Formal and informal insurance:

experimental evidence from Ethiopia

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Abstract

We examine the impact of formal insurance and informal risk-sharing institutions on welfare, and the complementarity between these forms of formal and informal insurance. As in a number of other studies, formal rainfall index insurance was offered to farmers. However in this study support to local risk sharing institutions—iddirs—was also provided to strengthen the extent to which they were able to insure members against idiosyncratic shocks. Access to insurance and support to iddirs was randomized across villages during two agricultural seasons. Results show that formal insurance has a significant impact on encouraging productive investments, particularly investments in fertilizer, replicating the results found in Ghana in Karlan et al (2013). Strengthening risk-sharing through iddirs increases formal insurance demand (consistent with the results in Dercon et al 2013) and some welfare outcomes, but does not cause insurance to have any additional effect on productive outcomes. There is also some evidence that strengthening risk-sharing through local institutions reduces individual bilateral transfers.

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1. Introduction

Households in rural Ethiopia, as many in sub-Saharan Africa, face significant uncertainty with regards to future consumption. This uncertainty is, in many instances, closely related to unpredictability in agricultural production due to weather risks. 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 (Dercon, Hoddinott and Woldehanna 2005). 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. As a testament to this, those who had suffered the most in the 1984-85 famine were found to still experience lower growth rates in consumption in the 1990s compared to those who had not faced serious problems in the famine (Dercon 2004).

Uninsured risk may keep poor households in a vicious circle of poverty, holding them back from adopting technologies that are high-return but often considered high-risk (Rosenzweig and Binswanger 1993). More specifically, in the absence of formal insurance, weather shocks not only result in lower welfare effects when they occur, they also influence the decisions poor households make about their future livelihoods. Using one of longest-running panel data from rural Africa, the Ethiopian Rural Household Survey (ERHS), Dercon and Christiaensen (2011) find that in expectation of low consumption outcomes when droughts hit, farm households in Ethiopia are discouraged from adopting chemical fertilizers that would otherwise be critical to increasing productivity. A number of other studies from the semi-arid tropics point to similar outcomes of weather related uncertainties. For example, Dercon (1996) finds that farm households from Tanzania that were unable to smooth consumption after a shock were more likely to grow safer but lower return crops, foregoing up to 20% of their income as implicit insurance premium. Rosenzweig and Binswanger (1993) estimated a one-standard deviation decrease in weather risk can raise average profits by up to 35% for the lowest wealth quintile of their sample in semi-arid India. Hill (2009) finds that more risk averse coffee farmers in Uganda are less likely to allocate labor to high-risk but high-return coffee production (Hill 2009). This was particularly so for poorer households that were unable to insure themselves against income fluctuations ex post.

All of these studies point to the fact that the cost of uninsured weather risk can be substantial both in terms of immediate production losses to households as well as hindering them from making critical investments that promote livelihoods. Well organized insurance markets have the potential to help mitigate the adverse consequences of such risks and consequently the provision of simple and affordable insurance products to those households has received significant attention in recent years. Recent developments in index-based weather insurance offer new possibilities of providing insurance for smallholder farmers in those areas and, as such, become a glimmer of hope to help farmers adapt to and build resilience against ever changing weather conditions (Skees et al., 1999, Barnett and Mahul, 2007) and some experimental evidence shows substantial increases in productive investments as a result of increased insurance (Karlan et al 2013). However, basis risk—residual risk left uninsured by the index—remains a key challenge to index-based weather insurance reducing the latter's value for farmers (Clarke 2011).

Traditional groups—such as iddirs—prevalent in rural Ethiopia are the most common forms of informal insurance in developing countries. However, they too are prone to covariant shocks that hamper wide areas. Dercon et al (2012) show that the presence of basis risk in index insurance makes it a complement to informal risk sharing, implying that index insurance crowds-in risk sharing and that demand for index insurance will be higher among groups of individuals that can share risk. Integrating index-based weather insurance with traditional groups could thus have the dual advantages of reducing basis risk, which will allow index-based insurance to function in those areas, and at the same time, enhancing the resilience and adaptation of traditional groups in the face of covariant shocks. Moreover, iddirs can be used as sustainable retail outlets for index insurance thereby reducing transaction costs, increasing trust, and potentially, elevating the organization of iddir functioning to national level.

This study from Ethiopia is one of several in which rainfall index insurance is offered to farmers. A unique feature of this study is that the study also randomized provision of support to local risk sharing institutions—iddirs—to strengthen the extent to which they were able to insure members against idiosyncratic shocks. Access to insurance and support to the risk-sharing activities of iddirs was randomized across villages during two agricultural seasons. The research design allows us to examine the impact of index insurance and local risk-sharing on welfare, and the complementarity between formal and informal insurance.

Results show that insurance has a significant impact on encouraging productive investments, particularly investments in fertilizer, replicating the results found in Ghana in Karlan et al (2013). We find that strengthening iddirs increases insurance demand and some welfare outcomes, but does not cause insurance to have any additional effect on productive outcomes. There is also some evidence that strengthening informal insurance through local institutions reduces individual bilateral transfers.

The returns to critical national investments made to increase agricultural productivity using modern technologies in Africa remains low. Since nutrients available from organic sources in low-fertility African ecosystems are inadequate, chemical fertilizers are often recommended for recapitalization[1]. However, a most severe constraint to fertilizer use and productivity in Africa is limited availability of water and high dependence on rainfall (Weight and Kelly, 1999). This is more so in countries like Ethiopia where historical soil nutrient depletion necessitates use of chemical fertilizers to increase productivity but production relies heavily on erratic rainfall. Dercon and Christiansen (2011) estimate that the use of chemical fertilizers is non-linearly related to rainfall for certain soil nutrient types in Ethiopia – fertilizer returns are high when rainfall is good and negative when rainfall is too low or too high. Analysis of zonal poverty trends in Ethiopia confirms these findings: poverty fell with increasing fertilizer input use only when rainfall and price conditions were favorable. When rainfall was not good, increased fertilizer use had no impact on reducing poverty (Hill and Tsehaye 2014).

