Improving trust and relaxing liquidity constraints to enhance uptake of weather insurance in Ethiopia

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About this formative study

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Summary

Insurance against weather shocks in rain-fed production systems could enormously help to promote agricultural intensification. In recent years, experiments with index-based insurance products have sought to overcome the well-known moral hazard and adverse selection problems associated with indemnity-based insurance. However, adoption of index-based insurance appears to be very low, mostly even below 10%. The literature identifies several reasons for low uptake of index-based insurance. In this study we focus on two potentially important reasons for low adoption of index-based insurance: lack of trust in the insurance product and lack of liquidity to pay for the insurance premium.

We organized a randomized controlled trial (RCT) in rural Ethiopia using a sample of 8. 579 farmers to study the impact of addressing these impediments. Specifically, we create exogenous variation in the marketing channel of index-based insurance to build trust, and allow a random subsample of subjects to pay the premium after harvest – we call this an IOU. The marketing treatment consists of marketing the index-based insurance product to farmers through Iddirs. Iddirs were created to help their members organize burial ceremonies. However, nowadays, they have increased their spectrum of activities, and have basically become insurance programmes that provide mutual aid and financial assistance when members face shocks.

Since premiums are deferred, a farmer may not pay the promised premium at the later date. Our study investigates the extent of this default and what reduces it. In particular, we study the impact of the IOU farmers signing a binding legal contract (promising to pay) or signing joint liability contracts to encourage peer monitoring.

We work together with Oromia Insurance Company (OIC) in Ethiopia. OIC, together with the Japan International Cooperation Agency (JICA) developed index-based insurance (IBI) for crops in the Rift Valley zone of Ethiopia to improve the resilience of households in the face of climate change. The product was originally implemented in five districts: Boset, Bora, Ilfata, Adamitullu-Jido-Kombolcha (AJK), and Arsi Negele. The standard insurance product is marketed and sold via cooperatives. Uptake of the standard product, however, is very low (around 7%). Thus the main objective of our intervention is to improve uptake of the weather insurance product offered by OIC in the Rift Valley Zone of Ethiopia, without inducing (strategic) defaults. We also test to what extent a combination of an IOU with a marketing treatment through Iddirs is recommendable. The key sources of data are three farmer surveys - baseline, midline and an end line. In addition, we use administrative data from OIC, the implementer of our experiment, and organized focus group discussions as well as in-depth stakeholder interviews.

Our pilot shows that both marketing via Iddirs and dealing with liquidity constraints via IOUs will enhance uptake. However, in isolation, neither intervention seem to be sufficient: the increase in uptake due to the marketing intervention alone is not significant, while the IOU intervention may be troubled by defaults. The latter can be resolved by requiring farmers to sign a binding contract, but if this is done, the increase in uptake again becomes insignificant. However, a combination of the two interventions: an IOU with a binding contract, marketed via Iddirs do lead to a significant increase in uptake (from 8% to above 30%) without default problems. A similar

result can be achieved by combining an IOU with Iddir marketing and using a joint liability contract to reduce default problems. Thus our study provides rigorous evidence that an IOU, with a binding contract or a joint liability contract, marketed via Iddirs, will enhance uptake of index-based insurance considerably, without serious default problems.

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Abbreviations and acronyms

Age:	Age in years
Barely:	quantity of barely produced in last cropping season
BoughtIBIbefore:	1,0 dummy with 1 if household has bought IBI before in 2015, 2014 or 201
Cultuvationland:	total size of cultivated land
Droughdummy:	1, 0 dummy for any drought in 2015, 2014 or 2013
Education:	education level (between 0 and 13) It refers to the years of schooling
Famsize:	Family size
FGD:	Focus group discussion
Haricot:	quantity of haricot produced in last cropping season
IBI:	Index–based insurance. We use the abbreviation IBI for the standard index insurance product offered (and marketed) by Oromia through conventional (cooperative) channels
IBIPRE:	a dummy with a one if IBI is preferred over IOU with premium 100, zero otherwise
IBIM:	IBI with marketing (M) channel (marketed via Iddirs)
Income:	total income last month
IOU:	Index insurance product with possibility to pay premium after the harvest, offered and marketed via the conventional channel
IOUC:	IOU offered through the conventional channel with a binding contract
IOUPREF:	an index varying between 0 and 4, indicating farmers preference of IOUs over IBIs (the higher the price the farmer is willing to pay for IOUs).
IOUM:	IOU promoted via Iddirs (marketing channel)
IOUMC:	IOU promoted through Iddirs with a binding contract
IOUMJLC:	IOU promoted through Iddirs with a binding contract
IOUMNC:	IOU promoted through Iddirs with a new legally binding contract
IOUNC:	IOU offered through the conventional channel with a binding contract
Liquidityconstr:	dummy for liquidity constraints (a 1 if farmer applied for a loan but did not get it).
Maize:	quantity of maize produced in last cropping season
Mstatus:	marital status (married=1; single=2)
OIC:	Oromia insurance company
Savings:	binary dummy: do you have savings? (1 =yes; 2=no)
Sex:	sex of respond (1 male; 0 female)
Sorghum:	quantity of sorghum produced in last cropping season
Teff:	quantity of teff produced in last cropping season
TOC:	Theory of change
uptake1:	uptake in round 1
uptake2:	uptake in round 2
Wheat:	quantity of wheat produced in last cropping season
WTP:	willingness to pay

1. Introduction

The majority of the world's poor reside in rural areas and their economic fate depends crucially on the performance of the agricultural sector (e.g., World Bank 2007, Haggblade, Hazell and Dorosh 2007, Christiaensen, Demery and Kuhl, 2010). To promote intensification of rain-fed agriculture requires the widespread diffusion of agricultural technologies such as improved seed varieties and fertilizer. However, the adoption of modern technologies remains low and stagnant. Evidence is growing that downside (production) risk is an important factor that impedes the uptake of these technologies. Promoting the uptake of insurance against adverse weather shocks may therefore be a critical component of strategies to modernize agriculture and lift large swaths of people out of poverty.

Insurance against weather shocks in rain-fed production systems could help to promote agricultural intensification (e.g., Mobarak and Rosenzweig 2013, Cai 2016, Elabed and Carter 2014, Karlan et al. 2014). In recent years, experiments with index-insurance products have sought to overcome the well-known problems associated with indemnity-based insurance: (i) prohibitive transaction costs, (ii) asymmetric information and moral hazard, and (iii) covariate shocks that are hard to re-insure. Index-insurance delinks payouts from farm-level losses, and allows farmers to purchase coverage based on an index correlated with these losses. This may be a measure of average biomass productivity or yield losses, wind speed, or typically a measure of rainfall during a certain time period – variables that are objectively quantifiable and verifiable. Payouts are triggered when the index falls short of a pre-determined threshold. However, arguing that insurance promotes agricultural intensification does not mitigate the development challenge – it merely shifts it back one step. The reason is that adoption of index insurance is also incomplete, and typically hovers below 10% (Cole et al. 2014). The literature identifies several reasons for low uptake of index insurance. Most prominently, index insurance provides only imperfect coverage for household shocks if individual damages are not perfectly correlated with the index – as is typically the case. If the index is not identical to on-farm losses, residual risk (or basis risk) remains. Individual losses may be high while the index does not reach the threshold, in which case insured farmers are worse off than they would have been in the absence of insurance because they paid the premium (Clarke 2016). "False negatives" undermine the expected utility of adoption, especially for highly risk averse farmers. The combination of uncertain rainfall and uncertain payouts implies the farmer faces a compound lottery, inviting ambiguity aversion (Elabed and Carter 2014).

In this study we focus on two alternative reasons for low adoption of insurance: lack of trust in the insurance product or lack of trust in the insurance provider, which amounts to the same problem (Burke et al 2010; Karlan et al 2014) and lack of liquidity to pay for the insurance premium (Gangopadhyay 2004 and 2007). We organise an RCT in rural Ethiopia to study the impact of addressing these impediments. Specifically, we create exogenous variation in the marketing channel of index insurance to build trust in index insurance, and allow a random subsample of subjects to pay the premium after harvest to mitigate potential liquidity constraints during the planting season.

We work together with Oromia Insurance Company (OIC) in Ethiopia. OIC, together with the Japan International Cooperation Agency (JICA) developed index-based insurance (IBI) for crops in the Rift Valley zone of Ethiopia to improve the resilience of households in the face of climate change. The product was originally implemented in five districts: Boset, Bora, Ilfata, Adamitullu-Jido-Kombolcha (AJK), and Arsi Negele. The insurance product is marketed and sold twice per year, in the months preceding the two rainy seasons, during April and during September, to provide coverage against losses during the seedling and flowering stages of crop

growth, respectively. The standard insurance product is marketed and sold via cooperatives. A household that decides to buy an insurance pays a premium of ETB[1] 100 per policy for the standard product of OIC. The pay-out depends on the level of rainfall measured at the nearest meteorological station. If the level of rainfall is below a threshold but above the exit level, a partial pay-out of ETB 250 is made. If the decrease in rainfall falls below the exit level, a full pay-out of ETB 500 is made to policyholders. The take-up of the standard product turns out to be very low (around 7%).

To study the role of trust we seek endorsement of the instrument by traditional leaders. In several treatment arms we will market index insurance via Iddirs, or informal insurance groups. Iddirs are informal social institutions in Ethiopia, originally created to help their members organize burial ceremonies (but currently engaged in a broader spectrum of activities and mutual aid to manage idiosyncratic shocks that their members face). They function on the principles of reciprocity and altruistic trust (Aredo, 2010). We have trained Iddir leaders about the benefits of index insurance, and encouraged them to share their knowledge with members of their Iddirs. While we will refer to this as marketing via Iddirs, it is important to emphasize that insurance was also sold to individual members via the traditional channel – the local coop. We did not sell insurance to Iddirs (or even through Iddirs); rather we promoted our insurance product through iddirs since this is a customary channel helpful to build loyalty and trust on the product. Selling insurance to Iddirs was proposed by Dercon et al. (2014) (see also De Janvry, Dequiedt and Sadoulet. 2014), who point to potentially important coordination benefits from group-wise purchasing of index insurance. In the presence of basis risk, formal and informal insurance may be complements. After receiving the insurance payout, groups can organize an informal redistribution stage in which detailed knowledge about individual-level damages is used to attenuate basis risk. Our design does not promote this feature, and rather it focuses on building trust or confidence in the insurance product.

To study the role of liquidity we allow farmers from randomly selected Iddirs to pay the premium after harvest. Many smallholders are unable to mobilize the resources needed to pay for the upfront premium payment. Such outcomes may be due to either poverty gap dynamics, or to present bias of subjects (hyperbolic discounting leading to procrastination – see Duflo, Kremer and Robinson, 2011). Farmers are asked to pay a premium when disposable income is at its lowest and the marginal utility of cash is at its highest – just before the "hunger season." In return, they might receive compensation after harvest when, no matter how meagre, disposable income is often higher than in the planting season. We allow Ethiopian smallholders to postpone premium payment until after the harvest, and call this insurance product IOU. The properties of the IOU, except for the delayed payment, are identical to those of a standard product, but the delayed premium is higher to account for the opportunity cost of time (and to make the two premiums inter-temporally equivalent). A crucial issue for the viability of IOU schemes is whether farmers default on the premium payment in case there was no payout. We probe this issue by exploring legally binding contracts and leveraging group dynamics as commitment devices.

Our study comes closest to the following two papers. First, Dercon et al. (2014) propose selling index insurance to Iddirs, and evaluate the impact of an intervention that trains Iddir members to benefit from post-payout redistribution. They find that half a day of such training increases the uptake of insurance by the Iddir. Our approach is different as we do not sell insurance to Iddirs, and do not seek to reduce basis risk by informal sharing. Iddir members still go to the coop to purchase their own insurance, but learn about the insurance product through a traditional leader rather than a company representative or coop employee. Second Casaburi and Wills (2016) study delayed payments of the premium to induce insurance uptake, but their insurance is interlinked with a contract farming scheme (which all but prevents defaults on the

[1] ETB (Ethiopian Birr), 1 USD = 20 ETB.

premium payment commitments). They find uptake increases to 72%, compared to 5% for the standard contract. It is an open but important question whether this result extends to other contracting arrangements, because most smallholders are not engaged in contract farming (Oya, 2012).

We use a factorial design involving 144 Iddirs and 8,579 individual subjects to test whether delayed premium payments or promoting insurance via Iddirs affect adoption of index insurance, and analyze several approaches to mitigate default. We test for “level effects” as well as complementarities. Our main results are that the IOU has a large effect on uptake when introduced in isolation. Promoting standard insurance via Iddirs does not significantly increase adoption, but the combination of IOU and Iddir outperforms all other modalities. Moreover, for the various IOU sub-treatments we find low (but non-zero) default rates that are statistically indistinguishable from one another. Overall we conclude that IOUs are a profitable intervention for insurance companies in our case study.

The remainder of this report is organized as follows. Section 2 describes the context of the intervention. This section will explain where the intervention takes place, and why we have decided to select this study site. Section 3 describes the intervention in detail. This section also presents a theoretical model that provides a framework for thinking about trust, liquidity and the adoption of insurance. While farmers benefit from buying insurance, large premiums have to be paid up-front when they have liquidity needs to meet expenditures on fertilizers, seeds and various types of hired labor. We show this prevents farmers from buying insurance, and show the IOU relaxes this liquidity constraint – encouraging greater uptake. We also show how lack of trust in the insurance company adversely affects uptake. Based on this theoretical model we derive a theory of change (TOC). Section 4 surveys the monitoring plan. We will describe the relevant input, output and outcome indicators used to monitor the intervention, the source and mode of data collection for each of the relevant indicators and the measures taken to ensure quality of data collected. Section 5 presents the main evaluation objectives and questions, as well as the primary outcomes of interest. Section 6 deals with the evaluation design. It describes the sampling strategy, the methods of data collection as well as the analyses methods; It deals with both the quantitative and the qualitative analyses. Section 7 presents the time line of the study. Section 8 presents the main results of the analyses. Section 9 and 10 survey the main implications and lessons learnt, respectively.

