linking insurance with accumulation and income growth priority 1).

3.1 Product development

Thus far, index insurance products have designed a payout schedule that links the index to the yields of a specific crop (see Hess and Hazell 2009 for a comprehensive review). These schedules have been defined using water-balance crop models to reduce the basis risk between farmers' losses and the index on which payouts are determined. The water-balance crop models and yield reduction coefficients that are available are somewhat limited for this task in that they have largely been modelled and tested in temperate climates for crops grown under ideal conditions (no nitrogen or phosphate deficiency) on large plots that are not intercropped (Allen et al 1998, Hansen and Jones 2000, Hansen 2001). Through adaptation in focus group discussions the crop models can be carefully applied to a given area, but the underlying parameters are still from an environment quite different to the one we are considering and as a result there is a limit to the accuracy of their predictions. There are also some constraints imposed on the insurance by taking a crop model approach: the insurance can become more complex as the payout is often a weighted sum of rainfall deficit; the explicit link to crop yield can lead to basis risk being more hidden in marketing; it makes the contract inherently less flexible if farmers switch crops or varieties; and it segments the customer base when farmers in one area are growing many different crops.

One alternative is a generic weather-index insurance product designed to insure farmers against bad weather events rather than specific crop losses (Skees, Hazell and Miranda 1999, Lefley 2009). A recent example of such a product is the flood insurance offered by Axa Re in Indonesia in which farmers are paid on the basis of the level of water recorded at a given point in the river. Hill and Robles (2009) similarly piloted a number of "weather securities" contracts that insure farmers against different characteristics of drought. In this model each security pays a fixed amount for a different aspect of weather risk (in this case the amount of rainfall at the local weather station in different months) and farmers build their own portfolio by buying securities for the rainfall risk they are most concerned about given the crops they grow and the production practices they use. The constant feature of these generic weather insurance products is that they are very simple (they pay a fixed amount based on the insured event occurring and nothing otherwise) and they are not specific to a given crop.

While generic weather insurance products have the advantages of being simple and flexible, there is a potential trade-off in how well they are able to fit the crop losses that farmers face. With the purchase of any index product (however well designed) a farmer will face some residual risk that is uninsured by the policy, but this risk may be higher when products are designed with simplicity and flexibility in mind. In some situations the trade-off will be worth it, in others perhaps not. It is essential to understand more about this trade-off and to identify in which situations, and for which farmers, generic-weather insurance products make sense.

We propose designing generic weather insurance products for flood risk in Bangladesh and drought and frost risk in Ethiopia. However empirical analysis on existing data will be conducted to understand the relationship between the index, yields and welfare outcomes and to assess the trade-offs being made by using generic weather insurance products. Whilst a variety of econometric techniques will be considered, we specifically propose to invest in non-parametric analysis as it is distributional relationships that require estimation.

IFPRI has invested in a wealth of panel datasets as part of long-term quantitative research projects and recent impact evaluations. In Ethiopia data has been collected over the course of 15 years for 2000 households in the main agro-ecological zones in Ethiopia. In Bangladesh data has been collected for 1000 households over a ten year period. These data sets have collected information on production practices, yields and welfare and can be combined with rainfall, river-level and satellite data to better understand the relationship between available weather indices and yields, and, ultimately, the relationship between available weather indices and consumption.

As highlighted above, the defining characteristic of generic weather-index insurance is that a simple and easily verifiable weather or climate related variable is used to determine whether or not an insurance payment is made. For simplicity, suppose that this determining variable is represented by X, a random variable taking values on $S_X \subseteq \Re$, with distribution function $F_X(x): S_X \rightarrow [0,1]$ and associated density function $f_X(x): S_X \rightarrow \Re_+$. The estimation of $F_X(x)$ depends on the collection of observations on one or several weather or climate related variables. We represent these n observations by $\{x_i\}_{i=1}^{n}$. The index i could represent observations through time at a given weather station or a multi-dimensional index that represents observations through time on various measurement taking locations (weather stations, satellites, etc.) It is important that little structure be placed on $F_X(x)$. As such we will assume that $F_X(x)$ belongs to a class of distributions that is fully nonparametric, that is, no assumption will be made that F_X can be indexed by a finite dimensional parameter. In addition, we will dispense with the often made assumption that $\{x_i\}_{i=1}^{n}$ is a collection of independent and identically distributed observations. Observations through time often display dependence, and weather related observations taken at different but close locations often display spatial dependence. Using the developments in Bosq (1998), Jennish and Prucha (2009) and Mynbaev and Martins-Filho (2010) we will obtain nonparametric kernel based estimators $\widehat{F_X(x)}$ for $F_X(x)$.