Ethiopia's agriculture is dominated by smallholders (< 0.5 ha) deriving livelihoods from crop production mainly for household consumption, with over 75 percent of cultivated land dedicated to five major cereals (Seyoum Taffesse et al, 2011). Modern inputs, mainly chemical fertilizers and improved seeds are the two most important yield increasing investments available to farmers in Ethiopia. Cognizant of this situation, Ethiopia's recent ambitious Growth and Transformation Plan (GTP, 2010 -2015) targets doubling cereal productivity through providing modern technologies viz. fertilizer (90 % adoption targets), supply of improved seeds (expand supply by six fold), and small scale irrigation (expand area under irrigation by twofold) and scaling up of "best practices" (expand extension services by threefold) (see table in Appendix). Previous growth plans in the decades prior to the GTP had also cereal

[1] Early farmer-field level trials (e.g., by SASAKAWA GLOBAL) in Ethiopia have shown very high yield returns to fertilizer us and expected returns are promising in many parts of Ethiopia.

intensification as core policy intervention to increasing production and productivity. Despite major supply side efforts to increase adoption and application rates of modern inputs e.g., fertilizer, adoption and application rates remain low even by SSA standards - only 30 to 40 percent of Ethiopian farmers use fertilizer and application is limited to an average of 37 to 40 Kg per hectare (MoA, 2012). All of these efforts and targets assume that farm households are willing and able to assume the risks involved when adopting modern inputs and practices. A recent study by Berhane et al (2014) using data from Ethiopia's high-agricultural potential areas indicates that although 87% of the 304 communities surveyed reported fertilizer was available at the Kebelle[2], only 56% of farmers applied fertilizer to 72% of their cultivated area (37% of total cultivated land in the high potential areas). The study also finds that controlling for access and agro-ecological heterogeneities, higher rainfall variability is associated with lower smallholder demand for fertilizers. On the supply side, Rashid et al (2012) find close to 50% of Ethiopia's massive annual parastatal-based fertilizer import - averaging to 275 thousand tons (almost half of the total annual imports) between 2009 and 2011 - has been carried over to the next year, pointing to lower than planned annual fertilizer demands by smallholders.

All of these stylized facts point to the hypothesis that is tested in this paper, namely that providing affordable insurance products to smallholders will help them mitigate the risks surrounding increased fertilizer use thereby increasing demand. In this paper we examine what types of products, or set of complementary financial products, can help provide insurance to smallholders and whether increased access to these products encourages households to take risk and invest in their farms by adopting modern inputs such as chemical fertilizers.

The rest of the paper is structured as follows. Section 2 focuses on the experimental design and the methods used to identify impact as a result. In Section 3 we provide more details on the sample, and show that the treatment groups were identical to each other and to the control group for a wide range of variables. In Section 4 we present the results of the empirical analysis. Section 5 concludes.

2. Experimental Design

2.1. Experimental treatments

We conducted a randomized control trial to evaluate the welfare benefits of (i) providing a well-priced, well-designed insurance product (ii) the impact of supporting informal risks-sharing groups, and (iii) combining support to informal risk sharing groups and weather index insurance. 110 villages were included in the study across three study sites.

Each of the three sites fell within a 15km radius of a weather station with good historical data and was served by a Buusaa Gonofaa MFI branch office. Moreover, each site was select from districts that were included in the Ethiopian Rural Household Survey (ERHS), a unique historical panel survey that has been conducted from 1994 to 2009 in varied agro-climatic regions in Ethiopia. The ERHS is the longest running panel of African households that asks questions about rainfall risk, agricultural production, incomes and consumption, with 7 survey rounds conducted over the 15 year period[3]. Access to this rich dataset

[2] Kebele refers to the lowest administration unit composed of 3-4 villages in Ethiopia.

[3] In one of the sites—Tibe—data has been collected from 1999 to 2009 with 3 survey rounds conducted over this ten year period. We focus our analysis of product quality on the sites for which we have 7 rounds of survey data, Dodota and Shashemene.

allows us to build up a rich picture of risk to agricultural incomes for households in the selected sites. Although the three sites have quite distinct agro-ecological characteristics, the major source of covariate risk in all three sites is drought – households from all sites have reported significant rainfall risk.

In 60 of these villages insurance was offered for the main cropping season. The annex provides details on the type of insurance offered, and the evidence available from the ERHS that suggests these policies insured rainfall risk faced by these farmers.

In 25 of these villages insurance was marketed and sold to individual farmers. In 35 villages insurance was offered in conjunction with a number of group activities under taken to strengthen the risk-sharing function of iddirs.

In the iddir villages, iddirs were encouraged to strengthen their ability to make interest free loans to members who had experienced adverse events not covered by the insurance policy. For example pests that reduced yields or ill health that prevented members from agricultural work. In 18 villages pre-specified guidelines about how the loans were to be made were mandated ("mandated villages") and in 17 villages no guidelines were pre-specified ("non-mandated" villages). To encourage groups to set up rules governing the loans, a cash payment was promised at the end of the insured period to all groups that participated. Similar cash transfers were made to selected individuals in the individual villages.

The allocation of villages to treatment and control groups was stratified by each study site. This allows us to look at the impact of insurance separately in each study site.

Previous studies on weather index insurance for farmers, have documented anemic demand (Cole et al 2013) and we saw similar levels of low demand for the insurance product during initial sales in 2011. As a result we decided to offer price incentives for the late season policies in 2011. In two of the three study sites we randomly selected 16 individuals to receive free insurance (these were not necessarily the same individuals that were included in the survey). In one study site (Shashemene) we provided a randomized price discount on insurance policies. The magnitude of the discount was randomized across villages and took one of the following values: 40%, 60% and 80%.

In addition to offering free and discounted insurance in 2011, we randomly selected 16 individuals in each of the "individual insurance" villages to receive a 50 Birr unconditional cash payment at the end of the insured period. This cash payment was provided to allow us to control for the expected value of the insurance discount that was provided to households, given this is quite sizable, especially for those given free insurance. Unlike other studies in the literature that have use a cash payment to disentangle the endowment and insurance effect of providing free or discounted insurance, our cash payment was not paid at the same time as insurance was given. Instead we offered a promise to pay the cash grants at the same time as the insurance would make a payout (if any payout was required). This was so as to mimic not only the size of the expected payout but also the timing. In "iddir" villages the equivalent amount of money, 800 Birr, was provided to the iddir.

In 2012 smaller price discounts were randomly allocated across all villages in all three study sites. The discount values offered were: 10%, 20%, 40% and 60%. Given no free insurance was provided and the size of the discount was smaller no cash payments were provided in 2012. Table 1 summarizes the allocation of discounts by year and study site.

TABLE 1: ALLOCATION OF DISCOUNTS BY YEAR AND STUDY SITE

*Discount	Sh-2011	NotSh-2011	Sh-2012	NotSh-2012
*0		x		
*10			x	x
*20			x	x
*40	x		x	x
*60	x		x	x
*80	x			
*100		x		

2.2. Assessing the impact of insurance

Karlan et al (2013) have estimated the impact of offering insurance to individuals in Ghana, and we start by replicating their results. To do this we use the sample of those in control villages and those in individual villages. We ignore, in this first analysis, the iddir villages as the focus is on determining whether the impact observed in Ghana is also observed in Ethiopia.

We use the randomized provision of insurance in selected villages and the exogenously induced variation in the price of insurance (treating free insurance as insurance priced with a 100% discount) to identify the impact of insurance on household production decisions.

Specifically, we assess the relationship between purchasing insurance and production behavior, and use allocation to the insurance treatment and the discount value to instrument an individual's decision to purchase insurance. This IV estimation strategy gives us the local average treatment effect of insurance.