2. Context

We work together with Oromia Insurance Company (OIC) in Ethiopia. This organization, in collaboration with the Japan International Cooperation Agency (JICA), developed drought index insurance for crops in the Rift Valley zone of Ethiopia. JICA and OIC jointly implemented the standard index-based insurance (IBI) for crops in the dry Rift Valley zone of Ethiopia in 2013 to improve the resilience of households in the face of climate change. The product was originally implemented in five districts: Boset, Bora, Ilfata, Adamitullu-Jido-Kombolcha (AJK), and Arsi Negele. The insurance product is marketed and sold twice per year, in months preceding the two rainy seasons (April and September). Insurance provides coverage against losses during the seedling and flowering stages of crop growth. It is marketed and sold via cooperatives. A household that buys insurance pays a premium of ETB 100 per policy (ETB 20 = USD 1). The payout depends on the level of rainfall measured at the nearest meteorological station. For rainfall levels below a threshold but above the so-called exit level, a partial payout of ETB 250 is made. If rainfall is below the exit level, OIC pays out ETB 500 per policy.

We identified three districts in the Rift Valley zone for the experiment: Bora, Adami Tullu and Arsi Negele districts. The Rift Valley zone is a semi-arid plain plateau area with a low land agro-ecology. This zone comprised of about 15 million smallholders and about 95% of them are

dependent on rain-fed agriculture. The pattern and intensity of rainfall exhibits considerable spatial and temporal variation with a bimodal type of distribution. The area receives very low average annual rainfall during May to August and another short rainfall during October and November. Moisture stress and drought frequently cause devastating crop failure, rampant livestock mortality and herd collapse. Major droughts in the area include the 2015-16 drought which followed the historical trend of droughts during 1973-74, 1983-84, 1991-92, 1999-2000, 2005-06 and 2011-12 (Dercon, 2004). Households in the area are smallholder subsistence farmers who mainly produce maize and wheat. They often face drought-induced income shocks that translate into erratic consumption patterns. Their ex-post shock coping mechanisms include reducing frequency of meals per day, distress livestock sales, reducing farm investment on chemical fertilizer and improved seed varieties, forcing pupils to withdraw from school for casual labour, renting land and family labour for local landlords and wage employment on floriculture farms of foreign investors. Future drought shock predictions in Ethiopia are pessimistic with expected rises in temperature from 23.08 to 26.92℃ (Hulme et al., 2001). As a result, the wide crop-livestock mixed farming system in dry and semi-dry areas like the Rift Valley zone were projected to transform into extensive systems to respond to the risks of climate change (Meinke and Stone, 2005, Thornton et al., 2010). Hence, innovative drought risk management mechanisms like adoption of drought insurances were highly recommended for farm households in the area.

The agricultural sector accounts for, on average, about 42% of the GDP, employs about 85% of the rural labour force and contributes around 90% of the total export earnings. Farmers face weather-related shocks every year and catastrophic risk every five years, resulting in significant welfare losses. About 82% of the smallholder households in the study area have no access to formal financial service. They also do not have access to non-traditional risk coping mechanisms. Thus, drought insurance technologies can help to cover covariate losses and safeguard informal insurances. The co-existence of market-based insurance with the predominant social insurance institutions in the study area provides an interesting setting to undertake an adequate analysis for effective adoption of these technologies. However, as in many other localities where index insurance is offered, take-up is very low – approximately 7-8%.

3. Intervention description and the theory of change

3.1 The main intervention

The standard index insurance product (*IBI*) that OIC offers has the following characteristics: A household that decides to buy insurance pays a premium of ETB 100 per policy. The pay-out depends on the level of rainfall measured at the nearest meteorological station. If the level of rainfall is below a threshold but above the exit level, a partial pay-out of ETB 333.5 is made. If the decrease in rainfall falls below the exit level, a full pay-out of ETB 667 is made to policyholders. The standard product is sold and marketed via cooperatives. Thus the standard insurance product basically covers events of rainfall shortage. The payouts imply that Oromia insurance charges a pure premium of 15 percent of the pay-outs. So, the pay-out for a complete loss is determined as follows: Pay-out=Premium/0.15. For instance, for a single insurance with premium of ETB 100, the pay-out for a complete loss is 100/0.15 which is about ETB 667. OIC also exercised this year a linear proportional partial loss indemnification

approach. Accordingly, for instance, in areas where the index indicates a 50% loss, a partial pay-out of about ETB 333.5 is paid to the farmers.

As in many other localities where index insurance is offered, take-up of the standard product is very low – approximately 7-8%. OIC suspects two constraints are mainly responsible for low uptake: lack of liquidity and trust. To test this, and explore potential solutions, we designed an RCT with multiple treatment arms. Specifically, to relax a binding liquidity constraint we allow farmers to pay the premium after harvest, and to generate trust we trained Iddir leaders and reached out to potential clients via Iddirs (the so-called marketing treatment). We call the product for which the premium can be paid later an *IOU*. To compensate for the delay, the premium of the IOU was set at 106, with the 6% surcharge based on the interbank rate in Ethiopia. Apart from the possibility to pay the premium later, and the somewhat higher premium, the IOU is the same as the standard index insurance of OIC. Regarding the "marketing" treatment, Iddir leaders informed households during the monthly iddir ceremony meetings about (i) nature and seasonality based weather variations, and the emerging climate change induced drought that they face on their individual farms (ii) the need for insurance to mitigate the adverse effects of these risks and (iii) the IOU insurance working philosophy.

To better understand the logic behind our marketing treatment, it is helpful to explain what the role of Iddirs is in Ethiopia. Iddirs are indigenous voluntary mutual help associations that can be found throughout almost all of the country, both in rural and urban settings. They are associations made up by a group of persons united by ties of family and friendship, by living in the same district, by jobs, or by belonging to the same ethnic group. The number of members, the composition, the functions, and the organization can differ from one iddir to another. These organizations have been originally created to take care of the activities linked to the burial ceremonies and to support their members during the time of funeral. But through time, they have progressively expanded their spectrum of activities. Currently, iddirs serve as social insurance institution that cover different risks such as funeral ceremonies, death of major productive assets (such as draft oxen), medical expenses, food shortages, and so on. All these associations are however based on a voluntary mutual agreement between community members in order to collaborate when one of them or one of their direct relatives faces a serious shock. They require, therefore, a high-level of participation from their members. It is also important to note that virtually all Ethiopian farmers belong to one or more Iddirs: "these groups are widespread in Ethiopia, with virtually every household a member" (Dercon et all. 2014). The external validity of the experiment, therefore, seems high. On the other hand, cooperatives in Ethiopia are statutory organizations often formed by government. The most common types of cooperatives in Ethiopia are agricultural cooperatives mainly meant for distribution of agricultural inputs including fertilizer and improved seed varieties. Similar to other rural producer organizations in developing countries, cooperatives in Ethiopia are often found to be ineffective and inefficient for adoption of rural technologies due to their state control and bureaucratic operation systems. Moreover, while some farmers are connected to cooperatives, they never go there.

How does trust come into the picture? Since Iddirs in Ethiopia are informal social insurance groups that function on the basis of mutual help, reciprocity and altruism, members of Iddirs usually have inherent trust that promotions or ideas advertised through Iddirs are beneficial to them. Hence, our study attempts to compare how insurance marketed through

Iddirs (customary channel) improves trust and increases uptake as compared with insurance marketed through cooperatives (statutory channel).

We also interacted the IOU and the marketing treatments, to analyse impacts on uptake. As allowing farmers to pay the premium later may result in default problems we also consider the impact of the interventions on default, and consider to what extent binding contracts may reduce default problems and affect uptake (see the appendix for the binding contracts).

We use multi-level randomization to assign 144 Iddirs to six experimental arms. We first randomized at the Iddir level and used stratified randomization to assign Iddirs to one of the following three arms: Category I, II and III (each 48 Iddirs). All households belonging to Category I were offered the standard insurance product (*IBI*), and received information about the standard product via Iddirs (the marketing treatment, denoted by an *M* at the end of the abbreviation; so this group is denoted by *IBIM*). Households from category II were assigned to the IOU/Iddir group and were offered the IOU product (*IOU*) after receiving information and endorsement through the Iddir (marketing treatment: *M;* so *IOUM*). Category III could purchase standard insurance (*IBI*) using the standard approach, i.e., via cooperatives (denoted by *IBI*). Leaders of the 96 Iddirs of Categories I and II participated in a training workshop. During the training, important aspects of agricultural insurance and the details of the insurance modality that was offered to them (IOU and standard insurance, respectively) were explained.

After the first randomization, we further allocated categories II and III. Category I, the standard product via Iddir promotion (*IBIM*) is not part of this further allocation. However, to probe interaction effects between contracts and the marketing channel, we reallocated the Iddirs in Category II into two random sub-groups (of 24 Iddirs each): IOU via Iddirs with a contract (*a* contract denoted with *C* at the end of the abbreviation; so *IOUMC*), and IOU via Iddirs without a binding contract denoted by *IOUM*. Comparing uptake and default across these two bins allows us to learn something about the impact of legal contracts, conditional on promotion via Iddirs. We also further allocated Category III households to probe uptake of IOU via traditional channels and to probe the impact of contracts. As Category III households are not treated via "Iddirs" we could use individual level randomization. This resulted in the following three additional experimental bins: farmers who were offered standard insurance via cooperatives (this is the comparison group for the other treatments (*IBI*)); farmers in group 5 were offered IOU via cooperatives after signing a legal contract to limit default (denoted by *IOUC*); and a group of farmers who is offered IOUs via cooperatives without a contract (denoted by *IOU*). Comparing uptake and default across arms *IOUC* and *IOU* allows us to draw inference about the impact of legal contracts, conditional on promotion via cooperatives.

The multilevel randomization resulted in the following six groups (see figure 1), with sample sizes in parentheses.

1) standard insurance through IDDIR promotions (*IBIM*) [3056]
2) IOU through IDDIR promotions with binding contract (*IOUMC*) [1465]
3) IOU through IDDIRs without binding contract (*IOUM*) [1887]
4) standard insurance through conventional channel (*IBI*) [853]
5) IOU through the conventional channel with binding contract (*IOUC*) [633]
6) IOU through the conventional channel no binding contract (*IOU*) [685]

The six groups enable us to study the significance of the two main interventions: 1) the impact on uptake of marketing via Iddirs, by comparing *IBI* with *IBIM* and 2) the impact of

reducing liquidity constraints on uptake, by comparing *IBI* with *IOU*. It also allows testing the relevance of combining the two interventions (compare *IBI* with *IOUM*). Finally, the grouping enables us to test to what extent the impact of the IOU intervention changes if binding contracts are used, conditional on promotion via coops or Iddirs (compare IOU with IOUC and IOUM with IOUMC, respectively).

Although some groups contain the same number of Iddirs, the number of households varies a lot. To a small extent this reflects differences in the number of households per Iddir. More importantly, it is a consequence of the second-round randomization. We deliberately oversampled households in subdivide groups I and II (the two categories with Iddir treatment in the first randomization) so that they can be further sub-divided in anticipated follow-up work focusing on the Iddir channel. It is important to note that the number of observations across all cells is large, and we are not underpowered for the questions we want to study. Precision decreases when the allocation between treatment and control groups becomes more unbalanced, Yet, "because precision erodes slowly until the degree of imbalance becomes extreme…there is considerable latitude for using an unbalanced allocation." (Bloom, 2006, p. 6).

3.1.1 A second round of interventions

Originally we planned to have two (and potentially even three, if budget allowed) similar interventions during a period of a year. However, when we started analysing the results of the first intervention, we decided to slightly change the second intervention. By changing the interventions, we are able to test some alternative designs that can guide us in terms of designing an appropriate up-scalable index insurance product to be tested in terms of impact in a potential second phase. Most importantly, we wanted to further address alternatives to reduce default rates related to IOUs. Specifically, we aimed to test to what extent a joint-liability IOU contract would be appropriate. The joint liability contract implies that farmers of a particular Iddir are only allowed to buy an IOU in the next round if everybody from this Iddir has paid the premium on the IOU. Moreover, as the binding contract we designed turned out to be too strict (details will be given below), and not in line with a standard legally binding contract in Ethiopia, we decided to test the implications of a binding contract that is exactly in line with a standard legal contract in Ethiopia.

Using the sample of farmers of the first round, we re-constructed four new groups out of the original six groups. The three groups for which the insurance products are marketed via Iddirs (groups 1 (IBIM), 2 (IOUMC) and 3 (IOUM) above) are randomly (Iddir randomization) regrouped into 2 new groups:

1: Farmers of this group are allowed to buy IOUs with a legally binding contract (NC) via Iddir promotion (IOUMNC: 3431);

2: Farmers of this group are allowed to buy IOUs with a joint liability contract (JLC) via iddir promotion (IOUMJLC: 2977).

The control group (group 4 (IBI) above) remains the control group, i.e.

