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Remote sensing data for managing climate risks: Index-based insurance and growth related applications for smallhold-farmers in Ethiopia

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ABSTRACT

The aim of most index-based insurance programs is to act as a social security mechanism and to provide defense against social and financial exclusion for people whose existing coping strategies are failing. For such schemes, insurance payouts do not depend on the individual losses but on an index which serves as a proxy for the losses. As proposed in this paper, also remote sensing data can be used for index-based insurance which gives additional advantages in comparison to traditional on-ground based indexed instruments. Furthermore, distinguishing between a promotion as well as protection level within such schemes is beneficial from a supply as well as demand side perspective and we suggest an approach how both can be simultaneously introduced within a remote sensing index based insurance framework. The applicability and usefulness of the approach is tested for smallhold farmers in North Shewa, Ethiopia. It is found that the use of remote sensing data is indeed a possible alternative to traditional weather based micro-insurance schemes which offers new ways to tackle current problems of such schemes from a supply side as well as demand side perspective.
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Introduction

The aim of most micro-insurance programs is to act as a social security mechanism and to provide defense against social and financial exclusion for people whose existing coping strategies are failing (Mosley, 2009). The idea is that if people's livelihoods are protected it would encourage investment among lower-income groups and raise overall investment and growth rates. In other words, micro-insurance should reduce the incidence of "poverty traps" by providing low-income households, farmers, and businesses with access to post-disaster liquidity and securing or rehabilitating their livelihoods and habitations (World Bank, 2009). Moreover, insurance is thought to enhance the creditworthiness of the insured households and farms, thereby promoting investments in productive assets and/or higher-yield crops (Hess and Syroka, 2005).

Farmers especially face a variety of weather, market and production risks that make their incomes volatile from year to year, for example when crops are destroyed by drought or pest outbreaks. These risks are particularly burdensome to the poor, including many smallholder farmers (Carter et al., 2006). In providing a more effective solution in the absence of adequate relief, index-based insurance for agriculture has emerged as a novel mechanism across the globe (Alderman and Haque, 2008). Index-based insurance involves writing contracts against specific perils that are defined and recorded at

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regional levels (usually at local weather stations). For such schemes, insurance payouts do not depend on the individual losses of policyholders but on the regionally recorded index, which serves as a proxy for the losses in a particular region. It is therefore a contingent claim contract for which payouts are determined by an objective index, most of the times weather related parameters (Hochrainer-Stigler et al., 2012). Such parameters need to be highly correlated with farm-level yields or revenue outcomes. In general, rainfall-indexed insurance seems well suited to insure agricultural production in regions where widespread crop losses are caused by drought or excess rainfall. In other areas, farm income can be indexed on temperature indicators for heat or frost sensitive production activities such as horticulture (Mechler et al., 2006). However, as proposed in this paper, remote sensing data can also be used for index-based insurance schemes thereby giving additional advantages in comparison to traditional on-ground based index instruments. For example, they could be applied on the global level without the necessity to have local stations measuring the index. Furthermore, risk spreading over large regions would be possible, which could decrease premium payments considerably (World Bank, 2007).

There are several additional reasons why index-based insurance may serve as an alternative to traditional indemnity based instruments. For example, because payouts for indexed contracts are automatically triggered once a weather parameter reaches a pre-specified level, the insured may receive timely payouts. An automatic trigger also reduces administrative costs for the insurer by eliminating the need for tedious field-level damage assessment. As administrative costs are reduced, premiums may also be lowered and products made more affordable to farmers. Additionally, the objective and exogenous nature of the weather index prevents "adverse selection" (that is, since farmers know more about their risks than the insurer, the low-risk farmers may opt out, leaving the insurer with only high-risk customers) and "moral hazards" (that is, when farmers' behaviors can influence the extent of damage that qualifies for insurance payouts) (see Linnerooth-Bayer and Hochrainer-Stigler, 2014). Indexed products also facilitate risk transfer to the international markets, because international reinsurers are likely to provide better terms when the insurance is based on measurable weather events, instead of farm-level losses.

However, as suggested in this paper, to make index-insurance work, both demand and supply side perspectives must be taken into account (Hochrainer et al., 2010). From the supply side, risk must be quantified in a satisfactory manner (Brown and Churchill, 2000). This is the foremost prerequisite since when risk cannot be quantified, then it is impossible to design an insurance product. Additionally, covariate risk is a chief concern from a supply side perspective as the possibility of large claim payments needs to be addressed (e.g. additional re-insurance must be bought, which can be quite costly in many instances, see Hochrainer, 2006). From a demand side perspective, two pre-requisites are very important. First, there must be interest in insurance and second, premiums must be affordable (see for example the Consultative Group to Assist the Poor, 2003). This is especially important in the context of micro-insurance as premium payments may involve high opportunity costs for the insured, therefore causing other negative consequences such as a decrease in consumption and foregone opportunity to invest in more productive activities (Helgeson et al., 2013).

In that regard, Hess and Hazell (2009) introduced a useful distinction between protection and promotion models for micro index-insurance arrangements that is applied in this article as well. The protection model focuses on protecting people against shock-induced destitution, and provides counter-cyclical safety nets by partially replacing traditional government and international funding for disaster relief and recovery. Under this system, beneficiaries do not pay premiums ex-ante, but may engage ex-post in public works programs. One example is the WFP's food for work programs, in which beneficiaries receive food rations in exchange for participation in programs such as road reconstruction works. The promotion model, on the other hand, promotes increased income and livelihood opportunities by providing access to agricultural credit that may be used to adopt new technologies, improve farming practices and change the risk/return profile of clients. Premiums, which are sometimes bundled with credit provisions, would be paid by beneficiaries. The target group for this type of micro-insurance mechanism is small-holder farmers with some growth potential (Hess and Syroka, 2005).

In this article, we take this idea forward and couple the protection as well as the promotion dimension via the use of remote sensing data within an index-based insurance scheme. The combination of these three aspects has not been explicitly investigated in the micro-insurance and growth literature yet. Our paper should fill part of this gap. The study focuses on Ethiopia, where a large set of new innovative insurance related products, mainly against drought impacts, are currently being tested. While it does not represent a full analysis of all aspects related to index-based schemes, our approach provides a blueprint of how supply and demand side considerations can be taken into account using remote sensing data. Consequently, the application of our suggested approach is therefore not geographically limited and could be applied to any region of the world.

The paper is organized as follows. The "Methodology" section introduces the methodology used for the case study, which is presented in detail in the "Case study area and data" section. The "Results" section presents the results and discusses the limitation of the approach and possible ways forward. Finally, we end with a conclusion and outlook to the future.

Methodology

As discussed at the beginning, index-based insurance uses a proxy for losses and not the losses themselves to trigger claim payments. While usually weather related parameters are employed to create the index, we instead look at remote sensing data as a possible alternative. Furthermore, we distinguish between a protection as well as promotion dimension within an index-based insurance scheme. The protection dimension includes the risk a farmer wants to avoid and is based

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