Given the size of the discount in 2011 was determined by study site (two sites being provided with free insurance and one site being provided with discounted insurance). Using the size of the discount alone will conflate a study-site and a discount effect. We may expect the study site to have an impact on production behavior for other reasons, unrelated to the purchase of insurance. Given all randomization was stratified by study site in both 2011 and 2012, we can control for this by interacting the discount size by study site and year dummies.

2.3. Assessing the impact of strengthening informal risk-sharing groups

Secondly, we consider the impact of the group activities undertaken in our experiment. Formal insurance products are only one means by which households can insure themselves. In the absence of well-functioning insurance markets individuals rely on networks to provide informal insurance for idiosyncratic shocks. In this test we specifically test whether an intervention to strengthen informal insurance provided by iddirs has an impact on households.

In all group villages two activities were undertaken. Individuals were offered index insurance as before, *and* iddirs were encouraged to set up a new set of bylaws to establish how a common fund of 800 Birr was going to be used to insure individuals against idiosyncratic risk. Iddirs were also encouraged to purchase insurance on behalf their members. In order to ascertain the additional effect of this treatment on outcomes, we compare outcomes between individual and iddir villages. All villages in this sample were offered insurance and so the difference between iddir and individual villages can be attributed to the activities undertaken to strengthen group functioning and encourage demand for insurance through the iddir.

2.4. Assessing the impact of insurance in a setting where informal risk-sharing groups have been strengthened

We are also additionally interested in ascertaining whether the impact of insurance changes in a context in which activities have also been undertaken to strengthen groups. To do this we test whether buying insurance in a village in which group-strengthening activities were undertaken has a significantly differential effect on the impact of insurance.

The full sample is used in this specification. A dummy is included to indicate whether the village is one in which group-strengthening activities have been undertaken. We interact purchasing insurance with this group strengthening dummy to test whether purchasing insurance in these villages had any additional effect.

3. Data collection

Following the experimental design of the pilot, a baseline and four follow-up household surveys were conducted in all three study sites (i.e., Shashemene, Dodota, and Bako-Tibe) between February 2011 and September 2013. These surveys were conducted on a total of 1760 randomly selected households, 16 households from each of the 110 pilot villages (50 of them control villages). Of the total, 800 households were from the control villages and 960 households were from the treatment villages.

The baseline survey was conducted in February – March 2011, well in advance of first season (i.e., May 2011 to October 2011) marketing activities that took place in April 2011. The three follow up surveys were conducted few months after the marketing, sales and payouts (if any) were conducted. The first follow up survey was run in December 2011 after the payout for the period May 2011 to September 2011 was made between October and November 2011. A total of 1734 households in the 110 villages were re-visited, with very little attrition rate (of 1.5%). The second follow up survey was run in February-March 2011 and the third follow up survey was conducted in December 2012 – January 2013. All of the households visited in the first follow up survey were visited in these later follow ups[4].

3.1. Characteristics of sample

A quick look at the baseline data (Table 2) shows the average family size is 6 and average landholding is 3 ha. The most common crop types grown in Meher season are wheat, maize, teff, and sorghum, with overall yield ranging between 2quintals/ha (when rains are bad) and 6quintals/ha (when rains are good). Most farmers (88%) have reported they had used fertilizer in the last five years. The average age of household heads is 43 years old, and 84% are male headed. Most people are in these villages illiterate (three years of schooling is the average of highest school achieved by the household) and hardly familiar with the concept of insurance, banking or basic measurement concepts used in the insurance product (only 7% had a bank account in a microfinance or bank and only 21% have ever heard of a 'millimeter').

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[4] The fourth follow up survey was conducted in September – October 2013 but this dataset is not used in this analysis.

TABLE 2: SUMMARY STATISTICS OF HOUSEHOLD CHARACTERISTICS AT BASELINE

Variables	Obs.	Mean	Sd.	Min	Max
Number of transfers the household made to another household or households	1760	0.74	1.52	0	8.0
Land owned (hectares)	1760	2.77	3.58	0	37.8
Size of household	1760	5.86	2.33	1	16.0
Age of household head	1756	42.51	14.45	11	105.0
Head is male (yes=1)	1759	0.84	0.36	0	1.0
Head's highest school achieved	1750	2.85	3.43	0	14.0
If the rains are very good what yield do you expect to get (quintals/Timad, 1timad=.25ha)	1745	6.23	4.79	0	132.0
If the rains are very bad what yield do you expect to get (Quintals/Timad, 1timad=.25ha)	1748	2.22	1.9	0	30.0

As in many other poor areas in Ethiopia, a typical year in these villages is characterized by incidence of multiple shocks. **Error! Reference source not found.** shows the most common types of shocks that households reported to have experienced in the last ten years.

As indicated in most other studies on Ethiopia (see e.g., Dercon, Hoddinot and Woldehanna 2005), drought is the most important shock for majority of households in these villages– 51% of households reported they had experienced drought in the ten years preceding the survey. Some (14%) households reported their crops did not receive sufficient rainfall in the last Meher and close to 10% of them had to replant some of their plots. Illness of husband or wife, death of household members, pest and diseases that affect livestock, too much rainfall or floods are also counted as most important shocks in these villages (see Table 3)

Informal risk-sharing arrangements are rampant in these villages. The most common risk-sharing groups are iddirs – 92% of respondents reported they are members of 1-5 iddirs and only 5% reported they do not belong to any iddir. A most important characteristic of iddirs in these areas is that their membership coverage is limited to the village they belong to - close to 80% of iddirs span within the village. Traditionally iddirs are funeral societies and are meant to support families of a deceased household member[5]. Most iddir transfers are thus made when a shock of that nature occurs to a household. Although rare within the iddir (only 1.2%), other forms of transfers are also common in these villages – in the last one year, 11% of households have reported they have made transfers to another household and 21% of households have reported they have received transfers from others. The average household makes at least one transfer a year and some report to have transferred up to eight times (see Table 2). However, the size of transfers made is often small. Only a little more than half of them have reported they are able to mobilize a 1000 ETB for a medical emergency. This proportion significantly decreases when the size of money needed for medical emergency is raised to 4000 ETB (see Table 4).

[5] However, there are recent anecdotal evidences showing that the iddir is evolving to cover other risks such as death of key draft animals as oxen

TABLE 3: SHOCKS THAT MATTER TO HOUSEHOLDS

Most important shock that affected the household in the last 10 years	Percent of households
Drought	51.1
Illness of husband or wife	13.9
Death of another person in the household	7.0
Pests or diseases that affected livestock	6.8
Too much rain or flood	6.1
Death of husband or wife	5.5
Pests or diseases that affected crops	3.8
Illness of another person in the household	3.5
Frosts or hailstorm	1.1
Others	1.4
Number of valid responses (N)	1,597

Formal insurance services do not exist in these areas (Table 4). In fact, very few (10%) respondents had heard about traditional (car, life or health) insurance and no one had heard of weather or crop insurance before. Focus group discussions with farmers revealed that there was substantial amount of risk left uninsured and that farmers were eager to hear about new insurance products.