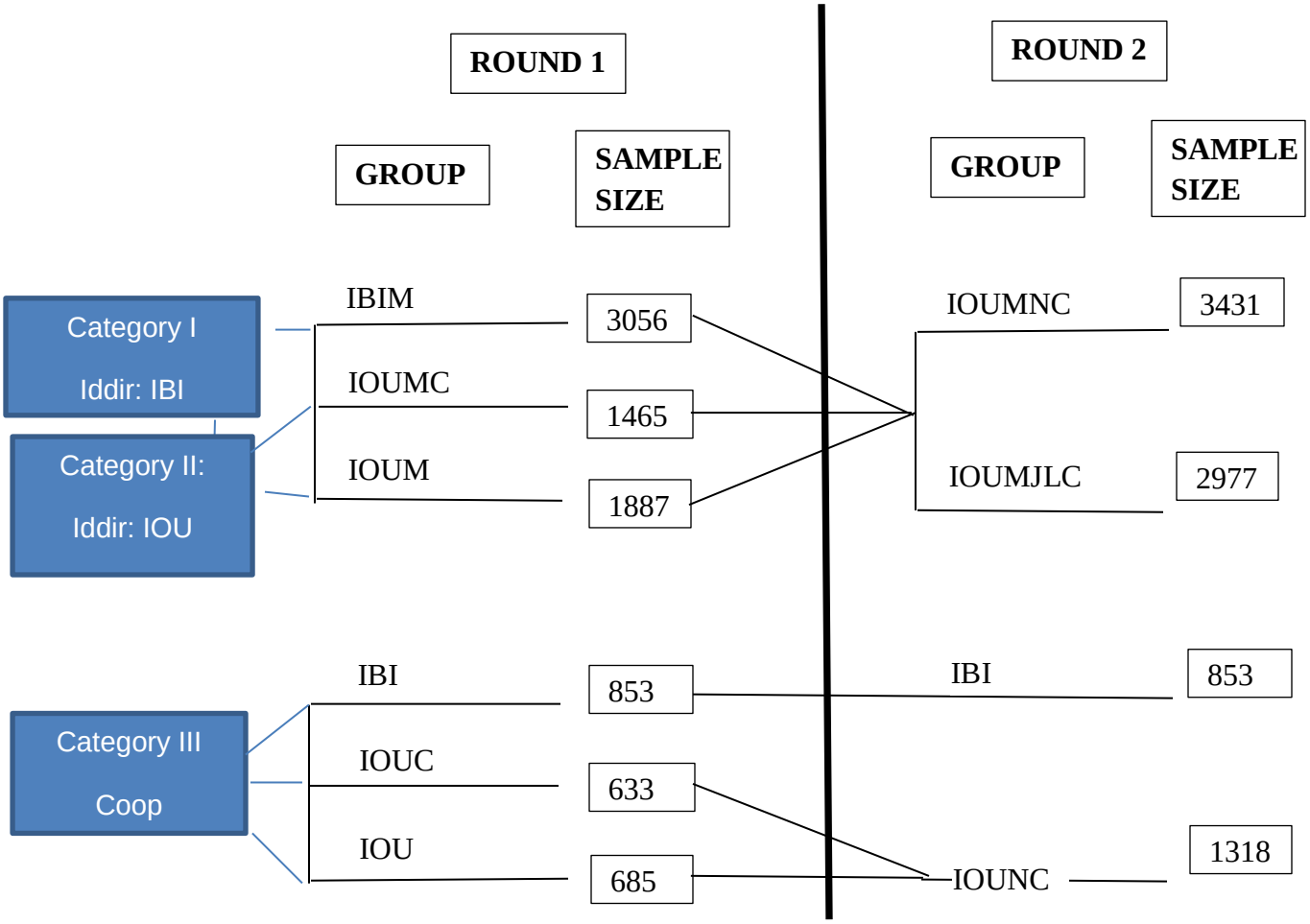
3: farmers in this group need to buy the standard insurance promoted and sold via cooperatives (IBI: 853)

Finally, we merged the two groups that are allowed to buy IOU in the standard way (5 (IOUC) and 6 (IOU) above) into one new group:

4: Farmers in this group are allowed to buy the IOU in the standard way, but need to sign the new legally binding contract (IOUNC: 1318),

The figure below surveys the two rounds of interventions:

Figure 1: The interventions



Notes: I *IBI*: the standard index insurance promoted via cooperatives; *IOU*: The new IOU index insurance promoted via cooperatives; A *M* at the end of the abbreviation refers to marketing treatment (promoted via Iddirs). There are two possibilities: both the standard

product and the IOU can be promoted via Iddirs (*IBIM* and *IOUM*, respectively). The IOUs can be offered without a contract (*IOU* and *IOUM*, respectively), or with a binding contract (denoted with a C at the end of the abbreviation; so *IOUC* and *IOUMC*, respectively). Regarding the second round intervention: *NC* refers to new binding contract; *JLC* refers to Joint Liability contract.

3.2 A theoretical model

The objective of our intervention is to address two key hurdles faced by farmers in buying insurance: liquidity constraint and trust. To address the first hurdle, we introduce a new weather insurance product (IOU) where the premium payment is deferred till after the uncertainty is resolved (after the harvest). To address the second hurdle we allow for the possibility of promoting insurance products through social organisations (IDDIRs).

In this sub-section we present an illustrative theoretical model that shows how trust in the insurance product or company affects uptake of drought insurance, and derive conditions under which the IOU induces more people to purchase drought insurance compared to an equivalent insurance product with up-front payments. The latter insurance product is a standard one where farmers pay a premium before the uncertainty is resolved and obtain payments depending on the states realized after the uncertainty is resolved. To focus on trust and liquidity we abstract from basis risk and moral hazard in the exposition.

There is a continuum of farmers indexed by their current liquidity y_0, $y_0 \epsilon [y_0^L, y_0^H]$, with $y_0^H > y_0^L \geq 0$. The measure of all farmers is normalized to unity and has the cumulative distribution denoted F, with $0 \leq F(y_0^L) < F(y_0^H) = 1$, where $F(y)$ is the proportion of farmers with liquidity less than (or equal to) y. There are two periods, $t = 0,1$. There is no uncertainty at $t = 0$ but outcomes in $t = 1$ are uncertain. The farmer has a certain amount of liquidity y_0 in period 0 and an uncertain income $\tilde{y}_1$ in period 1. Period 1 income is positively dependent on rainfall which is stochastic. The farmer's two-period utility without insurance is given by:

$$\underline{U} \equiv u(y_0) + \beta\left[\overline{y}_1 - \left({}^1/_2\right)\rho{\sigma_y}^2\right] \quad (1)$$

where, $\overline{y}_1 \equiv E(\tilde{y}_1)$, ${\sigma_y}^2$ is the variance of $\tilde{y}_1$, β represents time-preference, ρ is the farmer's constant absolute risk-aversion parameter, and E is the expectations operator.

Assumption 1: We assume that $u'(.) > 0$, $u''(.) < 0$ and that $u(.)$ satisfies the Inada end-point conditions. The farmer is risk averse and this is represented by a second period utility function that can be expressed in certainty-equivalent form.

The farmer can buy a rainfall-indexed insurance contract that pays out depending on rainfall realizations. The insurance pay-out, $\tilde{x}$, is inversely dependent on rainfall and given that $\tilde{y}$ is positively correlated with rainfall we have $\tilde{x}$ and $\tilde{y}$ are negatively correlated, i.e., $Cov(\tilde{x}, \tilde{y}_1) \equiv \sigma_{xy}$<0. Let the cost (or premium) for this insurance be denoted π, $\overline{x} \equiv E(\tilde{x})$ and ${\sigma_x}^2$ is the variance of $\tilde{x}$. The farmer has two options: (i) to stay without insurance and have a two-period utility given by (1) or, (ii) buy insurance and obtain a two-period utility given by equation (2)

below. Buying insurance entitles the farmer to an income stream $\tilde{z} \equiv \tilde{y}_1 + \tilde{x}$ in period 1. If the farmer buys insurance, she gets:[2]

$$U^0 = u(y_0 - \pi) + \beta\left[\overline{y}_1 + \overline{x} - \left({}^1/_2\right)\rho\left({\sigma_y}^2 + {\sigma_x}^2 + 2\sigma_{xy}\right)\right]$$
$$\cong u(y_0) - \pi u'(y_0) + \beta\left[\overline{y}_1 + \overline{x} - \left({}^1/_2\right)\rho\left({\sigma_y}^2 + {\sigma_x}^2 + 2\sigma_{xy}\right)\right] \quad (2)$$

where we have used a first-order Taylor expansion to derive the expression in the second line of (2). The farmer buys insurance if and only if equation (2) utility is greater than U, i.e. if:

$$\beta\left[\overline{x} - \left({}^1/_2\right)\rho\left({\sigma_x}^2 + 2\sigma_{xy}\right)\right] \geq \pi u'(y_0). \quad (3)$$

The left-hand-side (LHS) of inequality (3) is the additional utility from buying into the uncertain income stream generated by insurance. The right-hand-side (RHS) is the utility cost of buying the income stream generated by insurance. While the benefits from insurance will accrue in the next period, and only if rainfall is low, the premium has to be paid today. The relative comparison of cost and benefit depends on the premium, π, but also on the utility cost for the farmer who loses liquidity today. The same premium will mean different things to different farmers, depending on the amount of liquidity they have today. We measure this cost of liquidity by $u'(y_0)$ with the implicit assumption that as y_0 rises, the cost of liquidity falls. Observe that if $u'(y_0) = 1$, then the RHS of (3) is simply the premium, or the benefit of insurance must be greater than its premium. As y_0 decreases, $u'(.)$ falls, implying that people with smaller period 0 liquidity will suffer a greater utility cost of paying the insurance premium.[3] Given insurance pay-out $\tilde{x}$, let (3) hold with equality at $y_0 = y^*$. Then all farmers with $y_0 \geq y^*$ will buy insurance and others will not buy the insurance. Hence, the proportion of farmers buying insurance equals $1 - F(y^*)$.

Now suppose the farmer has access to the IOU with the same pay-out plan as the erstwhile insurance, but its premium can be paid in the second period. The delayed premium payment is of an amount $\pi(1 + r)$ where r is the risk-free interest rate that the insurance company could get on its one-period cash holdings. If the farmer takes this, she gets utility:

$$U^I = u(y_0) + \beta\left[\overline{y}_1 + \overline{x} - \pi(1 + r) - \left({}^1/_2\right)\rho\left({\sigma_y}^2 + {\sigma_x}^2 + 2\sigma_{xy}\right)\right] \quad (4)$$

Observe that the two-period utility in (4) will be greater than that in (1) if and only if

$$\beta\left[\overline{x} - \left({}^1/_2\right)\rho\left({\sigma_x}^2 + 2\sigma_{xy}\right)\right] \geq \pi\beta(1 + r) \quad (5)$$

There may exist a subsample of farmers who will buy the IOU if offered, even if they do not buy the standard insurance. In particular, farmers with high liquidity cost will not buy the standard insurance, but some of them will buy the IOU if offered. Theoretically, in a perfect

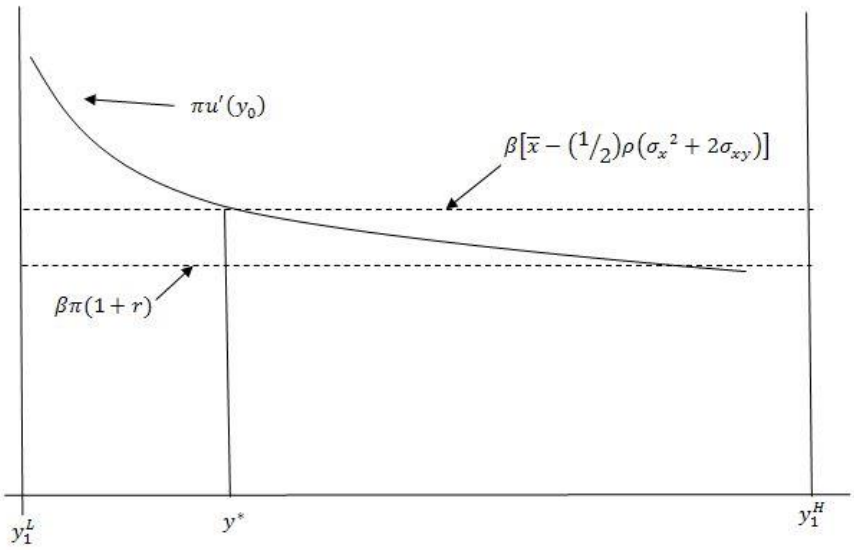
[2] This results from the fact that the variance of the sum of two random variables, equals the variance of variable 1, plus the variance of variable 2, plus two time the covariance, i.e. Var(x+y) = var(x)+var(y)+ 2cov(x,y).

[3] This cost of liquidity in period 0 will depend on a number of different factors in addition to income – size of the family, outstanding debt obligations that are payable today, cost of education of children, etc. For simplicity, we assume income is a sufficient measure of liquidity cost.

capital market, identical rates of time discount, no aggregate uncertainty and with a borrowing rate equal to the lending rate, the rate of time discount will be such that $\beta(1+r)=1$ and the RHS of (5) collapses to π. This is the same as the RHS of (3) when $u'(y_0)=1$. The question then boils down to the relative sizes of $\beta(1+r)$ and $u'(y_0)$ and that of $\beta[\overline{x}-(1/2)\rho(\sigma_x{}^2+2\sigma_{xy})]$ and π.

One possibility is depicted in Figure 1. On the horizontal axis we measure today's non-stochastic income and the vertical axis measures the money value of utility. Given our assumption of decreasing utility costs of liquidity in income, we obtain the falling $\pi u'(y_0)$ line. By construction, $\beta[\overline{x}-(1/2)\rho(\sigma_x{}^2+2\sigma_{xy})]\geq\pi u'(y_0)$ for all $y\geq y^*$ and, hence $[1-F(y^*)]$ proportion of farmers will buy the standard insurance while $F(y^*)$ will not buy anything.

Figure 2: Liquidity and the uptake of insurance



To complete the analysis, we consider the firm selling insurance. Since all buyers of insurance (and the IOU) get paid according to a rainfall index, all farmers face the same probability of receiving a payout. From Figure 1, we know the proportion of farmers who buy the standard insurance, namely $[1-F(y^*)]$. Suppose this translates to $N(y^*)$ farmers, with $N'(y^*)<0$. If the insurance company makes non-negative profit, its expected pay-out must be less than its expected receipt of premium:

$N(y^*)\overline{x}\leq N(y^*)\pi(1+r)$ or, $\overline{x}\leq\pi(1+r)$

6)

Here we assume that the premium paid in period 0 is held by the insurance company as a risk-less interest bearing asset. For the insurance market to work, both equations (3) and (6) must be satisfied; i.e., for a given rain-indexed schedule of pay-outs $\tilde{x}$, there exists $y^* \epsilon [y_0^L, y_0^H)$ and $\pi \epsilon (0, \infty)$ such that both (3) and (6) are satisfied.

In the IOU, the premium payment is deferred to period 1 and the relevant expressions are (5) and (6). First, let us suppose that there is no default, i.e., all farmers pay $\pi(1+r)$ if they sign up for the IOU. Then equation (6) remains the same as long as π is the same in the IOU as it was in the standard insurance. And for (5) and (6) both to hold we need:

$$\left[\overline{x} - \left({}^{1}/_{2}\right)\rho\left({\sigma_x}^2 + 2\sigma_{xy}\right)\right] \geq \pi(1+r) \geq \overline{x} \qquad 7)$$

Hence, for insurance to be sustainable we must have $\left({\sigma_x}^2 + 2\sigma_{xy}\right) < 0$; otherwise, the provider of insurance will make a loss.[4] Assuming this is the case, we can show two results. First, all risk averse farmers will prefer the IOU over the standard product. Second, all farmers will purchase insurance via the IOU if that is offered to them. Both results are clear from Figure 1.