We assume that from the households' perspective, an undesirable state of nature involves a consumption loss L ($0 \leq L < \infty$) from an expected consumption level c_e.[1] The estimation of $P(L > 0)$ is more involved since it requires two stages (described below) with much greater data requirements. First, note that losses are defined relative to expected consumption levels, denoted by c_e. As such a model of expected consumption (C) conditional on a set of variables $W_1, \cdots, W_D$ must be defined. We write,

$$E(C|W_1, \cdots, W_D) = m(W_1, \cdots, W_D)$$

where m is a sufficiently smooth function. Deviations $U = C - m(W_1, \cdots, W_D)$ are random variables that by construction satisfy $E(U|W_1, \cdots, W_D) = 0$ and for a set of n realizations $\{(c_i, w_{i1}, \cdots, w_{iD})\}_{i=1}^{n}$ we have that $u_i = c_i - m(w_{i1}, \cdots, w_{iD}) < 0$ corresponds to realized consumption values that are below expected values given $w_{i1}, \cdots, w_{iD}$. We take losses incurred by individual i to be $l_i = -u_i$ for $i = 1, \cdots, n$ and consider the estimation of $P(L > 0)$ based on $\{l_i\}_{i=1}^{n}$. The estimation of $P(L > 0)$ requires two stages. First, since $m(\cdot)$ is unknown, it must be estimated based on $\{(c_i, w_{i1}, \cdots, w_{iD})\}_{i=1}^{n}$. As in the case of F_X above, we place no parametric structure on m. Given the fact that D may be large, we bypass the slow convergence rates associated with nonparametric regression estimators by considering an additive model for m. Hence, we assume

$$m(w_{i1}, \cdots, w_{iD}) = m_0 + m_1(w_{i1}) + \cdots + m_D(w_{iD})$$

and estimate m using the spline backfitted kernel estimator of Wang and Yang (2007). Given the estimator $\hat{m}(w_{i1}, \cdots, w_{iD})$ from the first stage, we obtain $\hat{l}_i = -\hat{u}_i = -\left(c_i - \hat{m}(w_{i1}, \cdots, w_{iD})\right)$. In the second stage we use $\{\hat{l}_i\}_{i=1}^{n}$ to obtain a kernel based nonparametric estimator $\hat{f}_L(l)$ for the density function $f_L(l)$ for the losses L. Effective generic weather-index insurance requires substantial knowledge of $F_X(x)$ and $P(L > 0)$ so that the cut-offs beneath which payments are made (x_0) can be chosen such that $P(L > 0) = F_X(x_0)$.

If the trade-off is low-enough the best simple generic products will be considered for testing through focus group discussions. Focus group discussions have already been conducted in selected sites in Ethiopia to design simple weather insurance products as part of an experiment conducted in 2009 and as part of pilot work being conducted in 2010 and funded by Agence Francaise Development and the International Growth Centre.

3.2 Mitigating basis risk through group provision

In both Ethiopia and Bangladesh the insurance product will be sold through groups as this is the most economical way for insurance companies to enter into contracts with smallholder farmers in rural areas. We note that it is common practice for our partner in Ethiopia, Nyala Insurance S. C. (NISCO), to work with groups, and we expect that this will be the case with the insurer we work with in Bangladesh. Providing insurance through groups reduces the costs of retailing insurance: trainings can be organized with group leaders; and group leaders can subsequently train

[1] We will also consider estimating losses in yields and income directly as consumption measured in household surveys may already incorporate some (perhaps very costly) consumption smoothing behavior (Townsend 1994).

members, assemble a list of demands, collect premium payments, and distribute insurance certificates and claims to members. Groups can also help members with the timing of premium payments. In practice any type of group can be used to retail insurance in this way. As long as contracts are still made in which the coverage of individual members is individually recorded, the purpose of the group is to act as a retailer and nothing else.