When a prototype index-insurance product was described to respondents during the survey, many of them (87%) reported they were interested to buy if such a product is offered. However, only 32% believed rainfall at their plots can be approximated by rainfall measured at the nearest weather station suggesting that a substantial amount of basis risk might exist even for an insurance product designed few kilometers around a weather station owning to micro-weather system variations between the local weather station and farmers' plots. In this experiment, such basis risk was tackled by introducing new product features to the index product designed early on.

TABLE 4: SUMMARY OF ADDITIONAL HOUSEHOLD CHARACTERISTICS AT BASELINE

Other household characteristics at baseline	**Obs.**	**Percent of households**
Has your household made any transfer of more than 100 ETB to another household in the last one year? (yes=1)	1760	10.5
Has your household received any transfer of more than 100 ETB in the last one year? (yes=1)	1760	20.9
Was the transfer made to a household that belong to the same iddir you belong to? (yes=1)	1760	1.2
I believe Iddir leaders do what is right for the iddir (agree=1)	1738	76.3
Could the household obtain :		
4000 ETB for medical emergency? (yes=1)	1759	29.5
1000 ETB for medical emergency? (yes =1)	1759	56.1
4000 ETB for business startup (yes=1)	1756	21.3
Generally, would you prefer to buy insurance through	1743	
Iddir		43.9

Individual		56.1
Both		0.1
Would buy an index-insurance product of the type just described for you? (yes =1)	1730	86.1
Do you know what a millimeter is? (yes=1)	1751	20.8
Do you think rainfall measured at the nearest weather station is similar to that of your plot? (yes =1)	1709	31.5
Did any of your crops suffer from lack of rain during the last Meher? (yes=1)	1743	14.1
Have you ever used fertilizer in the last 5 years? (yes =1)	1750	88.6
Did you have to re-plant any of your plots last Meher? (yes =1)	1752	9.7
Are you or any of your household members a member of at least one iddir? (yes =1)	1760	89.9
Are you or any member of your household a member of a cooperative? (yes=1)	1759	32.0

3.2. Tests of balance across treatment group

As discussed in the experimental design section, randomization took place at the village level with villages randomly assigned to control and treatment groups. We thus do not have reason to believe that the characteristics of households coming from these randomized villages can be systematically different. To ascertain this, we take the baseline data to test if this claim indeed holds between the different treatment and control groups. We considered several variables of interest that characterize household investment and crop yield or productivity differentials at baseline, mainly the proportion of households that purchased and applied modern inputs such as chemical fertilizers, the intensity and timing of use of such modern inputs and differences in the productivity of and revenue from main crops planted. Regression results comparing the treatment and control groups for several treatments implemented are presented in Table 5. Results indicate that indeed there are no statistically significant average differences of the key variables considered specifically between those that received the insurance treatment and those that did not. We find that there are few statistically significant differences between the two groups for savings offered in the treatment villages.

TABLE 5: TEST OF BALANCE ACROSS TREATMENT GROUPS

				Average difference for those offered…		Coefficient on discount in …		
	Adama	Dodota	Shashemene	insurance	savings	Shashemene, 2011	Adama/Dodota, 2012	Shashemene, 2012
Proportion of household that:								
Applied fertilizer	0.83	0.63	0.89	-0.014	0.003	-0.000	-0.000	-0.000
Purchased fertilizer	0.84	0.62	0.912	-0.049	0.003	-0.000	-0.001	-0.001
Purchased pesticide	0.76	0.79	0.704	-0.015	-0.149*	-0.000	-0.001	0
Purchased seed	0.79	0.91	0.897	-0.031	0.045	-0.000	-0.001	0
Hired labor	0.41	0.59	0.318	-0.007	0.050	0.001	0.002	-0.002
Rented oxen	0.13	0.17	0.16	-0.047	-0.138***	-0.000	0.001	-0.001
Ln of total input cost in Birr	7.36	7.50	7.123	-0.101	-0.429**	0.001	-0.003	0.001
Ln of quantity (kg) of fertilizer applied	2.91	0.62	3.533	-0.481	-0.469	-0.001	-0.008	-0.016
Ln of expenditure (Birr) on…:								
Fertilizer	5.41	3.76	5.877	-0.315	-0.416	0.002	-0.013	0.011
Pesticide	3.16	3.18	2.997	-0.031	-0.864**	0.001	-0.004	0.001
Seed	6.48	7.01	6.103	-0.166	-0.168	-0.000	-0.006	-0.006
Hired labor	2.61	3.76	1.997	-0.157	-0.005	0.007	0.011	-0.013
Rented oxen	1.60	1.09	1.997	-0.526	-1.311***	-0.004	-0.007	-0.012
Ln of total crop revenue (Birr)	9.20	9.27	9.03	0.072	-0.379*	0.003	-0.003	0.006
Applied fertilizer late in season (after time of insurance offer in 2011)	0.80	0.60	0.772	0.032	0.068	0.001	0.000	0.001
Yield (quintal per hectare) of								
White teff	9.45	12.52	10.335	-2.236	-2.179	-0.006	-0.082	0.054
Wheat	11.02	16.15	20.731	-2.381	-2.208	0.033	-0.138*	0.069
Maize	14.00	16.06	21.454	-2.058	-3.804*	0.002	-0.099	0.083
Predominant crop	11.23	15.60	27.217	-5.016	-1.801	-0.109	**-0.280****	-0.087

4. Results

4.1. Assessing the impact of insurance

We start by assessing whether we find similar effects of insurance on productive investments as found by Karlan et al (2013) in Ghana. To do this we focus on the control and individual villages in which no additional interventions were taken to strengthen risk-sharing institutions. We estimate the average impact of insurance during the two years of insurance sales. We present IV estimates of the impact of insurance on production behavior for the full sample in table 6 and for all sites excluding Bako Tibe in table 7. The results indicate that insurance had a significant impact both on the type of inputs used and on yields and revenue. However, we note that the results for the full sample suggest considerably more impact than those for the restricted sample. Given our concerns over the self-reporting of insurance purchases in Bako Tibe, we focus our discussion on the results that hold across both the full sample and also the sample excluding Bako Tibe.

We find that insurance has a considerable impact on fertilizer use. For example, we show that insurance increases the number of plots on which it is reported that fertilizer is used (column 1), it increases the proportion of households spending on fertilizer during the season (column 2), the amount of fertilizer purchased (column 8) and the amount spent on fertilizer purchases (column 9). These effects are consistent with existing literature on Ethiopia that suggests that fertilizer use is constrained by uninsured weather risk (Dercon and Christiaensen 2011). These results are also remarkably consistent with those found in Karlan et al (2013).