Next, consider default. The IOU design introduces the possibility of strategic default, or default due to time-inconsistent preferences: some people who promised to pay the premium later, do not pay up when the time comes. This problem only emerges in states where the farmer does not receive pay-outs, else the insurance company can always make payments net of $\pi(1+r)$: instead of paying $\tilde{x}$, it can pay $\tilde{x} - \pi(1+r)$. In our experiment, the farmer gets a pay-out (x_1) when rainfall is below a threshold, and she gets a lower amount (x_2, with $0 < x_2 < x_1$) when rainfall is above between this threshold and a second (higher) threshold. The farmer receives nothing ($x_3 = 0$) if rainfall exceeds the second threshold.[5] Let the probabilities corresponding to each pay-out state be denoted $q_i, i = 1,2,3$ and let D be the default rate. The expected payoff to the company from each farmer is:

$$q_1(\pi(1+r) - x_1) + q_2(\pi(1+r) - x_2) + q_3(1-D)\pi(1+r)$$

$$= \pi(1+r) - q_3 D\pi(1+r) - \overline{x} = \pi(1+r)(1 - q_3 D) - \overline{x} \qquad 8)$$

For the company to offer the IOU, this expression must be non-negative. Observe that if $D = 0$ this non-negativity condition reduces to the last inequality in (7). Also observe that in the presence of default, insurance premiums will go up. Sufficiently high premiums undermine the attractiveness of the IOU for farmers.

Finally we ask how trust enters the farmer's considerations. Farmers must be confident that the provider of insurance will pay up when the state warrants a pay-out. Trust becomes an

[4] In fact, the following two assumptions need to be satisfied: (a) insurance payout and farmer's income are negatively correlated ($2\sigma_{xy} < 0$), and (b) pay-outs must be such that $\left({\sigma_x}^2 + 2\sigma_{xy}\right) < 0$. Obviously, if (b) is satisfied, so is (a) (since ${\sigma_x}^2 > 0$). The probability that these are satisfied improves as the correlation between the rainfall index and the farmer's income (from farming) improves. If the rainfall index is perfectly (positively) correlated with the farmer's income, i.e., the index used is the amount of rainfall *on* the farmer's land, then there is no basis risk for the farmer. But if the index is based in measurement of rain elsewhere, the correlation may not be perfect.

[5] We have assumed here that $\pi(1+r) \geq x_i, i = 1,2$. This is not necessary. $\pi(1+r) \geq x_i$ for at least one i is all we need.

issue only when the insurance company has to make a pay-out. Let this trust factor be represented by p, or the expected probability that the insurance company will pay-out when this is required. So far we assumed $p = 1$. Lack of trust, however, lowers the expected value of the pay-out in state 1 to px_1 and in state 2 to px_2. The expected pay-out from standard insurance is $q_1 px_1 + q_2 px_2$, where q_i, $i = 1,2$ is again the probability of state i. Recall that in state 3, the good state, the insurance company is not expected to pay anything. The expected value of pay-outs $\tilde{x}$ reduces to $p\overline{x}$ and its variance is $p^2\sigma_x^2$. Equation (2) is now replaced by

$$U^0 \cong u(y_0) - \pi u'(y_0) + \beta\left[\overline{y}_1 + p\overline{x} - \left({}^1/_2\right)\rho\left({\sigma_y}^2 + p^2{\sigma_x}^2 + 2p\sigma_{xy}\right)\right] \tag{2'}$$

$$= u(y_0) - \pi u'(y_0) + \beta\left[\overline{y}_1 + \overline{x} - \left({}^1/_2\right)\rho\left({\sigma_y}^2 + {\sigma_x}^2 + 2\sigma_{xy}\right)\right]$$

$$-\beta(1-p)\left[\overline{x} - \left({}^1/_2\right)\rho\left({\sigma_x}^2(1-p) + 2\sigma_{xy}\right)\right]$$

The utility associated with (2') is reduced by $\beta(1-p)\left[\overline{x} - \left({}^1/_2\right)\rho\left({\sigma_x}^2(1-p) + 2\sigma_{xy}\right)\right]$, which is positive if $0 < p < 1$ and $\left({\sigma_x}^2 + 2\sigma_{xy}\right) < 0$. As p decreases, reflecting falling trust among farmers in the insurance company, fewer people will be willing to buy the standard insurance. In Figure 1, the upper of the two broken lines shifts down, y^* shifts to the right and, $[1 - F(y^*)]$ falls.

How does a lack of trust affect the IOU? Suppose rainfall is such that we are in state 1. Then with probability p the company will pay out $x_1 - \pi(1+r)$, i.e., the amount to be paid in state 1 minus the deferred premium owed to the company. With probability $(1-p)$, the company pays nothing. Similarly, one can enumerate pay-outs in state 2. While lack of trust erodes expected gains associated from taking up insurance, in an IOU context the farmer cannot be made worse off. The outcome where farmers pay a premium but do not receive the payout they are entitled to cannot occur.

Finally, consider the situation in state 3. Assume that when this state happens the company comes to collect the deferred premium payment of the farmer even when it denies payment to farmers who are in state 1 or 2. In this case farmers are called upon to make the payment $\pi(1+r)$ with probability 1 even when farmers in state 1 or 2 are receiving pay-outs with probability p, $p < 1$. The IOU then generates an expected payoff to the farmer of $q_1 p[x_1 - \pi(1+r)] + q_2 p[x_2 - \pi(1+r)] + q_3[-\pi(1+r)] = p\overline{x} - \pi(1+r)$. Equation (4) now becomes

$$U^I = u(y_0) + \beta\left[\overline{y}_1 + p\overline{x} - \pi(1+r) - \left({}^1/_2\right)\rho\left({\sigma_y}^2 + p^2{\sigma_x}^2 + 2p\sigma_{xy}\right)\right] \tag{4'}$$

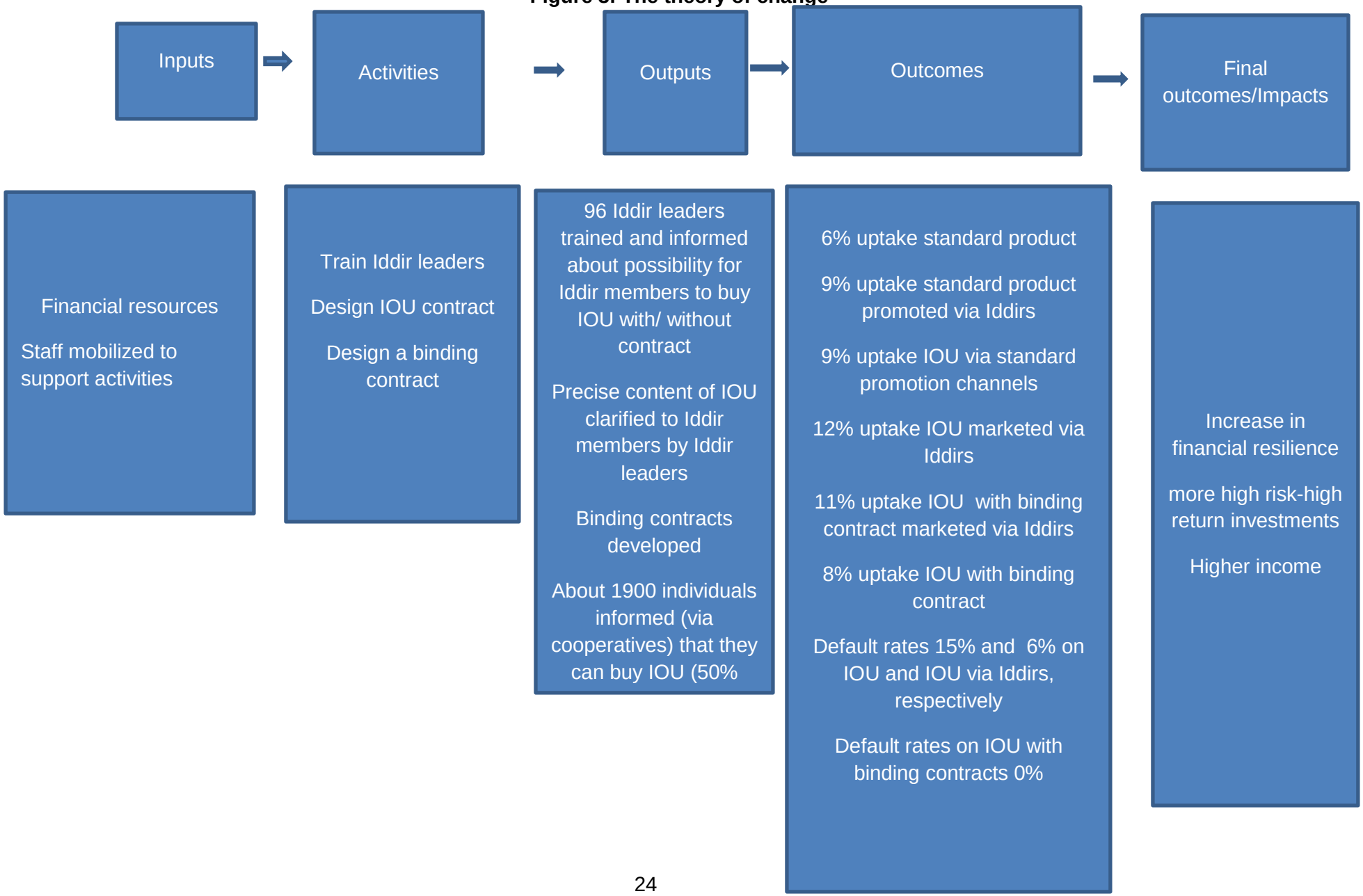
$$= u(y_0) - \beta\pi(1+r) + \beta\left[\overline{y}_1 + \overline{x} - \left({}^1/_2\right)\rho\left({\sigma_y}^2 + {\sigma_x}^2 + 2\sigma_{xy}\right)\right]$$
$$-\beta(1-p)\left[\overline{x} - \left({}^1/_2\right)\rho\left({\sigma_x}^2(1-p) + 2\sigma_{xy}\right)\right]$$

The difference between equation (4) and (4′) is the same as that between equations (3) and (3′), and the comparison between equations (3) and (4) continues to be valid between (3′) and (4′).

3.3 The theory of change

The main interventions we consider are: 1) selling IOU insurance to address liquidity constraints; 2) market the insurance product via Iddirs to address (reversed) trust issues. In addition, to address potential default problems with IOUs, we consider the relevance in terms of uptake and default of a binding contract. Our initial theory of change is depicted below in the form of a results chain.

Figure 3: The theory of change



Guided by our theoretical model (and detailed discussions with OIC), we expect the IOU to improve uptake by means of addressing liquidity constraints. Specifically, our theoretical model suggests that farmers with high liquidity cost will not buy the standard insurance, but some of them will buy the IOU if offered. We expect that the IOU increases uptake from 6% (standard uptake: based on actual uptake figures) to 9%. That is, based on discussions with Oromia, an increase of uptake to 9% (without serious default problems, say below 5%) would be seen as a successful intervention.

Our theoretical model also suggests that trust in the insurance provider will improve uptake. We assume that marketing the insurance product will enhance trust in the insurance product – presumably because of endorsements by traditional leaders. We assume that this channel will be successful if it increases uptake to 9%. Our intervention also considers the combination of IOU and marketing via Iddirs. We assume that the combination will have an additional impact on uptake rates, and expect an increase in uptake to 12%.

We assume that marketing index insurance via Iddirs will improve uptake by means of enhancing trust in the product. Yet, it should be noted that the literature identifies two other reasons why our Iddir design may improve uptake. First, if formal and informal sharing are complements, and post-payout redistribution of any insurance benefit occurs at the group level, then selling to groups may be an effective way to mitigate basis risk – increasing the value of the insurance product for farmers (Dercon et al. 2014, De Janvry, Dequiedt and Sadoulet, 2014). However, we do not believe this to be an important consideration in the set-up we study. Most importantly, insurance is not sold to groups but to individuals (via coops). The second reason why marketing via groups might matter is superior information sharing. Group members may be more motivated to learn from co-Iddir members, or such members may be better able to convey the complex messages regarding index insurance to their peers. In that case, higher uptake in our Iddir-based treatment arms is due to better understanding of the insurance product; higher financial literacy, or higher cognitive ability. We have tested whether this alternative explanation holds, but found no evidence in favor of it (see section below)

As the farmer is required to pay the IOU premium after the uncertainty is resolved, this shifts risk from the farmer to the insurance company as the farmer may decide not to pay if the state is good. This possibility of strategic default may attract additional farmers to uptake the product, and confound the intervention. The marketing of contracts via Iddirs may reduce this problem by means of peer pressure. As there are no similar studies available, we can only "guess" default rates: we expect default rates around 15% for the IOU design, and default rates around 6% for IOUs marketed via Iddirs. Note that the default rates presented in Figure 3 should not be seen as "targets" but as expectations. The target would be a very small default rate, say 5% or lower, which we do not expect to obtain with IOUs without contracts.

In order to test to what extent selling via IDDIRs reduce strategic defaults due to peer pressure, we will make a sub-sample of smallholders sign a binding contract (committing to pay the premium at a later date) with OIC when they opt for the IOU. Consequently, we assume that uptake of the IOU designs with binding contracts will be somewhat lower as compared to the IOU designs without binding contracts. In order to address potential default problems, we test to what extent a binding contract will reduce defaults. We expect this to be the case, and thus assume that IOUs with binding contracts will not suffer from default problems. As IOUs may

lead to adverse selection problems, and attract risky farmers, the binding contract may have consequences for uptake.

Regarding the legal contract, the main idea was that if the legal contract has any bite, then it will give confidence to the insurance selling company that those who have experienced the good state will not default on their premium payments. (Note that those who suffer a negative shock are not relevant here because they need to get a payment from the company and their premium can always be deducted from what the company is due to give them.) However, the fact that the farmer is being legally bound to pay the premium may appear daunting to a farmer who has little understanding, or faith, in legal institutions as upholders of justice for the common farmer. Given that there was a farmer protest and uprising going on in this region, it was important for us to allow for this possibility. Thus we want to test difference in behavior between groups with and without legal contracts (i.e. comparing groups 5 (IOU) and 6 (IOUC), see figure 1 above).

Finally, we expect that higher uptake of the insurance product will have positive impacts in terms of making farmers more resilient to (weather) shocks, will cause a change in investment patterns, and ultimately enhance income. However, note that given the timeframe of this study, we will not address impacts of increased uptake, Rather, we will focus on uptake and defaults only.