However, this research project will consider whether there are additional advantages to working with groups, when these groups are already engaged in insurance, savings or credit activities. Providing index-insurance through such groups not only offers a means by which to retail the product, it is also a means by which some of the basis risk inherent in an index product can be mitigated, and a means by which the existing savings, credit and insurance activities of the group can be strengthened. We propose working with two types of group: (i) traditional mutual insurance groups (ii) savings and credit associations / microfinance groups.[2]

When we consider that an individual is a member of a locally based group we can decompose the basis risk an individual faces as a result of an insurance contract into a covariate and an idiosyncratic component. The covariate component of basis risk is the basis risk common to all members of the group to which the individual belongs. It exists because the index is not perfectly calibrated to average losses and because local weather conditions differ from those recorded in the index.[3] The idiosyncratic component of basis risk is the basis risk that is specific to that particular household, and it arises because individual yield losses will differ from the average yield of the group on account of cropping practices, differences in the type and slope of land owned (Suri 2006) or the presence of pests and disease.

Idiosyncratic basis risk can be handled within the group, if the group can develop clear payment rules that pay members conditional on an assessment of actual losses by other members within the group. Payments can be made with group savings or with collection in the moment of need, and payments could be grants or loans (currently groups in Ethiopia organize themselves in both ways for insuring idiosyncratic shocks such as death, ill-health or fire (Dercon, Krishnan, Hoddinott and Woldehanna, 2008). In some cases such payment rules may not be easy to institutionalise as they will require difficult assessment of individual losses and measures to counter moral hazard. However for risks that are clearly observable and not related to effort (for example frost that strikes some households and not others, or flood damage that is worse for some than for others) institutionalizing such rules might be quite possible.

When such rules can be institutionalised, index-insurance can be bought by the group to insure (or reinsure) the group as a whole. Claims will be paid to the entire group and the group will determine how to disburse claim payments and other payments to their members. When combined with payment rules to cover idiosyncratic basis risk, index-based insurance can more closely mimic indemnity based outcomes (Clarke 2010). This is very similar to

[2] In Ethiopia we will also work with primary cooperative societies if, by the time the project is implemented, cooperatives are offering credit to their members for input purchases.

[3] This can be reduced by investing in the recording infrastructure, such as in automatic weather stations or increasing the number of points at which the water-level is measured. If area yield insurance was possible covariate risk would be eliminated, but area yield insurance requires accurate historical records of yield data which is not present for the context and crops we are considering.

the model of insurance provision that has been successfully applied in Mexico in the case of the Fondos in which indemnity insurance is provided at the group level, and variations in yields within the group are managed by members assessing the losses of fellow members and determining payout rules (Ibarra and Mahul 2005). In this case we will be looking at index-insurance provision, and as such there may also be basis risk that is common to all members of the group. This covariate basis risk could be managed by institutionalising a common network payout rule for cases in which downside basis risk is realised by the group as a whole, but it will require preparation by the group by increasing group savings for this express purpose.

This research will examine the feasibility of combining index insurance with group-based loss-assessment and payout rules. It will consider the extent to which basis risk can be mitigated through such activities, and what payout rules are feasible for what types of risk. It will examine whether the ability of groups to undertake these activities depends on whether they are primarily risk-sharing or credit groups. It will also consider what type of training (e.g. training in loss assessment) needs to be provided for pre-existing groups to develop and implement such rules.

In order to design the group product and provide the appropriate training, the following strategies are proposed: (i) visit the Fondos in Mexico, and collate and analyse secondary data on their functioning to better understand the insurance coverage provided to members and the operations of well-functioning groups, (ii) conduct experimental demand assessments in Ethiopia and Bangladesh (in the form of a willingness to pay module fielded as part of a baseline impact evaluation survey) to assess demand for generic weather products and their provision through groups, (iii) learn from ongoing pilot work on providing insurance to risk-sharing groups in selected sites in Ethiopia to assess how groups make decisions on insurance purchases and what types of payout disbursement rules endogenously arise, and (iv) conduct field visits with extension workers and loss-adjusters to assess the feasibility of farmer-assessment of different losses and the type of training that would be needed.