Insurance has a negative effect on the amount spent on oxen rent. Examining the impact of insurance in the first and second year of sales separately we see that it appears to be the first year that is driving this effect. Oxen are rented primarily for ploughing land in preparation for planting, although they can be used in the harvesting of some crops such as maize. Given insurance was offered after land preparation, the results suggest that having insurance reduced expenditure on rental of oxen at harvest time. It is not clear why this would be. The impact of insurance on maize yields is positive and weakly significant. However, no significant effect is observed for the yield of other crops or of overall Meher revenue, although estimated coefficients are positive as expected.

Results from the first stage are presented in the Appendix. This shows that the instruments have power in predicting insurance take-up. It is important to note from this table that we have much more power in predicting take-up in 2011 when discounts were large (and some households receiving insurance for free) than in 2012 when discounts were smaller. This has a strong implication on the impact of the effects that we observe across years.

When we consider the impact of insurance on behavior in each of the insurance periods separately we see that it is the first season of sales that is driving results (Tables 8 and 9). Although the impact of insurance on fertilizer use and purchase is still positive and significant (in some measures) in the second year, the significance of the estimates is much stronger in the first year. The stronger impact of insurance in the first year may be expected given our instruments are stronger in the first year (when insurance was randomly provided). Interestingly, even though power was lower in the second year, we see that offering insurance prior to the start of the planting season encourages investment in seed purchases also.

Insurance was offered quite late in the season in the first year, after planting and the first round of fertilizer application. We look at whether we were offering the free insurance prior to the second fertilizer application, typically made eight weeks after planting for most crops. Using data on timing of planting, and timing of insurance provision/sales we find that insurance was offered in time to impact this. In column 16 of table M and N we test whether the impact of fertilizer application is stronger when we consider only the plots where planting was late enough for the insurance policies to be issued by the time this second fertilizer application is made. As expected the results are stronger in this case. However we were not in time to affect planting (column 15), explaining why we only see insurance having a positive impact on seed purchases in the second year of sales.

We conducted a number of robustness checks. We find that the results are robust to changing the specification of the instruments—the results hold if discount value is continuous or not and if the discount value is interacted with region and year dummies or not. The results are also robust to including or excluding the savings treatment.

Finally, we examined whether the second year results were affected by any insurance payouts received in the first year, we found that this was not the case. Adding payouts in the previous year did not affect the results.

TABLE 6: IMPACT OF INSURANCE ON PRODUCTIVE INVESTMENTS, POOLING ACROSS YEARS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	plot_fert	fertilizer	pesticide	seed	hired	rentoxen	lninputcost	lnfert_kg	lnfertilizer	lnpesticide	lnseed	lnhired	lnrent	ncroprev_ml	lot_lateplar	plot_latefert	d_whiteteff_	ld_wheat_r	ld_maize_r	yield
insurance	0.104*	0.132**	-0.148**	0.103*	-0.118**	-0.083***	0.110	1.042*	0.835*	-0.894***	0.811**	-0.782**	-0.966***	0.192**	-0.084***	0.159**	1.099	2.078	1.432	0.494
	(0.059)	(0.053)	(0.061)	(0.053)	(0.051)	(0.030)	(0.176)	(0.591)	(0.454)	(0.323)	(0.354)	(0.305)	(0.244)	(0.093)	(0.022)	(0.069)	(1.234)	(2.820)	(2.746)	(2.480)
saving	-0.071	-0.072	-0.047	-0.050	0.039	0.054	-0.231	-0.607	-0.541	-0.220	-0.060	0.118	0.295	-0.295*	-0.070***	-0.033	-3.619***	-3.214	-4.163**	-3.325**
	(0.065)	(0.051)	(0.058)	(0.062)	(0.070)	(0.052)	(0.308)	(0.434)	(0.334)	(0.253)	(0.380)	(0.367)	(0.371)	(0.163)	(0.023)	(0.081)	(1.057)	(2.042)	(1.591)	(1.566)
Constant	0.633***	0.581***	0.554***	0.292***	0.519***	0.091***	4.151***	1.850***	3.628***	2.214***	1.533***	2.744***	0.954***	4.323***	0.028***	0.562***	6.640***	11.723***	12.149***	8.612***
	(0.040)	(0.038)	(0.053)	(0.034)	(0.032)	(0.015)	(0.521)	(0.236)	(0.275)	(0.211)	(0.429)	(0.223)	(0.162)	(0.270)	(0.008)	(0.045)	(0.534)	(1.497)	(1.201)	(0.954)
Observatio	2,087	2,222	2,222	2,222	2,222	2,222	2,049	2,213	2,168	1,999	2,180	2,150	2,145	2,062	1,071	1,071	597	580	1,390	1,781
R-squared	0.092	0.122	0.142	0.263	0.121	0.053	0.201	0.177	0.196	0.154	0.232	0.172	0.065	0.290	0.063	0.206	0.122	0.145	0.192	0.283

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 7: IMPACT OF INSURANCE ON PRODUCTIVE INVESTMENTS, POOLING ACROSS YEARS (NOT BAKO)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	plot_fert	fertilizer	pesticide	seed	hired	rentoxen	lninputcost	lnfert_kg	lnfertilizer	lnpesticide	lnseed	lnhired	lnrent	ncroprev_ml	lot_lateplar	plot_latefert	d_whiteteff_	ld_wheat_r	ld_maize_r	yield
insurance	0.207***	0.240***	-0.178	0.049	0.096	-0.072	0.304	2.089**	1.762***	-0.750	0.499	0.637	-1.739**	0.275	-0.034	0.152**	1.827	2.087	6.669*	1.457
	(0.075)	(0.072)	(0.129)	(0.106)	(0.104)	(0.050)	(0.220)	(0.851)	(0.471)	(0.575)	(0.824)	(0.669)	(0.836)	(0.189)	(0.040)	(0.065)	(1.429)	(2.819)	(3.489)	(2.301)
saving	-0.231**	-0.178	0.017	0.010	-0.130	0.018	0.186	-1.566*	-1.018	0.087	0.257	-0.650	0.074	-0.560*	-0.092***	-0.216**	-3.093*	-3.216	-5.886**	-3.657*
	(0.106)	(0.109)	(0.113)	(0.102)	(0.120)	(0.081)	(0.189)	(0.925)	(0.645)	(0.437)	(0.695)	(0.730)	(0.629)	(0.318)	(0.031)	(0.097)	(1.531)	(2.043)	(2.218)	(2.065)
Constant	0.619***	0.590***	0.527***	0.357***	0.521***	0.086***	4.055***	1.817***	3.569***	2.128***	2.287***	3.263***	1.003***	3.918***	0.026***	0.539***	6.462***	11.717***	9.034***	6.976***
	(0.047)	(0.044)	(0.062)	(0.032)	(0.035)	(0.015)	(0.683)	(0.256)	(0.311)	(0.231)	(0.460)	(0.249)	(0.178)	(0.288)	(0.008)	(0.054)	(0.548)	(1.499)	(1.252)	(1.010)
Observatio	1,415	1,471	1,471	1,471	1,471	1,471	1,393	1,464	1,436	1,314	1,461	1,422	1,425	1,399	717	717	520	574	767	1,184
R-squared	0.098	0.112	0.097	0.251	0.115	0.060	0.221	0.168	0.198	0.137	0.245	0.173	0.074	0.311	0.091	0.115	0.114	0.140	0.194	0.298