Obviously, our intervention faces several risks. We identify the following main risks: 1) It may be the case that there are low-uptake differentials between the different treatment arms. There are no studies available that can give us any indication about how big the effect sizes will be. Therefore, we may run into power problems. We may also face power problems in that we may lose some farmers in our sample: attrition. However, given the relatively big sample we have, we anticipate this not to be a major issue. We try to come around power problems by rolling out the pilot over a relatively big sample (see below); 2) Our IOU design may lead to adverse selection and moral hazard problems, and consequently lead to high defaults. We will explicitly test whether this is the case, and use binding contracts as a potential solution; 3) The binding contracts may be difficult or costly to enforce. Moreover, it may turn out that the binding contract is “too binding” and scares off farmers from taking up the IOU; 4) The implementing organization, OIC, does not implement the treatments in line with the design; 5) The Iddir leaders who are informed about possibility to buy IOU do not inform the Iddir members. 6) Another potential risk related to the political situation in Ethiopia. It turns out that the political situation in Ethiopia, including our intervention area, is quite unstable. In some of our intervention places, like Arsi Negele, Zeway, and Meki it is not recommended for a foreigner to stay or travel across rural villages. In order to address this issue as much as possible, we decided to work with local enumerators who know the situation best. A consequence of this choice was that we were not able to use tablets as this would have required some outsiders to travel to our intervention areas to train local enumerators to use the tablets. Thus, the different surveys have been done on paper.

3.3.1 Some remarks regarding theory of change second round of interventions

In the second intervention round we test the uptake and default of IOUs with a newly designed binding contract as well as a joint liability contract. The newly designed binding contract is less

stringent than the binding contract we used in the first round of interventions. Thus we expect a somewhat higher uptake, but also a bit more defaults as compared to the IOUs with the original binding contract. We expect the joint liability contract to have similar impacts, both in terms of uptake as in terms of defaults.

4. Monitoring plan

The main input, output and outcome variables are provided in Figure 3, the theory of change. In terms of output, the main variables are: 1) Iddir leaders should be trained; 2) the iddir leaders should inform the Iddir members; 3) the IOU contract as well as the binding contracts should be designed and 4) individual cooperative members should be informed about the possibility to buy IOUs.

The training of the Iddir leaders, as well as the information sharing with individual cooperative members has been done by the implementing organisation, OIC. Regarding the training of the Iddir leaders, before starting the interventions, both for the baseline (June 2016) and the midline (September 2016) of the IOU offer, we have organized training workshops. Participants included Iddir leaders, development agents from each kebele, field supervisors as well as district and kebele level agricultural officers. On the trainings, the main aspects of agricultural insurance and the details of the IOU insurance including the contract arrangements were explained. To be specific, on both workshops, we invited 98 iddir leaders, 12 development agents (DAs), 3 fieldwork coordinators, 12 local administrative unit (kebele leaders) and 3 agricultural bureau representatives and 3 cooperative leaders. These participants have raised various issues for discussion and obtained adequate explanations on the concept, implementation and the merits of our project in helping the smallholders. A representative of Kifiya Financial Technology, that technically assists OIC to design insurance products, also attended the workshop. Mr Temesgen Belissa (team member) from Haramaya University attended the workshops and carefully monitored the training.

In order to monitor the implementation of the project, starting from the inception of the idea of our IOU project, we have been discussing with our implementing agency, OIC. We held various meetings at the office of OIC in Addis Ababa on the issues related to the insurance product design, feasible intervention channel (cooperatives vs iddirs), and the need for allowing farmers to sign or not sign contracts to minimize defaults that arises from the differed payment of IOU. Finally, we came up with the insurance product that postpones the premium payment – IOU insurance – to be marketed through Iddirs for some groups of households or coops for other groups. Temesgen Belissa stayed in close contact with the implementing organisation during the entire pilot period, and followed the implementation closely. In this way, we were able to see whether the activities of the implementing organisation were in line with the design of the study.

The IOU contract, as well as the binding contract has been designed by us, in close cooperation with Oromia. In the Appendix an example of the binding contract is given.

Our main outcome indicators are (1) uptake and (2) default. The uptake and default rates are authentically obtained from Oromia, so, there was no need to carry out surveys to

obtain these data. Oromia gave us access to the uptake and default data of the various interventions.

We organised three short surveys (see the Appendix): (1) a baseline survey. The main purpose of the baseline survey is to be able to conduct balancing test, in order to see whether the randomisation “worked”. (2) A midline survey, conducted after the first intervention, but before the second. This survey has been done to test whether groups are balanced in terms of financial knowledge and financial literacy. The reason for this test is as follows. As the higher uptake in our Iddir intervention may also be due to better understanding of the insurance product (see our TOC), i.e. due to higher financial literacy and/or higher cognitive ability. The midline survey allows us to test whether this alternative explanation holds. (3) An endline survey. The main purpose of this survey is to get some additional information relevant for upscaling the IOU, and thus the possible Phase 2. In particular, we try to obtain some additional information about optimal price setting of the IOU, and the appreciation for IOUs by farmers.

The fieldwork (and all logistic arrangements) has been organised and supervised by Temesgen Belissa from Haramaya University. The data entry (as well as the quality check) has been supervised by Temesgen Belissa. All calculations have been done by team members. Specifically, the first round of calculations has been done by Robert Lensink. The other team members have checked all calculations.

In order to get some better knowledge on the relevance of our TOC, we also organised focus group discussions (FGDs) and in-depth interviews (see Section 6, below). These FGDs were supervised (and partly conducted) by Temesgen Belissa.

5. Evaluation questions and primary outcomes

The main objective of our intervention is to improve uptake of the weather insurance product offered by OIC in the Rift Zone of Ethiopia, without inducing (strategic) defaults. While during this pilot period we are not able to explicitly test impact, we assume that higher uptake of insurance products will ultimately improve resilience of farmers to weather shocks. We focus on two key hurdles faced by farmers in buying insurance: liquidity constraint and trust. To address the first hurdle, we introduced a new weather insurance product (IOU) where the premium payment is deferred till after the uncertainty is resolved (after the harvest). Farmers buying the IOU have to pay a 6% higher premium for a maximum of 6 month delay period. The 6% was based on the interbank rate in Ethiopia. To address the second hurdle, we allowed for the possibility of promoting insurance products through social organisations (Iddirs).

The related evaluation questions are as follows: 1) to what extent will the IOU lead to a substantial increase in uptake (say an increase of a minimum of 3 percentage points)?; 2) to what extent will marketing via Iddirs lead to a substantial increase in uptake (also around 3 percentage points)?; 3) are there additional benefits in terms of uptake if the IOU and marketing via Iddirs are combined?

As the IOU may lead to defaults, we also consider the role of legal contracts (first round of interventions) and joint liability contracts (second round of intervention) in terms of reducing

defaults. This leads to some additional evaluation questions: 4) Will the IOU lead to substantial defaults (say above 15%?); 5) to what extent will a binding contract be able to avoid defaults?; 6) to what extent will a joint liability contract be able to avoid defaults?

Finally, as both the binding and joint liability contracts may have consequences for uptake, we evaluate to what extent the uptake of IOUs with either a binding or a joint liability contract is still significantly higher than the standard index insurance product.

The primary outcomes of interest of the study, however, are uptake rates, and default rates.

6. Evaluation design, data and methods

6.1 Data collection and sampling strategy

We organised three surveys: (1) a baseline survey; (2) a midline survey and (3) an endline survey.

The main purpose of the baseline survey is to enable verifying whether the randomization exercise achieved "balance." We will also include baseline variables as controls in the regression models to increase precision. The aim of the midline survey is to test the possibility that the marketing intervention (the Iddir intervention) increased by means of increasing financial literacy. Thus the midline survey, which was conducted on the baseline farmers, focused on financial literacy questions. It contains 7 cognitive ability questions; 4 financial literacy questions and 5 IBI comprehension questions. Using these questions, we constructed 3 indices by summing the correct answers (scored with a 1) per category (hence a cognitive ability index; a financial literacy index and a IBI understanding index). The main aim of the endline survey is to obtain some additional information about uptake (especially regarding the importance of price setting).

The three questionnaires (see the appendix) are short, and took 15-30 minutes per interview. We conducted the surveys at the Farmers' Training Centre (at the cooperative), at the same moment as the "insurance" selling took place. Using this surveying strategy we could keep costs relatively small.

The surveys were undertaken by experienced enumerators, who were selected on the basis of a set of criteria, including the requirement of having finished a bachelor degree, at least three years of experience of working with households, and collecting socio-economic data (see Table A.5 in the appendix). In total we recruited 13 enumerators (4 enumerators in each of the two districts: Arsi Negele and Bora) and 4 enumerators in Adami Tullu. We have also recruited 3 data collection supervisors, one per each district.

The sample sizes are given in Section 3. We have used a cluster randomization procedure, where the randomization was done at the level of Iddirs. For ethical reasons and in order to avoid spillovers, we randomised at the Iddir level. Due to the cluster randomization, a

large sample size is needed to be able to pick up relatively small effects sizes. Our sample sizes are based on ex ante power calculations.

Note that our main focus for this pilot is on uptake and default rates and whether different types of farmers (as obtained from base-line information) respond differently to the various treatments. The uptake and default rates are authentically obtained from OIC and, so, there was no need to carry out surveys to obtain these data.

In addition to the quantitative analyses, we conducted Focus group discussions (FGDs) and some in depth stakeholder interviews to better understand the reasons for uptake, and to triangulate our quantitative results. More specifically, we organised "group discussions" with a total of 1,963 households at 12 Farmers' Training Centres (FTCs) in Ethiopia. The number of households involved per discussion was around 15. All our enumerators, including the coordinator Belissa (see Table A5 in the Appendix) were involved in the FGDs. On average, each enumerator conducted 7 FGDs, each lasting somewhat less than 1 hour. We also organised group discussions with Iddir leaders at two centres in Arsi Negele and Meki Batu towns. Finally, we conducted in-depth interviews with the chief executive officer (CEO) and the manager of the microinsurance Department of the Oromia Insurance Company (OIC).

6.2 Data analysis

The main part of the data analysis consists of balancing tests, as well as simple uptake and default regressions, for the two intervention rounds. The balancing tests refer to simple OLS regressions of household characteristics on the intervention groups (see below). The uptake and default regressions refer to OLS regressions of an uptake dummy and an indicator for default on the intervention groups, as well as some relevant controls. All standard errors are clustered at the Iddir level. All data analyses have been done by team members (all original estimates have been conducted by Robert Lensink, and checked by others in the team)

6.3 Quality control and ethical issues

The empirical work in Ethiopia (i.e. the surveying part, and the trainings) has been supervised and overseen by Temesgen Belissa who was in the field during all critical stages of the pilot. He also supervised the data processing (entry and coding).

For each survey round, all members of the research team, including Prof Robert Lensink, Prof. Shubhashis Gangopadhyay, Dr. Francesco Ccechi and Mr. Temesgen Belissa contributed to the questionnaire. All enumerators and supervisors were called for a one-day training to understand the questionnaires. All enumerators went to their respective kebeles for data collection. The data collected by 4 enumerators in 4 kebeles of the Arsi Negele district were submitted to the district supervisor. The supervisor checked whether the questionnaires were filled appropriately. All questionnaires approved by the supervisor were handed over to the field work coordinator. The questionnaires that were not approved were returned to the enumerators to redo them. The coordinator also checked the questionnaires handed over by the supervisors. In case they were completed appropriately, the questionnaires were sent to the statisticians to digitalize.

The data entry has been done by two academic staff of Haramaya University. They had completed an MSc in Statistics and Econometrics. The coordinator of the fieldwork received the soft copies of the completed questionnaires, and verified whether all the questionnaires were completed appropriately.

Haramaya University has an ethical review board. Before we undertook the field activities, we presented the aim of our research and the instrument of data collection to the board for approval. After the board approved, we started data collections.

7. Time line

Table 1 presents the time line of the pilot. The pilot started in April/May 2016 with a small baseline survey on approximately 8500 smallholders. The first round of interventions started in June 2016. A midline survey was conducted in November 2016, just before the second round of interventions that took place in December 2016. In May 2017 an endline survey was organized. A final (limited) round of interventions took place in June 2017. Shortly before each intervention, trainings were organised. During June/July 2017 focus group discussions and in depth stakeholder interviews were organised. The endline workshop, which was originally planned in June 2017, was postponed until 4 September, 2017 to better integrate the final results into the discussions. The pilot ends on October 1, 2017.

Table 1: Time line of the pilot

Activity	Period
Baseline survey (Including training)	May-June 2016
First round of interventions	June-July 2016
Midline survey	November-December 2016
Second round of interventions (with new trainings preceding)	December 2017
End line survey	May-June 2017
(Limited) third round of interventions	June-July 2017
Focus group discussions and in depth interviews	June-July 2017
Report writing	August-September 2017
Endline workshop	September 4, 2017
End pilot	October 1, 2017

8. Findings from the evaluation

In this section we present the main results of the pilot, but before doing so we will test whether the randomisation has “worked” by presenting balancing tests.

8.1 Balance tests

In light of potential non-random non-compliance, it is important to verify whether randomization resulted in similar groups in terms of observables. We conduct balancing tests by estimating OLS models, regressing household observables on treatment group dummies and a constant. We conducted separate balancing tests for the first round of interventions (see Tables 2a and 2b below), and the second round of interventions (see tables A1a and A1b, in the appendix).

Table 2a: Balance tests on socio-economic variables

VARIABLES	Age (years)	Sex (1=male)	Mstatus	Education (years)	Famsize size	Income	Drought dummy	Bought IBI Before
IBIM	-0.84	0.11	-0.01	0.05	0.14	-198.24	0.01	-0.05
	(1.138)	(0.089)	(0.029)	(0.426)	(0.325)	(186.348)	(0.049)	(0.045)
IOUMC	-1.10	0.16	-0.02	0.05	0.43	62.84	-0.06	-0.03
	(1.361)	(0.096)	(0.031)	(0.473)	(0.429)	(248.140)	(0.059)	(0.051)
IOUM	-0.48	0.12	-0.02	0.34	0.32	303.50	-0.05	0.08
	(1.356)	(0.109)	(0.036)	(0.559)	(0.362)	(558.396)	(0.057)	(0.064)
IOUC	-1.80*	0.02	0.00	0.11	-0.38	-160.66	0.05	-0.08**
	(0.781)	(0.063)	(0.022)	(0.355)	(0.244)	(245.663)	(0.028)	(0.030)
IOU	-2.34**	0.01	-0.03	0.40	-0.19	-58.50	0.07*	-0.09*
	(0.854)	(0.072)	(0.032)	(0.396)	(0.286)	(400.776)	(0.033)	(0.036)
Constant	39.40**	0.47**	0.90**	1.91**	5.67**	854.30**	0.87**	0.12**
(mean of IBI)	(0.901)	(0.073)	(0.025)	(0.347)	(0.299)	(161.121)	(0.041)	(0.041)
Test IBIM=IOUMC	0.84	0.58	0.85	0.99	0.38	0.22	0.15	0.58
Test IBIM=IOUM	0.76	0.94	0.76	0.55	0.46	0.36	0.18	0.01
Test IBIM=IOUC	0.41	0.23	0.65	0.89	0.03	0.86	0.41	0.24
Test IBIM=IOU	0.11	0.23	0.59	0.44	0.17	0.71	0.07	0.08
Test IOUMC=IOUM	0.66	0.71	0.88	0.59	0.76	0.67	0.87	0.05
Test IOUMC=IOUC	0.61	0.11	0.56	0.91	0.03	0.41	0.04	0.16
Test IOUMC=IOUC	0.30	0.11	0.71	0.49	0.10	0.78	0.005	0.08
Test IOUM=IOUC	0.33	0.32	0.50	0.67	0.01	0.42	0.05	0.002
Test IOUM=IOU	0.11	0.29	0.84	0.92	0.08	0.58	0.005	0.001
Test IOUC=IOU	0.44	0.82	0.28	0.35	0.26	0.61	0.12	0.58
Observations	8,579	8,579	8,579	8,579	8,579	8,579	8,579	8,579

Notes: Robust standard errors in parentheses, clustered for 144 Iddirs; *** p<0.01, ** p<0.05, * p<0.1. Test gives p-values of Wald tests. The constant reflects the average in the control group: IBI.