Once designed the impact of marketing a group product on insurance take-up and outcome variables will be determined through the use of a randomized control experiment. Insurance will be provided to risk-sharing groups and credit groups, but in a random selection of groups training will be provided to explain to groups how a buying an index product as a group could work, and how to conduct loss assessment and set up payment rules. The impact of marketing a group product on insurance take-up and on behaviour will be assessed in a follow-up survey.

3.3 Explicitly linking insurance to savings and credit

In a second year of insurance provision we will consider whether providing index insurance to savings and credit groups increases their ability to undertake savings and credit activities or whether insurance products should be explicitly linked to savings products or to credit provision to encourage improved savings and greater borrowing. We will also consider the related question of whether explicitly linking savings and insurance products, or credit and insurance products increase insurance take-up.

In the first season that insurance is offered we propose that no linking of insurance and credit or savings would take place, rather the focus will be on design and delivery as discussed above. In the second season, insurance combined with savings, and insurance combined with credit will be piloted in a random sample of locations.

- *Insurance combined with savings:* As described previously savings may be required in order for groups to provide insurance to their members in cases in which downside basis risk is experienced by the group as a whole. Combined insurance and savings products may also better mimic informal insurance schemes, by ensuring that part of the money contributed (that contributed as savings) remains owned by the group. Whilst savings, on their own may be difficult to commit to (Ashraf, Karlan and Yin 2006, Wahhaj 2008), when combined with an insurance product they may become more attractive—especially when the insurance product also protects savings against major weather risks.[4]
- *Insurance combined with credit:* Berhane and Gardebroek (2010) argue that current utilisation of microcredit is low on account of the joint-liability credit contract, the strict enforcement of repayment (even in the case of widespread shocks), and the high degree of covariate shocks. If this is the case then offering credit with an index insurance contract that insures the borrowing group against the occurrence of covariate weather shocks reduces the risk of group default thereby potentially increasing borrowing rates. We will test whether explicitly linking insurance and credit provision is required in order for insurance to bring about increased borrowing.

A final survey will be conducted to collect data on credit and savings behaviour. This will allow us to assess the impact of explicitly linking insurance to savings and credit.

3.4 Links to I4 Research Priorities

The proposed contract will advance the I4 research priorities in developing livelihood focused contract design in the following ways:

- Hybrid mechanisms: This research will focus on determining how to combine index insurance with group-based savings and loans in order to mitigate the basis risk inherent to index insurance contracts.
- Use of panel data and focus groups to assess risks and ensure demand-driven contract design: The risks that are most important to households will be identified through rigorous analysis of panel data for selected households in intervention areas. Analysis will utilise non-parametric methods given the focus is on carefully identifying distributional relationships. Focus groups will also be conducted to verify and inform this analysis. The contracts designed will be chosen to be simple, but have value to the household.
- Robust contracts: On the basis of this analysis simple building block contracts will be designed. Each contract will directly insure against a specific weather occurrence paying out a fixed amount if the event happens and nothing otherwise. All contracts will be available to all farmers and farmers will be able to select the

[4] We also note that the literature on precautionary savings suggests that lower overall household savings rates (or a less-liquid portfolio of assets) may result from insurance provision. This will be considered.

contracts that reflect the risk they face. This allows for a flexible index mechanism that is robust across an array of livelihood activities.

- Catastrophic protection versus trust building: By designing a system of building block contracts, individual contract prices can be low whilst at the same time there is a high probability that one contract in the system will pay out in a given year. This builds trust in the system of contracts.

The proposed research will also consider how to link insurance and credit and savings. As such this proposal will also address the I4 research priority of explicitly linking insurance with accumulation and income growth.

4. Implementation

There are two key actors that are required for this proposed research to work, namely locally based insurance companies, and savings and microfinance groups.