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 8: IMPACT OF INSURANCE ON PRODUCTIVE INVESTMENTS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	plot_fert	fertilizer	pesticide	seed	hired	rentoxen	lninputcost	lnfert_kg	lnfertilizer	lnpesticide	lnseed	lnhired	lnrent	ncroprev_ml	lot_lateplar	plot_latefert	d_whiteteff_	ld_wheat_r	ld_maize_r	yield
insurance	0.300***	0.308***	-0.039	-0.040	0.108	-0.045	0.314*	2.703***	2.111***	-0.100	-0.213	0.655	-1.204**	0.392***	-0.034	0.152**	1.946	2.203	8.506***	3.156*
	(0.051)	(0.061)	(0.119)	(0.073)	(0.089)	(0.045)	(0.161)	(0.815)	(0.391)	(0.539)	(0.514)	(0.547)	(0.555)	(0.145)	(0.040)	(0.065)	(1.622)	(2.551)	(2.903)	(1.819)
savings	-0.276***	-0.212*	-0.055	0.037	-0.133	0.011	0.139	-1.849*	-1.185*	-0.231	0.469	-0.664	-0.047	-0.605*	-0.092***	-0.216**	-3.099**	-3.267*	-5.886***	-3.908**
	(0.099)	(0.111)	(0.097)	(0.099)	(0.112)	(0.080)	(0.179)	(0.961)	(0.651)	(0.393)	(0.649)	(0.685)	(0.695)	(0.359)	(0.031)	(0.097)	(1.453)	(1.613)	(2.012)	(1.931)
Constant	0.600***	0.553***	0.494***	0.141***	0.476***	0.073***	4.080***	1.622***	3.103***	1.992***	0.406	2.843***	1.396***	4.342***	0.026***	0.539***	8.358***	11.241***	12.653***	8.722***
	(0.055)	(0.054)	(0.066)	(0.031)	(0.034)	(0.014)	(0.589)	(0.292)	(0.347)	(0.257)	(0.521)	(0.240)	(0.247)	(0.331)	(0.008)	(0.054)	(0.617)	(1.476)	(1.208)	(0.884)
Observatio	708	739	739	739	739	739	694	736	722	663	734	714	716	706	717	717	263	285	419	598
R-squared	0.144	0.160	0.097	0.268	0.103	0.063	0.203	0.216	0.243	0.139	0.271	0.158	0.031	0.319	0.091	0.115	0.082	0.105	0.156	0.313

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 9: IMPACT OF INSURANCE ON PRODUCTIVE INVESTMENTS (NOT BAKO)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	plot_fert	fertilizer	pesticide	seed	hired	rentoxen	lninputcost	lnfert_kg	lnfertilizer	lnpesticide	lnseed	lnhired	lnrent	ncroprev_ml
insurance	0.068	0.173	-0.621	0.655**	0.199	-0.158	0.363	1.872	1.918	-1.634	3.988	2.257	-3.831	0.325
	(0.181)	(0.186)	(0.408)	(0.306)	(0.278)	(0.236)	(0.955)	(1.480)	(1.248)	(1.828)	(2.527)	(1.747)	(4.054)	(0.906)
Constant	0.646***	0.626***	0.516***	0.448***	0.515***	0.081***	3.598***	1.964***	3.714***	2.033***	2.896***	3.219***	0.463***	3.361***
	(0.057)	(0.047)	(0.065)	(0.044)	(0.041)	(0.018)	(0.871)	(0.263)	(0.344)	(0.225)	(0.545)	(0.296)	(0.160)	(0.395)
Observatio	707	732	732	732	732	732	699	728	714	651	727	708	709	693
R-squared	0.075	0.078	0.093	0.193	0.123	0.053	0.203	0.128	0.153	0.156	0.173	0.180	0.149	0.320

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2. Assessing the impact of strengthening informal risk-sharing groups

We now turn to the impact of strengthening informal risk sharing arrangements offered by the local iddir institution. Two strategies were randomly allocated o villages to strengthen iddir functioning. In one strategy, no particular guidance was given to iddirs on how to increase informal risk-sharing, in the second strategy guidance was much stronger and a set of rules was mandated.

We first explore the impact of treatments on changes in iddir rules. As expected, mandating increased lending by iddirs. Respondents in iddir villages were more likely to report that their iddir had started making loans for crop losses. However, this was driven by changes in mandated iddir villages given that no difference was observed between the non-mandated iddir villages and the control villages (Table 10). This suggests that the intervention did result in anticipated iddir rule changes in mandated iddir villages, and additional risk-sharing may have been crowded in. As a result, we find that the perceived and actual ability of individuals to receive transfers in times of need was higher in mandated iddir villages. We focus on rules in which rules were mandated in the rest of the analysis as it was only these villages in which rules were changed.

TABLE 10: ACCESS TO LOANS AND TRANSFERS

	Grant or loan for crop	**Grant or loan for crop**	**Loan for crop loss**	**Loan for crop loss**
Iddir	0.051**		0.066***	
	(0.022)		(0.022)	
Iddir (not mandated)		0.010		0.024
		(0.027)		(0.026)
Iddir (mandated)		0.087***		0.102***
		(0.029)		(0.029)
Individual	0.024	0.024	0.042*	0.042*
	(0.023)	(0.023)	(0.022)	(0.022)
Constant	0.199***	0.199***	0.177***	0.177***
	(0.017)	(0.017)	(0.017)	(0.017)
R-squared	0.010	0.013	0.013	0.016

Source: Authors' calculation based on survey data.
Notes: 3,850 observations; Standard Errors in brackets; ***, **,* Significant at 1%, 5%, and 10% level, respectively.

In villages where informal risk-sharing was increased through mandating rules, insurance purchases were higher. This confirms the finding of Dercon et al (2013) in another experimental setting in the SNNP region of Ethiopia.

Table 11 shows the impact of encouraging changes in iddir rules on welfare outcomes. The comparison groups for this analysis are those in the individual villages and those in the iddir (mandated) villages. We find that wealth is positively affected by mandating and that increasing the role of insurance offered by iddirs results in some crowding out of individual to individual insurance transfers.