Table 2b: Balance tests for production variables and savings

VARIABLES	Maize	Haricot	Teff	Sorghum	Wheat	Barley	Land	Savings
IBIM	2.30	0.19	-0.10	0.07	2.73	-0.13	-0.40	0.06

	(1.201)	(0.158)	(0.380)	(0.144)	(4.212)	(0.132)	(0.867)	(0.068)
IOUMC	2.23	0.17	-0.34	0.01	-1.03	-0.14	0.82	0.01
	(1.513)	(0.148)	(0.375)	(0.103)	(1.767)	(0.134)	(1.178)	(0.068)
IOUM	0.54	-0.01	-0.05	-0.01	0.74	-0.20	-1.24	0.02
	(1.167)	(0.073)	(0.452)	(0.100)	(2.112)	(0.126)	(0.850)	(0.061)
IOUC	0.40	0.03	0.10	-0.08	-0.85	-0.06	-0.05	-0.03
	(0.730)	(0.069)	(0.295)	(0.059)	(0.991)	(0.128)	(0.415)	(0.035)
IOU	0.37	-0.04	-0.05	-0.10	-1.18	-0.14	0.31	0.00
	(0.751)	(0.067)	(0.406)	(0.074)	(1.277)	(0.152)	(0.617)	(0.042)
Constant	6.54**	0.21**	1.35**	0.19*	5.09**	0.29*	8.06**	0.21**
(mean of IBI)	(0.876)	(0.061)	(0.266)	(0.081)	(1.268)	(0.121)	(0.739)	(0.044)
Test IBIM=IOUMC	0.96	0.89	0.52	0.69	0.37	0.82	0.24	0.47
Test IBIM=IOUM	0.12	0.18	0.92	0.59	0.65	0.27	0.18	0.49
Test IBIM=IOUC	0.12	0.30	0.66	0.27	0.39	0.58	0.70	0.16
Test IBIM=IOU	0.14	0.13	0.93	0.19	0.34	0.86	0.49	0.38
Test IOUMC=IOUM	0.25	0.22	0.52	0.84	0.40	0.47	0.04	0.92
Test IOUMC=IOUC	0.24	0.35	0.31	0.27	0.51	0.48	0.48	0.52
Test IOUMC=IOU	0.24	0.15	0.54	0.14	0.90	1.00	0.70	0.88
Test IOUM=IOUC	0.90	0.60	0.77	0.35	0.41	0.20	0.19	0.41
Test IOUM=IOU	0.88	0.61	1.00	0.19	0.31	0.57	0.14	0.78
Test IOUC=IOU	0.94	0.18	0.60	0.53	0.50	0.53	0.34	0.35
Observations	8,579	8,579	8,579	8,579	8,579	8,579	8,579	8,579

Notes: Robust standard errors in parentheses, clustered for 144 Iddirs; *** p<0.01, ** p<0.05, * p<0.1. Test gives p-values of Wald tests. The constant reflects the average in the control group: IBI.

The variable definitions are:
Age = age in years
Barley = quantity of barley produced in last cropping season
BoughtIBIbefore = 1,0 dummy with 1 if household has bought IBI before in 2015, 2014 or 2013
Land = total size of cultivated land
Droughtdummy = 1, 0 dummy for any drought in 2015, 2014 or 2013
Education = education level (between 0 and 13) measured in years of schooling.
Famsize = Family size
Income = total income last month
Maize = quantity of maize produced in last cropping season
Mstatus = marital status (married=1; single=2)
Haricot = quantity of haricot produced in last cropping season
Savings = binary dummy: do you have savings? (1 =yes; 2=no)
Sex = sex of respondent (1 male; 0 female)
Sorghum = quantity of sorghum produced in last cropping season
Teff = quantity of teff produced in last cropping season
Wheat = quantity of wheat produced in last cropping season

Tables 2a and 2b suggest that the randomization has worked reasonably well, especially regarding crop production (Table 2)—farmers of the different treatment groups produce on average the same products. Compared to the control group (IBI), the average age in treatment groups IOU and IOUC is a bit lower; households in the IOU group experienced a bit more drought; and households in IOU and IOUC bought on average a bit less IBIs before. There are also some imbalances regarding family size (compare IBIM and IOUC as well as IOUM and IOUC), and some imbalances regarding drought experiences and IBI buying before. Yet these small imbalances are not a reason of concern, and do not disqualify the randomization. The tables in the appendix show that the randomization for the second round of interventions also worked well.

8.2 Uptake regressions

We present simple post-treatment ordinary least squares regressions to determine the impact of the different treatments on uptake. Table 3 present the results. We differentiate between the impact of the first round of interventions (columns 2, 3 and 4) and the second round of interventions (column 5). For the first round, we present estimates with and without baseline controls[6]

Table 3: Impact interventions on uptake

(1) VARIABLES	(2) Uptake first round	(3) Uptake first round with controls	(4) Uptake first round with controls	(5) Uptake second round
IBIM	0.07	0.07	0.05	
	(0.058)	(0.058)	(0.053)	
IOUMC	0.25	0.25	0.22	
	(0.088)***	(0.084)***	(0.069)***	
IOUM	0.35	0.35	0.33	
	(0.092)***	(0.091)***	(0.086)***	
IOUMNC				0.33
				(0.060)***
IOUMJLC				0.25
				(0.054)***
IOUC	0.03	0.03	0.03	
	(0.041)	(0.042)	(0.041)	
IOU	0.17	0.16	0.15	
	(0.067)**	(0.066)**	(0.062)**	
IOUNC				0.06
				(0.054)

[6] For the second round we also conducted regressions with baseline controls. However, as they did not change the results, we don't present them ehre for reasons of space.

Constant (=IBI)	0.08	0.16	0.47	0.11
	(0.029)***	(0.068)**	(0.116)***	(0.035)***
Age		-0.00	-0.00	
		(0.001)**	(0.001)***	
Sex		-0.05	-0.04	
		(0.041)	(0.037)	
Mstatus		0.02	0.02	
		(0.018)	(0.017)	
Education		0.01	0.01	
		(0.005)**	(0.004)**	
Famsize			0.02	
			(0.005)***	
Income			0.00	
			(0.000)**	
Droughtdummy			-0.09	
			(0.044)**	
BroughtIBIbefore			-0.18	
			(0.055)***	
Maize			0.00	
			(0.001)	
Haricot			-0.00	
			(0.002)	
Teff			-0.01	
			(0.002)***	
Sorghum			-0.00	
			(0.002)*	
Wheat			-0.00	
			(0.000)	
Barely			-0.00	
			(0.003)	
Land			-0.01	
			(0.002)***	
Savings			-0.14	
			(0.046)***	
Observations		8,579	8,579	
Adjusted R-squared		0.104	0.178	

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Column 2 shows that uptake for the control group –(IBI)- as reflected by the constant, equalled 8% during the first intervention round, which is very much in line with standard uptake that OIC experienced with its index insurance product. In terms of our main interventions – marketing via Iddirs (*IBIM*) and dealing with liquidity constraints via IOUs (*IOU*), column 2 shows that both interventions enhance uptake. However, only the IOU intervention significantly enhance uptake

(*IOU* is significant, while *IBIM* is not). The combination of the two interventions even increases uptake more (to 35%) and is highly significant (consider *IOUM*). However, the impact of the IOU intervention on uptake (consider *IOUC*) becomes insignificant if a binding contract has to be signed. However, if the IOU is combined with the marketing intervention, even the binding contract remains significant (consider *IOUMC*). Columns (3) and (4) show that the significance of these results is not affected if baseline controls are added. It is interesting to see that the presence of a binding constraint limits uptake differently for the standard intervention as compared to the marketing intervention. Only in case of the standard intervention, the impact of the contract on uptake is significant (compare IOU with IOUC, and IOUM with IOUMC, see table A3 in the appendix). This suggests interaction between the contract and marketing modality.

The first intervention round has a very clear result: for a significant increase in uptake the IOU intervention probably needs to be combined with the marketing intervention. The table suggests that a significant increase in uptake will not be achieved by the marketing intervention alone. The same holds if one tries to enhance uptake by a liquidity intervention by means of offering *IOUs* and ask farmers to write a binding contract to avoid default problems. Only in case the *IOU* with a binding contract is combined with *Iddir* promotion, the uptake will be enhanced significantly

As the binding contract we used in the first round of interventions is stricter than a standard legal contract in Ethiopia, we decided to conduct a second round of interventions using a newly designed legal contract. We also used a joint liability contract to further probe the relevance of using the "group" structure of Iddirs. Column 5 of Table 3 surveys the uptake results of the second intervention. The IOU with the new contract (*IOUNC*: column 5)) enhances uptake as compared to the IOU with the strict contract (*IOUC*: column 2). Yet, again it appears that the IOU intervention with a contract does not significantly increase uptake vis-à-vis the control group (IOUC: column 5). Thus, in order to enhance uptake significantly, the IOU needs to be combines with a marketing intervention via Iddirs (consider *IOUMNC* in column 5). A possible appropriate alternative to the new contract is a joint liability contract (consider IOUMJLC), this contract also significantly improves uptake, as compared to the control group, but is statistically not distinguishable from the *IOUMNC* (see Table A2 in the Appendix).

8.3 Defaults

Table 4 shows average default rates for round 1 and round 2. Default rates are determined by calculating defaulting farmers as a percentage of farmers that bought the index insurance product for each treatment arm. Thus, the default rates reflect the number of people that defaulted for a particular group divided by the number of people buying insurance for that group. Hence for IOUs marketed via Iddirs with a binding contract (IOUMC, the default rate is 5%; and for group IOUs marketed via Iddirs without a binding contract (IOUM) the default rate equals 9%. The standard errors control for clustering effects at the Iddir level.

The table shows that for some treatments defaults are sizable. This especially holds for the IOUs that are not marketed via Iddirs. However, note that none of the default rates are statistically significantly different from zero (and a fortiori not significantly different from each

other). The non-significance of the default rates is a direct consequence of the clustering (at Iddir) level of the standard errors: given the high correlation of defaults within iddirs confronted with the same intervention, and the much smaller sample (only including uptakes), we are underpowered to detect small default rates. Thus it seems much more relevant to consider average default rates as such (the "economic" significance). They suggest that, if defaults are to be kept low, a marketing treatment in combination with a binding contract, or probably even better, a joint liability contract, would be preferable. It is also noteworthy that the marketing treatment as such –even without a binding contract reduces average default rates. It even implies that the marketing treatment without a binding contract leads to lower average default rates than a binding contract without the marketing treatment (compare IOUM with IOUC). This once again underpins the importance of combining the IOU with a marketing treatment (marketing via Iddirs).

Table 4. Average default rates

VARIABLES	(1)	(2)
IOUMC	0.05	
	(0.040)	
IOUMNC		0.09
		(0.07)
IOUMJLC		0.01
		(0.01)
IOUM	0.09	
	(0.088)	
IOUC	0.14	
	(0.134)	
IOUNC		0.13
		(0.11)
IOU	0.17	
	(0.151)	
Observations	1,514	1968

Cluster robust standard errors in parenthesis.

8.4 Adjusted uptakes

The successfulness of our interventions depends on a combination of enhanced uptake (positive) and defaults (negative). Therefore it is relevant to consider to what extent the different treatment groups affect adjusted uptake, measured by Adjusted Uptake = Uptake*(1-Default). [7] In the Tables below, we present impacts using this new outcome indicator. As can be seen, the results are still very much in line with the results for the unadjusted uptake variable: the combination of the marketing intervention with an IOU works best.

[7] We thank a referee from 3ie for this suggestion.

Table 5: Adjusted uptake first round

VARIABLES	(1)	(2)
IBIM	0.07	
	(0.058)	
IOUMC	0.23	
	(0.089)**	
IOUM	0.31	
	(0.095)***	
IOUMNC		0.29
		(0.064)***
IOUMJLC		0.25
		(0.054)***
IOUC	0.02	
	(0.038)	
IOU	0.13	
	(0.060)**	
IOUNC		0.04
		(0.051)
Constant (IBI)	0.08	0.11
	(0.029)***	(0.035)***
Observations	8,579	8,579
Adjusted R-squared	0.072	0.056

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

8.5 Iddirs and uptake: a possible role for information?

We hypothesize and find that marketing via Iddirs tends to promote uptake via enhancing trust. However, as we have argued before, the literature identifies other reasons why using groups to sell index insurance may boost the adoption rate. A potentially important alternative channel is superior information sharing. Group members may be more motivated to learn from co-Iddir members, or such members may be better able to convey the complex messages regarding index insurance to their peers. In that case, higher uptake in our Iddir-based treatment arms is due to better understanding of the insurance product; higher financial literacy, or higher cognitive ability. To test this hypothesis, we organized a midline survey containing 7 cognitive ability questions, 4 financial literacy questions and 5 questions about index insurance (see appendix). We constructed 3 indices by summing the correct answers (scored with a 1) per category, and obtain a cognitive ability index; a financial literacy index and an index-insurance understanding index. Next we regressed these indices on treatment dummies. Regression

results are summarized in Table 6, and show that none of the groups score differently on any of the 3 indices. In the appendix we show that this also holds for the treatment groups distinguished in round 2. These results suggest that differences in information acquisition do not explain increased uptake in the arms where insurance is marketed via Iddirs.