In Ethiopia the research team has a pre-existing working relationship with Nyala Insurance S.C. (NISCO). NISCO has invested substantial time and resources in planning and piloting these research ideas, and therefore we propose to continue working with them. In Bangladesh we will follow a similar strategy to that followed in Ethiopia in order to identify an appropriate partner, and to build a working relationship. Through discussions with Bangladeshi collaborators we will identify and meet with insurance companies that are interested in providing flood index insurance. We will invite them to be involved in the research from an early stage. We will share the results of the analysis of historical data, and results from willingness to pay studies. We will work with them to propose a mutually agreeable flood index insurance contract. We will offer the option that, initially, real-time experimental games (i.e. experimental games that provide individuals with an endowment that they can keep or exchange for a contingent contract that will pay out at a later data (as in Hill and Robles, 2009)) can be used to pilot test contractual variations that are being proposed.

We will undertake a three stage process to identify savings and microfinance groups with whom we can work in Bangladesh and Ethiopia:

1. We will meet with contacts we already have in microfinance institutions and SACCOs to discuss and refine the idea and to suggest that a workshop be held on index-insurance and linking it to credit provision and savings. In Ethiopia IFPRI staff have conducted research with the Dedebit Credit and Savings Institution (DECSI), one of the largest MFIs in Africa (Lafourcade et al, 2005), and in Bangladesh IFPRI has a good working relationship with BRAC.
2. In each country we will hold a workshop on index-insurance and linking it to credit provision: the workshop would be an opportunity to explain the index idea, and also for microfinance providers to discuss the insurance needs of their clients.
3. On the basis of common interest and understanding we will identify the appropriate partners.

5. Assessing the likely impact of insurance provision

In both Bangladesh and Ethiopia uninsured weather risk is a major covariate shock that households find difficult to manage with the current instruments available to them. In both contexts risk has been shown to impact current welfare and also long run growth opportunities. Much research has suggested the purchase of insurance will result in behavioural change as households invest more in higher return but riskier activities (Sandmo 1971, Fafchamps 1992, Barrett 1996, Fafchamps 2003, Cai et al 2009).

In Ethiopia work has shown that households less able to insure their risk are less likely to invest in fertilizer (Dercon and Christiaensen 2007) and are more likely to plant low-return drought resistant crops such as enset (World Bank 2006). Behavioural experiments conducted in rural Ethiopia have suggested that farmers with insurance will be more likely to invest in fertilizer once insurance is provided (Hill and Viceisza 2010). In an examination of risk and asset allocation in Bangladesh, Yamauchi, Yohannes and Quisumbing (2009) show that a higher future disaster probability increases the likelihood that an agent would hold more human capital as opposed to physical capital. There is also an offsetting effect of disaster risk: future risk discourages investment because it renders returns uncertain, at the same time it encourages investment as a means of mitigating the impacts. They show that in disaster-prone areas, the latter effects offset the former. They do not say anything about optimality of these investments. So, even though these households invest it may not be in the most profit maximizing way given they face high disaster risks.

On the basis of this literature, we hypothesize that increasing the ability of households to manage risk will: smooth consumption, increase investments in high-return inputs and physical assets and cause households to grow a different portfolio of crops. A rigorous impact evaluation strategy needs to be put in place in order to assess the impact.

A corresponding set of questions will be posed to assess how group behaviour is impacted by formal insurance provision. For example, do iddirs in Ethiopia become more robust in insuring shocks they originally covered—illness and ill-health—on account of the covariate weather-dependent component of these shocks? Do microfinance groups in Bangladesh that engage in lending to members to cover consumption risk become better able to provide loans to cover this type of need? Or does formal insurance, if not carefully designed, crowd out informal insurance as suggested by Arnott and Stiglitz (1991) and Attanassio and Rios-Rull (2000).

A large part of this research will focus on how best to design insurance products and link them to savings and credit activities. Randomized evaluation—evaluation both of take-up and the impact of different designs on behaviour—is also required as part of this research. There will thus be two parts to the impact evaluation strategy.

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