TABLE 11: IMPACT OF STRENGTHENING GROUPS ON WELFARE OUTCOMES AND TRANSFERS

	Can receive help for 4000 Birr medical emergency	Can receive help for 1000 Birr medical emergency	Can receive help for 4000 Birr business	Have received support from	Amount of support received	Received from person in same	Have given support to	Amount of support given	Given to person in same iddir	Value of livestock owned	Oxen number	Sheep and goat number	Chicken number	Amount saved in last one month	Can save better than before
Iddir village	0.045	0.048	0.023	0.064	0.399	-0.007	-0.021	-0.130	-0.028**	0.346*	0.018	0.228	1.393**	86.358	0.222***
	(0.039)	(0.036)	(0.035)	(0.052)	(0.377)	(0.011)	(0.020)	(0.171)	(0.011)	(0.203)	(0.079)	(0.250)	(0.581)	(69.319)	(0.061)
Constant	0.214**	0.566***	0.005	0.054	-1.490***	0.039**	0.071**	-1.656***	0.032**	3.588***	0.400***	0.790	3.579***	5.394	1.693***
	(0.084)	(0.052)	(0.040)	(0.055)	(0.449)	(0.017)	(0.034)	(0.289)	(0.013)	(0.607)	(0.117)	(0.571)	(0.921)	(52.992)	(0.136)
Observations	1,361	1,361	1,357	1,361	1,354	1,361	1,361	1,355	1,361	666	666	666	666	681	631
R-squared	0.034	0.066	0.075	0.167	0.167	0.040	0.028	0.024	0.016	0.377	0.445	0.379	0.080	0.016	0.093

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

4.3. Assessing the impact of insurance in the context where informal risk-sharing groups are strengthened

We do not find an additional effect of insurance on productive investments or welfare outcomes in contexts where informal risk-sharing groups have been strengthened (Table 12). This suggests their primary effect is to increase take-up of insurance. If anything aggregate use of pesticides fell in iddir villages.

TABLE 12: IMPACT OF INSURANCE AND STRENGTHENED RISK-SHARING

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	plot_fert	fertilizer	pesticide	seed	hired	rentoxen	lninputcost	lnfert_kg	lnfertilizer	lnpesticide	lnseed	lnhired	lnrent	lcroprev_ml
Insurance	0.206***	0.241***	-0.066	-0.032	0.079	-0.051	0.324**	2.060***	1.752***	-0.318	0.044	0.506	-1.539**	0.189
	(0.039)	(0.041)	(0.125)	(0.083)	(0.080)	(0.035)	(0.161)	(0.718)	(0.308)	(0.546)	(0.673)	(0.487)	(0.680)	(0.114)
Insurance in iddir villages	0.339	0.290	0.905	0.558	0.143	-0.315	1.950	2.973	2.595	5.349	4.113	1.723	-1.292	-0.958
	(0.591)	(0.628)	(0.922)	(0.590)	(0.682)	(0.414)	(2.146)	(5.686)	(4.180)	(4.147)	(5.022)	(4.271)	(7.501)	(0.985)
Iddir village	-0.028	-0.029	-0.133**	-0.088	-0.049	-0.037	-0.318	-0.296	-0.201	-0.718**	-0.735	-0.310	-0.397	0.066
	(0.067)	(0.061)	(0.065)	(0.056)	(0.070)	(0.029)	(0.268)	(0.595)	(0.393)	(0.303)	(0.465)	(0.473)	(0.459)	(0.125)
Constant	0.615***	0.588***	0.558***	0.323***	0.529***	0.096***	3.616***	1.762***	3.663***	2.010***	1.935***	3.331***	1.032***	4.127***
	(0.043)	(0.040)	(0.058)	(0.033)	(0.033)	(0.015)	(0.571)	(0.244)	(0.273)	(0.216)	(0.412)	(0.236)	(0.176)	(0.292)
Observations	1,796	1,856	1,856	1,856	1,856	1,856	1,752	1,849	1,818	1,660	1,843	1,799	1,787	1,781
R-squared	0.058	0.079	0.062	0.254	0.101	0.043	0.181	0.136	0.150	0.050	0.241	0.148	0.068	0.262

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5. Conclusions

This paper presents results from a randomized control trial to evaluate the welfare benefits of (i) providing a well-priced, well-designed insurance product (ii) the impact of supporting informal risks-sharing groups, and (iii) combining support to informal risk sharing groups and weather index insurance.

We find that formal insurance has a significant impact on encouraging productive investments, particularly investments in fertilizer, replicating the results found in Ghana in Karlan et al (2013). Strengthening risk-sharing through iddirs increases formal insurance demand (consistent with the results in Dercon et al 2013) and some welfare outcomes, but does not cause insurance to have any additional effect on productive outcomes. There is also some evidence that strengthening risk-sharing through local institutions reduces individual bilateral transfers.

Appendix: first stage results

	(1)	(2)	(3)
	Both years	2011	2012
insurance	0.096**	-0.024	0.282***
	(0.046)	(0.023)	(0.099)
discount	-0.001	0.010***	-0.007**
	(0.001)	(0.000)	(0.003)
region* discount in 2011	0.001	-0.008***	
	(0.001)	(0.001)	
discount in 2012	0.010***		
	(0.001)		
reiogn * year discount in 2012	-0.001		
	(0.001)		
savings	0.167*	0.210**	
	(0.091)	(0.096)	
_Iworeda_2	0.005	0.006	0.029*
	(0.011)	(0.005)	(0.017)
_Iworeda_3	0.025**	0.001	0.014*
	(0.011)	(0.006)	(0.007)
year 2012	-0.024**		
	(0.011)		
Constant	0.005	-0.001	-0.007*
	(0.004)	(0.002)	(0.003)
Observations	1,579	793	783
R-squared	0.279	0.454	0.134
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Annex: Design and quality of insurance products offered

The indexed products offered to farmers were generic deficit-rainfall indices designed to capture the important months in the *Meher* season for the 3-4 main crops grown in each site. Each policy paid out on total monthly rainfall, with five months of policies available for purchase. The policies were designed to be easily understood by farmers and combined by farmers to insure against the rainfall risks that are of most concern to them given the crops they cultivate, their time of planting and the water-retention capacity of their soils. In the second season we worked with the MFI to add an innovative aspect to the policies offered: gap insurance to provide some insurance against design-induced basis risk that affects all index insurance products.

Conducting this experiment in places in which long-run panel data is available, provides us with a considerable advantage over other index insurance pilots. Unlike other pilots we are able to test how good the policies offered are in insuring farmers against the drought risk they face. We do this by comparing what historical payouts would have been with household reports of drought, production output and consumption.[6] We also checked which years the monthly cumulative policies would have paid out using reported drought years from focus group discussions undertaken during product design.