Table 6. Financial literacy

	(1)	(2)	(3)
VARIABLES	Cognitive Ability	Financial Literacy	IBI Understanding
IBIM	0.03	-0.11	-0.12
	(0.239)	(0.183)	(0.167)
IOUMC	0.01	-0.02	-0.31
	(0.262)	(0.189)	(0.206)
IOUM	0.35	0.04	0.12
	(0.225)	(0.197)	(0.202)
IOUC	0.27	0.04	-0.15
	(0.166)	(0.125)	(0.114)
IOU	0.20	0.07	-0.05
	(0.170)	(0.141)	(0.144)
Constant	4.29	1.97	3.70
(mean of IBI)	(0.173)***	(0.144)***	(0.128)***
Observations	8,579	8,579	8,579
Adjusted R-squared	0.006	0.003	0.011

Robust standard errors in parentheses adjusted for 144 clusters.
*** p<0.01, ** p<0.05, * p<0.1.

8.6 Correlations between first and second round

The impact of the round 2 interventions on uptake may be affected by uptake in round 1. Table 7 below shows that is indeed the case: the first column presents a regression of uptake in round 2 (*uptake2*) on uptake in round 1 (*uptake1*), which is highly significant. Does this imply that our main results regarding impact of round 2 interventions do not hold anymore? In order to test this, we present two alternative regressions. In column two we present a regression of uptake in round 2 on the different treatment groups (as before), but we control for interactions of the interventions in round one, with uptake in round one. That is, the interaction dummies have a one for the six groups of intervention, if uptake takes place. The results suggest that controlling for the uptake in round 1, the impact of the interventions in round 2 are in line with the results presented above. That is, especially the combination of the marketing treatment and the IOU enhances uptake. We also present a regression explaining uptake in round 2 by the different treatment groups, but only take the sample of households that did not purchase insurance in the first round (column 3). Also these regressions suggest that the main results still hold.

Table 7: Correlations between uptake in two rounds

VARIABLES	(1)	(2)	(3)
IOUMNC		0.40	0.42
		(0.057)***	(0.065)***
IOUMJLC		0.34	0.32
		(0.042)***	(0.044)***
IBI		0.11	0.11
		(0.037)***	(0.037)***
IOUNC		0.15	0.15
		(0.042)***	(0.042)***
Uptake1*IBIM		0.02	
		(0.106)	
Uptake1*IOUMC		0.19	
		(0.083)**	
Uptake1*IOUM		0.08	
		(0.083)	
Uptake1*IBI		-0.08	
		(0.033)**	
Uptake1*IOUC		0.09	
		(0.128)	
Uptake1*IOU		0.10	
		(0.141)	
Uptake1	0.12		
	(0.057)**		
Constant	0.30		
	(0.033)***		
Observations	8,579	8,579	6,545
Adjusted R-squared	0.012	0.380	0.347

Cluster Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.
Last regression is on a restricted sample: only for those who did NOT buy in first round. Dependent variable: uptake in round 2.

8.7 The willingness to pay for IOUs

During the endline survey we asked questions about the willingness to pay for IOUs. More specifically, we asked farmers to choose between IBIs with a premium of 100 and IOUs with a premium of 100, 106, 113 and 120, respectively (see endline survey in the appendix). These

questions are added as they can provide additional information about farmers' willingness to buy IOUs, and the price they are willing to pay for an IOU. This information helps us to decide on the appropriate premium that can be set by OIC if the IOU is to be scaled up. Based on the answers of farmers on the willingness to pay questions, we constructed the variable *IOUPREF. IOUPREF* measures farmers' preference of IOUs over IBIs. Specifically, it is an index varying between 0-4. A '4' indicates that the farmer prefers IOUs with a premium of 120 over standard IBIs (with a premium of 100); a '3' indicates that the farmer prefers IOUs with a premium of 113 over standard IBIs (but prefers IBIs over IOUs with a premium of 120); a '2' indicates that the farmer prefers IOUs with a premium of 106 over standard IBIs (but prefers IBIs over IOUs with a premium of 113 or more); a '1' indicates that the farmer prefers IOUs with a premium of 100 over standard IBIs (but prefers IBIs over IOUs with a premium of 106 or more); and finally, a 0 indicates that the farmer prefers standard IBIs over IOUs with the same premium (100).[8] Note that we didn't differentiate between IOUs offered by means of the marketing treatment or via the normal treatment. Thus the variable reflects preference of IOUs marketed in the standard way over IBIs. The table below summarizes the "preference" of farmers for IOUs.

Table 8: Preference of IOUs over IBIs

IOUPREF	Percentage of respondents
0	19
1	16
2	7
3	6
4	51
Total number of respondents: 8452	

The most interesting outcome of this analysis is that apparently more than 50% of the sample of respondents prefer an IOU over the standard IBI, even if they have to pay a premium of 120 for the IOU. This provides strong additional evidence for farmers' willingness to pay a somewhat higher premium for IOUs than for IBIs. However, this result should be taken with some caution as it is based on self-reporting based on hypothetical willingness-to-pay questions. Moreover, the questions did not differentiate between IOUs with/ without binding contracts. It is also noteworthy that around 20% of the respondents seem to prefer a standard IBI over an IOU with the same price. Probably this is a result of a lack of respondents' trust in a new product and/or a lack of financial knowledge about the new product.

It seems relevant to analyse the preference data further. Table 9 presents simple OLS estimates regressing *IOUPREF* on a range of potential explanatory variables (column 2) and linear probability regressions regressing preference for IBI, *IBIPREF* (a dummy with a one if IBI is preferred over IOU with premium 100) on the same set of indicators (Column 1).

[8] The calculations assume that farmers only switch once. That is, if a farmer has indicated that he/she prefers IBI over IOU with a premium of 106, we assume that this farmer also prefers a standard IBI over an IOU with a premium of 113 and an IOU with a premium of 120.

Table 9: Willingness to pay for IOU

VARIABLES	(1) IBIPREF	(2) IOUPREF
Age	0.00	-0.01
	(0.001)	(0.003)***
Mstatus	-0.02	0.16
	(0.011)*	(0.053)***
Famsize	-0.01	0.05
	(0.003)***	(0.014)***
Income	0.0000007	-0.00004
	(0.000)**	(0.000)***
Liquidityconstr	-0.06	-0.65
	(0.036)*	(0.188)***
Cognitive ability	-0.01	0.09
	(0.005)**	(0.027)***
Financial literacy	-0.01	0.13
	(0.008)*	(0.046)***
Understanding	-0.01	0.07
	(0.007)*	(0.030)**
IOUMNC	0.05	-0.02
	(0.036)	(0.210)
IOUMJLC	0.08	-0.05
	(0.043)*	(0.222)
IOUNC	0.02	0.00
	(0.019)	(0.133)
Constant	0.32	1.74
	(0.055)***	(0.260)***
Observations	7,469	7,469
Adjusted R-squared	0.026	0.064

Cluster robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Liquidityconstr refers to a one-zero dummy, with a one if a farmer applied for a loan, but did not receive it and a zero if he/she applied and got it.

The main results of the regression analysis are: (1) the preference for IBIs is positively correlated with income. The probability of preferring IOUs over IBIs is higher for poorer farmers (column 1). Moreover, poorer farmers are more willing to pay a high premium for IOUs (column 2); (2) Farmers with a liquidity constraint prefer IOU with same premium over an IBI (column 1). However, liquidity constrained farmers are not willing (and may be not able) to pay high

premiums for IOUs (see column 2); (3) Farmers with better understanding of the index insurance product more likely prefer IOUs (column 1) and are more willing to pay a higher premium for the IOU. This reflects the importance of carefully explaining the product and finally, the different treatment arms do not affect the willingness to pay for IOUs (column 2). Yet, it seems as if farmers that were treated with IOUs with a joint liability contract are more likely to prefer IBIs. This may reflect that the joint liability contract squares off farmers a bit (a result which is to some extent also reflected by the uptake figures).

The willingness to pay results certainly are interesting, and seem to provide additional evidence for the relevance of using IOUs as the majority of the participants prefer IOUs over IBIs. The regression analysis also provides some guidelines for the price setting. May be the most important results are that better understanding of the product enhances the willingness to pay higher premiums, and that the preference for IOUs is bigger for farmers with lower incomes. While these results are relevant, one should note that they are based on hypothetical questions and hence should be taken with caution.

8.8 Relevance of the intervention and relationship to TOC

We consider our intervention highly successful. The uptake of the index insurance product increased significantly, from approximately 8% to around 35%, if a combination of the marketing treatment and the IOU is used. It also appears that it is possible to enhance uptake rates by delaying premium payments, without causing high default rates.

The success of our intervention is confirmed by farmers and Iddir leaders during the FGDs. During the FGDs with farmers, we asked farmers about whether they trust the insurance product (and company) more if Iddir leaders, rather than cooperative agents inform them. Households in our FGDs mentioned that they feel that ideas that are advertised through Iddirs are beneficial to them. They argued that promotion of the insurance product through Iddirs build confidence in the product, and induces them to buy the insurance product. We also asked participants to list benefits of the IOU insurance. They indicated that most farmers have received payouts as indemnification for their losses. They also argued that better understanding and trust in the insurance product has induced them to invest more labor and financial capital on their farm. As oriented by their Iddir leaders, once they buy insurance their farms are insured in case they face drought. So, those who bought insurance mentioned that they have increased their use of improved seeds and fertilizer as well as their family labor to be spent on farm. As a result, these farmers explained that they have obtained higher crop productivity and yields. In a possible future rigorous quantitative impact analysis (phase 2), we aim to explicitly test risk management response to index insurance.

The FGDs with Iddir leaders also confirm the relevance of the intervention. Iddir leaders explained that three factors can explain why farmers are interested in insurance: (i) Since households are experiencing continuous weather variations, including declining intensity of rainfall and loss of production due to drought, members were interested to buy insurance (ii) Iddir leaders indicated that the IOU insurance offer doesn't require upfront premium payment, particularly at the time when their members face acute shortage of cash. So, this has motivated them to buy, and (iii) Due to the awareness creation and training given to iddir members by iddir

leaders, members gained more understanding about the insurance system and developed trust in the product.

While our intervention did not explicitly focus on basis risk, it is relevant to make some remarks. As we explained before, The IOU insurance intervention was undertaken in 12 kebeles randomly taken from three districts, namely, Arsi Negele, Adami Tullu and Bora. The index insurance triggered a 50% payout in the dry area (Arsi Negele district), 20% in the medium moisture area (Adami Tullu district) and 0% in the area that obtained good rainfall (Bora district). Thus, across the kebeles, most of the kebeles with payouts are located in areas that experienced severe drought. This seems to imply that basis risk was not a major issue during our pilot. We are not able to precisely test this, but some confirmation is given by the farmers during the FGDs: most of them considered the realized payouts fair.

Our results seem very much in line with our theory of change, in terms of the ordering of the most successful interventions. However, the realized increase in uptake rates is much higher than we expected when we drafted the TOC. While we expected that the combined intervention would be able to increase uptake from 6% to 12 % we realized uptake rates above 30%. Thus the impact on uptake of using IOUs, especially if combined with a marketing treatment by using Iddirs, appeared to be much bigger than we hoped for before we started this study.

8.9 Implementation fidelity, and compliance

We succeeded in reaching out to the intended target population. Participation of the targeted population in the activities (training and surveys) was very high and attrition very low (below 5%) and, hence, not a reason for concern. There was no uptake of IOU, or marketing via Iddirs outside our targeted population. We also were able to deliver almost all activities as per our plan. The main change we made related to the second round of interventions. Originally, we planned to conduct 2 similar types of interventions. However, when we started analyzing the uptake and default rates of the first intervention round, and after having received comments from participants of workshops were we presented preliminary results, we decided to change the second intervention round by focusing more on the default issue, and e.g. changed the binding contract and introduced in addition to the binding contract a joint liability contract. We also decided to refocus the midline survey on literacy questions to be able to study the role of knowledge in terms of enhancing uptake.

9. Implications of the study findings

The main finding of our pilot is that while trust in the standard insurance product might matter for adoption, marketing via Iddirs in and of itself is not sufficient to have a significant impact. The same holds for an IOU with a legal contract aimed at ruling out defaults. However, the combination of marketing via Iddirs and IOUs has a big impact on adoption. Thus, our study strongly suggests that a combination of an IOU with a marketing treatment through a socially

trusted customary channel will be very successful in enhancing uptake of index insurance. In order to make this a cost-effective scalable intervention, it is important to ensure that default rates are low. Our pilot suggests that this can be achieved by binding contracts and especially by joint liability contracts. The choice for either a joint-liability or a normal binding contract depends on the main purpose: the joint liability contract seems to reduce defaults more substantially than normal binding contracts. However, a trade-off may be that the joint liability contract deters farmers a bit, leading to somewhat lower uptakes than an IOU with a normal binding contract.

The time line of our intervention is too short for conducting an impact evaluation. However, in our view a full impact evaluation testing impact of a combined IOU and marketing interventions seems to us very important. The pilot suggests that the combined intervention will lead to reasonably high uptake rates, which, in combination with an appropriate identification strategy, enables us to satisfactorily address impact of uptake on a variety of outcome variables.

We conducted an in-depth-interview with the chief executive officer (CEO) and the manager of the microinsurance Department of the Oromia Insurance Company (OIC), the implementing agency of the IOU insurance project, to better assess the relevance and possibility of a further impact study of the new product. The OIC officials explained that the main passion of their company is to focus on innovative microinsurance interventions, as they will probably serve a large mass of smallholders, and has great importance for the company and value of the shareholders. Particularly, the CEO explained their company aimed to go away from the traditional insurance like motors and fire insurance towards innovative microinsurance aimed at insuring the assets of the smallholders (crop and livestock insurance) as well as health micro-insurance. In connection to this, the OIC officials explained the functions of their Micro-insurance Department. This department solely undertakes the implementation of micro-insurances. Through this department, Oromia Insurance Company (OIC) is currently engaged in implementing various innovative agricultural insurance products through its Micro-insurance Department. OIC is a vibrant insurance company in Ethiopia with a successful record in implementing innovative agricultural insurances, notably, the Index-based livestock insurance (IBLI) in Borana zone of southern Ethiopia and index-based crop insurance in different parts of the country. The OIC officials stated that the company has full interest and ability to upscale and implement the current pilot intervention that we designed to a full-fledged impact evaluation. They argued that the company is financially, technically and operationally capable of participating in the implementation of an impact evaluation.