We use historical rainfall data to calculate how much each of the policies would have paid out in the years for which we have data. We focus on the Ginbot and Meskerem policies for two reasons. The focus group discussions conducted in the design of these policies and sales activity suggest that these are the months most farmers care about. Additionally, with one exception, we only have consumption and agricultural production data for years in which Ginbot and Meskerem policies pay out.

In order to develop a benchmark from which to assess the performance of policies we develop fictional area-yield contracts that would pay out on the basis of average income of the full sample of farmers in each cluster. The contract allows for a trend in production defined on the basis of the six years of data we have, and each year pays out exactly the estimated average loss from this average trend. This is perhaps the best contract we could design for the covariate source of yield risk in each of the study sites. We design this contract for the two crops grown most predominantly in each site. In Dodota this is maize and teff, and in Shashemene this is maize and wheat. We compare the performance of our rainfall risk contracts to these "ideal" contracts. Results are presented in columns 1 to 4 of Table A1 and Table A2.

While instructive, the results in Table A1 and Table A2immediately alert us to the problems of using very few years of observations to assess the relevance of multiple policies. In columns 1 and 3 of Table A1 and Table A2 we see that whilst one of the "ideal" contracts is significantly negatively correlated with consumption and production (as we would expect), once controlling for payouts of this policy, the other policy is positively correlated with consumption and production. We also observe the opposite sign for

[6] We note that despite the rich picture of agricultural risk that we have for these sites there are still limits to how much this data can inform product design. Detailed data on incomes and consumption is available for 6 years. Data from focus group discussions suggest that these years include some bad drought years, but not the worst, and certainly not enough in order to fully characterize a household's vulnerability to weather risk. From the outset we note that even with the availability of such rich datasets, the extent to which such dataset can provide clear characterization of the joint distribution of policy payouts and agricultural incomes remains limited. This highlights an inherent weakness in index insurance policies. However well designed there will never be enough data to test and ensure that the products being offered are good products for smallholder farmers. Whilst due diligence is still required to ensure the products are as good as possible, alternate mechanisms to manage basis risk are needed. We present the evidence that is available, but we note that to go from this to estimating even a correlation coefficient between payouts and vulnerability would result in correlation coefficients with substantial confidence intervals (see Clarke and Hill 2012 for an example of this). Ultimately it is not a correlation coefficient for the whole distribution that is needed, but rather a measure of the correlation at the tail of the distribution: when households report bad years do the policies payout. There are even fewer observations available to draw conclusions on this.

one of our rainfall contracts and income losses in Shashemene. With this exception, we do find that at least one (if not both) of our rainfall policies would have paid farmers when they needed it. This is also true for the “ideal” contracts.

As a further test we take the drought recall data and assess whether the policies would have paid out in years in which drought was reported (column 5 of Table A1 and Table A2). The advantage of the drought data is that we observe many more years, so should avoid some of the small sample problems we faced when using consumption and production data. Indeed we see that both policies in Dodota and Shashemene are positively correlated with reports of drought. This lends support to the argument that these policies are useful for farmers. However note the low goodness of fit for the Shashemene policies.

We also look at the focus group reports for Dodota and Shashemene. These discussions did not limit the number of years that could be recorded as bad, and used more probing, so it may be that these reports provide a more accurate indication of which years were bad.

In Dodota, five years were reported as very bad and four years were reported as bad. Policies would have paid out in four out of the five very bad years and in three out of the four bad years. We thus observe two years of downside basis risk—2007 and 2009. This is a coincidence of loss and payout of 78% which is quite high, but understanding the reasons these years were bad—particularly for 2009 which was counted as very bad (2007 was not recorded as bad by any farmers when asked in 2009)—is important in improving the performance of these policies. There were also four positive basis risk events (years which were not recorded as bad but in which payouts were made. These years make the policies more expensive for farmers. When we look at these payouts we see that they were all the Meskerem policies. Whilst some Meskerem payouts do coincide with bad years, it is clear that every bad Meskerem does not necessarily imply a bad harvest. Better understanding of why this is, and helping farmers decide which years they need to buy Meskerem polices (years in which the rains start late for example) is likely to also be very important.

In sum, we use available data to assess whether or not these are good policies for small-holder farmers. The work undertaken here suggests that monthly cumulative rainfall policies for early and late season Kiremt rains do provide farmers with insurance against some of the largest crop losses. A policy that insures against low Belg rains is also likely to be very important in Shashemene. However, as this analysis has made clear there is a limit to the extent to which panel data—even when from one of the longest panels of African farmers—can be used to calibrate policies and improve policy design.

Given there will always be some design-induced basis risk associated with weather index products, and given farmers expressed concern about this aspect of basis risk. In the second and third season of sales we worked with the MFI to add “gap insurance” to all index products. Gap insurance allows farmers to call for a crop-cut if none of the weather-index insurance contracts pay-out, but they perceive there to have been widespread crop losses in the region. In the case that a crop-cut is called, 30 farmers are selected for each crop in each site and a portion of their fields are harvested in order to ascertain an average yield for a given crop in an area. If this average yield falls below the gap insurance cut-off (in turn defined using area yield estimates from the Central Statistical Agency) farmers will receive a gap insurance payout.

TABLE A1: PERFORMANCE OF MONTHLY RAINFALL CONTRACTS IN DODOTA

	(1) de-trended consumption	(2) de-trended consumption	(3) de-trended crop income	(4) de-trended crop income	(5) reported drought
Teff payout	0.200***		0.009***		
	(0.044)		(0.002)		
Maize payout	-0.128***		-0.005***		
	(0.027)		(0.001)		
Ginbot payout		-7.264***		-0.182**	0.101***
		(2.663)		(0.083)	(0.007)
Meskerem payout		3.361		0.467***	0.047***
		(2.469)		(0.080)	(0.008)
Constant	-0.899	0.544	-0.127*	-0.233***	-0.075***
	(1.785)	(2.188)	(0.068)	(0.085)	(0.008)
Observations	600	600	435	435	2653
R-squared	0.044	0.016	0.103	0.099	0.091
Number of households	114	114	114	114	116

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

TABLE A2: PERFORMANCE OF MONTHLY RAINFALL CONTRACTS IN SHASHEMENE

	(1) de-trended consumption	(2) de-trended consumption	(3) de-trended crop income	(4) de-trended crop income	(5) reported drought
Wheat payout	-0.080***		0.001		
	(0.030)		(0.001)		
Maize payout	-0.024		0.002***		
	(0.019)		(0.000)		
Ginbot payout		-25.416***		-0.233	0.017*
		(9.559)		(0.236)	(0.009)
Meskerem payout					0.035***
					(0.011)
Constant	-0.443	3.942	0.084	0.041	-0.015**
	(3.363)	(3.629)	(0.088)	(0.095)	(0.007)
Observations	548	548	432	432	2078
R-squared	0.019	0.016	0.035	0.003	0.008
Number of households	109	109	109	109	105

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1