The OIC officials explained that OIC benefited a lot from the intervention. They (obviously) were very happy about the substantial increase in uptake due to the IOU insurance intervention, with Iddir marketing. The manager also indicated that there is a great improvement in the portfolio: the number of new clients has increased significantly overtime. The manager of OIC also pointed out that our research could influence the insurance policy of the National Bank of Ethiopia. He explained that there is a directive of no premium no payout for all firms in the Ethiopian insurance industry. But the microinsurance service is a special service for smallholders. The farmers we work with are liquidity constrained, and may not be able to buy insurance if they have to pay the premium upfront. This may seriously reduce investments in

seeds and fertilizer. But after harvest their liquidity constrains will be resolved. Thus, there should (and actually will) be an official policy window that allows the postponement of the premium payment of smallholders.

Most importantly, the OIC officials stressed that, based on the evidence from the current IOU insurance research intervention, they have strong interest in a new project with greater scope for the Phase 2 of 3ie funding. OIC aims to scale up the current pilot project to provide feasible solutions to reduce the adverse impacts of drought risk on smallholders, as well as to promote more productive farming systems and improved livelihoods in arid and semi-arid areas of Ethiopia. They are very much interest to learn whether their product will actually achieve the intended results. These positive remarks about OIC's interest in upscaling the product were reconfirmed during the final workshop we organized (see the final workshop report).

10 Major challenges and lessons learnt

The main implication of the study is that we need to do a combined intervention: reach out via Iddirs and allow farmers to pay the premium later. Reaching out via Iddirs will not only increase uptake, but also reduce default rates. It even seems that binding contracts reduce defaults less than simply reaching out via Iddirs. A major challenge is that, while the combined intervention enhanced uptake much more than expected, uptake rates with (joint liability) contracts are still below 35%. Thus non-compliance is substantial, which implies that a huge sample is needed to measure impacts of uptake. This is especially the case if in control regions farmers are allowed to buy the standard index insurance. For power and impact it would be best to have control regions where uptake of any index insurance product is impossible. Finally, calculations of intra-class correlations using the phase 1 dataset suggest high intra-class correlations with Iddir randomization. This implies that many Iddirs should be taken in the sample to detect small effect sizes. Thus, one of the main lessons learned is that in order to be able to measure impacts, a big sample is required.

Regarding cooperation with the implementing organization OIC, we faced almost no problems. OIC was very willing to help and to implement the treatments. One problem OIC faced was that the company currently charges a premium-payout ratio of only 15 percent (it was 20% before). The premium covers costs, on average. Yet, a huge scale up of the product will entail additional (start up) costs which need to be covered somehow. Moreover, the IOU, even with a joint liability contract, may suffer from defaults. Thus a small increase in the premium seems reasonable. However, charging the smallholders a higher premium may discourage uptake (although our willingness to pay questions suggest that a majority of the farmers is willing to pay a higher premium on IOUs), This implies that before upscaling a thorough discussion regarding price setting need to be done.

During the data collection we faced some problems as there was some unrest in Oromia. Our intervention area was quite unstable during the intervention due to some political unrest. In some of our intervention places, like Arsi Negele, Zeway, and Meki it is not recommended for a foreigner to stay or travel across rural villages. Due to the political situation

we had to change our plan of conducting surveys with tablets as this would have required some outsiders to travel to our intervention areas to train local enumerators to use the tablets. We therefore decided to conduct all surveys on paper. It is hoped that the political situation in rural Ethiopia will be much more stable in the near future. Anyway, for the possible impact study we need to carefully take into account the political situation in the intervention region.

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APPENDICES

A Contracts

A.1 Binding contract of the first round

CONTRACT AGREEMENT BETWEEN HOUSEHOLDS AND OROMIA INSURANCE

I (Mr/Ms)_____in District_____
kebele_____ have signed a binding contract with Oromia Insurance Share Company in such a way that the Company provides me an index-based crop insurance policy of 100 ETB premium which entitles me with 500 ETB payout in case I incur crop losses due to drought during the 2015/16 production year. In return, I will pay the premium of ETB 106 until October 30, 2016 upon harvesting my yield. If I fail to pay the indicated amount till the due date, I will be (1) legally liable for the amount of the promissory note (2) socially deprived of all my privileges from my IDDIR which includes exclusion from membership, loss of members' participation on funeral ceremonies in case of death of my family members and loss of my contributions to the common IDDIR savings.

Name of the household: _____

Signature of the household: _____

Date: _____

Name (Oromia insurance delegate):_____

Signature: _____

Date:_____

A.2 Legally binding contract for the second round

CONTRACT AGREEMENT BETWEEN HOUSEHOLDS AND OROMIA INSURANCE

I (Mr/Ms) _____in District_____ kebele_____ have signed a liability contract with Oromia Insurance Share Company. The contract ensures that the Company provides me index-based crop insurance with the following characteristics. The insurance will payout a maximum of 500 ETB in case I incur complete crop losses due to drought during the 2015/16 production year. The contract allows me to retard the payment of the premium of ETB 106. The due date of the payment of the premium is December 31, 2016. If I fail to pay the indicated amount till the due date, I will be legally liable for the amount of the promissory note according to the Ethiopian Civil Code 1731/2005.

Name of the household: _____

Signature of the household: _____

Date: _____

Name (Oromia insurance delegate):_____

Signature: _____

Date:_____

A.3 Joint liability contract

JOINT LIABILITY CONTRACT AGREEMENT BETWEEN HOUSEHOLDS AND OROMIA INSURANCE

I (Mr/Ms)_____in District_____ kebele_____ have signed a joint liability contract with Oromia Insurance Share Company in such a way that the Company provides me an index-based crop insurance policy of 100 ETB premium which entitles me with 500 ETB payout in case I incur crop losses due to drought during the 2015/16 production year. In return, I will pay the premium of ETB 106 until December 31, 2016 upon harvesting my yield. I understand that all of my iddir members have got this opportunity. Hence, I agree that if anybody from our iddirs fail to repay the indicated amount till the due date, nobody from our iddir will be allowed to get this opportunity during the next 2016/17 production year.

Name of the household:_____

Signature of the household:_____

Date:_____

B Surveys

B.1 Baseline

IOU Index-based Insurance
Household Survey Baseline Questionnaire

Dear Sir/Madam,

We are currently undertaking research on **IOU Index-based Insurance in Ethiopia**. We are collaborating with Oromia Insurance Company (OIC). We would like to ask you some questions related to the relevance and economic benefits of such insurances. We guarantee you that this information is confidential and only used for academic purpose. Please contact Mr. Temesgen Keno (email:temesgen.belissa@wur.nl or Mobile +**251 913938370**) for any other problem.

1. Name _____ District_____ *Kebele* _____ Age _____Sex _____ Marital status[9] _____Education[10]_____ Family size _____ Mobile/phone No._____
2. (a) Did you face a severe drought (1) in 2013?_____ (2) in 2014?_____ (3) in 2015?_____
3. Did your household buy index-based insurance (1) in 2013?_____ (2) in 2014?_____ (3) in 2015?_____ (4) Not purchased insurance so far_____
4. If you have bought index-based insurance before, (a) did you collect payouts? _____ 1) Yes 2) No (b) in which year (s)? _____
5. How much total income[11] in Birr (1) Did you get in the last month? _____ 2) what would you expect your income to be in the next month? _____ 3) what would you expect your income to be in the next month if it were a good month? _____ 4) what would you expect your income to be in the next month if it were a bad month? _____
6. Indicate the best and the worst years in terms of earning for your household (Tick in Table below)

Year	2011	2012	2013	2014	2015
I earned the BEST income in					
I earned the WORST income in					

7. What is your main business? (1) Farming (2) Petty trade (3) other non-farming activities (indicate)_____

[9] 1=married 2=single 3=divorced/separated 4=widowed
[10] Years of schooling
[11] Include income (1) income from farming (crop sells, livestock or livestock product sells) (2) off-farming income (labor work, sells of firewood, charcoal, building materials, etc) (3) non-farm income (salaried employment, business income, rental income, remittances, pension, etc)

8. Please provide me with information related to your crop production in last cropping season in table below

Type of crop/vegetables/fruits	Quantity produced (*quintal*)	High-risk high-return inputs used					
		Fertilizer		Modern seed		Pesticide/herbicide	
		Amount (Kg)	Value (Br)	Amount (Kg)	Value (Br)	Amount (Kg)	Value (Br)
Maize							
Teff							
Sorghum							
Wheat							
Barely							

9. What is your total (in qarxi) (a) cultivated land size? _____ (b) irrigated land size? _____

10. How much of your cultivated land is (a) owned _____ (b) leased in?_____

11. Saving, access to credit and credit rationing

(a) Do you have some saving? _____1) Yes 2) No

(b) Do you have any outstanding loan? _____ (1) Yes (2) No

(c) Did you apply for a bank loan over the last five years?_____ (1) Yes (2) No

(d) Has your application been accepted?_____ (1) Yes (2) No

(e) Over the last five years, did you always repay your loan on time? _____ (1) Yes (2) No

12. Please provide me with your estimated average weekly food[12] consumption costs_____

[12] Include your expenditure maize, teff, wheat, barley, sorghum, rice, pasta, macaroni, lentils, beans, peas, potato, tomato, cabbage, oil, sugar, salt, coffee, drinks, cigarette, khat

B.2 Midline

Midline Household Survey Questionnaire for Index-based Insurance

Dear Sir/Madam,

We would like to ask you some questions related to your understanding of IBI. The survey is meant only for academic purpose. Respond as "I don't know (IDK)" for issues which you do not know. Contact Mr. Temesgen Keno (Mobile +**251 913938370**) for any other problem.

Part A: Household basic information

Household ID: _____Name _____Mobile: _____*Iddir*_____

Part B: Cognitive ability

1. How much is (a) one-tenth of Birr 400? _____(b) Birr 400 plus 300?_____ (c) 3 times 6?_____
2. If you buy clothing for Birr 75 and pay Birr 100, how much change should you get? Birr_____
3. If the chance of getting a loan from a bank is 10%, how many people of 1000 would be expected to get the loan? _____
4. Transport fee from Zeway to Addis Ababa has doubled b/n 1998 and 2008. If the fee was Birr 34 in 1998, then, it is _____in 2008.
5. A salvage mobile is selling for Birr 300. This is 2/3 of what a new one costs. How much is the cost of a new mobile? Birr_____

Part C: General financial literacy

1. Suppose you had Birr 100,000 in a bank and the simple interest is 20% per year. How much will you have in your account after 5 years without withdrawing any amount?____ (a) more than Birr 200,000 (b) exactly Birr 200,000 (c) less than Birr 200,000 (d) I don't know
2. Suppose interest on your savings was 1% and inflation was 2% per year. After 1 year, how much would you be able to buy with the money? _____(a) more than what can today (b) exactly what you can today (c) less than what you can today (d) I do not know
3. If you borrow Birr 100 from a bank and agreed to pay 2% interest per month, how much will you pay back after 2 months? _____ Birr 100 (b) Birr 102 (c) Birr 104 (d) Birr 106
4. If you want to borrow Birr 500 today and repay after a month, which of the following loan arrangements do you prefer? _____ (a) Loan 1 which requires a repayment of Birr 600 (b) Loan 2 which requires a repayment Birr 500 plus 15% interest after a month (c) IDK
5. Your neighbour is offering you a goat at a price of Birr 500. You have Birr 500 in your savings account which offers an interest rate of 3% per year. You were planning to buy the goat in next year's livestock market at an expected price of Birr 500+5%. Which one is better for you?____(a) wait to buy the goat at next year's market (b) Buy the goat from your neighbour today (c) Cannot say

Part D: Understanding index-based insurance

As per the insurance agreement between Oromia insurance and your kebele members, if you have bought a 100 Birr premium insurance policy against drought you will be paid up to about Birr 666 for rainfall deficiency below 30mm, on average over 4 months.

1. If it rains 50 mm on average over the 4 months, would you get a payout? _____(a) Yes (b) No (c) IDK
2. If it does not rain at all over the 4 months, will you get an insurance payout? _____ (a) Yes (b) No (c) IDK
3. How much of a payout would you receive If it does not rain at all over 4 months? _____ (a) Birr 222 (b) Birr 333 (c) Birr 666 (d) IDK
4. If it rains 15 mm on average over the 4 months, will you get an insurance payout? _____(a) Yes (b) No (c) IDK
5. How much payout would you receive if it rains 15 mm on average over the 4 months? ____ (a) Birr 222 (b) Birr 333 (c) Birr 666 (d) IDK

Part E: Understanding the IOU insurance arrangement

1. Have you ever heard of the IOU insurance? _____ (a) Yes (Continue with the next **Q2**) (b) No (end the interview)
2. Did you buy the IOU insurance? _____(a) Yes (Continue with the next **Q3**) (b) No (end the interview)
3. If you have bought the IOU insurance, why you did so? _____ (a) the IDDIR leader told us to buy (b) cannot pay insurance premium but here I can pay later (c) insurance requires premium payment but here I do not have to pay at all (d) everyone else was buying
4. Do you know (1) the individual liability contract?_____(a) Yes (b) No (2) the joint liability contract?_____(a) Yes (b) No

Name and signature of the enumerator _____Date of the interview:_____

B.3 Endline

IOU Index-based Insurance
Household Survey Baseline Questionnaire

Dear Sir/Madam,

We are currently undertaking research on **IOU Index-based Insurance in Ethiopia**. We are collaborating with Oromia Insurance Company (OIC). We would like to ask you some questions related to the relevance and economic benefits of such insurances. We guarantee you that this information is confidential and only used for academic purpose. Please contact Mr. Temesgen Keno (email:temesgen.belissa@wur.nl or Mobile +**251 913938370**) for any other problem.

13. Name _____ District_____ *Kebele* _____ Age _____Sex _____ Marital status[13] _____Education[14]_____ Family size _____ Mobile/phone No._____

14. Did you face a severe drought (1) in 2016?_____ (2) in 2017?_____

15. Did your household buy index-based insurance (1) in 2016?_____ (2) in 2017?_____ (3) Not purchased insurance so far_____

16. If you have bought index-based insurance before, (a) did you collect payouts? _____ 1) Yes 2) No (b) in which year (s)? _____

17. How much total income[15] in Birr (1) Did you get in the last month? _____ 2) what would you expect your income to be in the next month? _____ 3) what would you expect your income to be in the next month if it were a good month? _____ 4) what would you expect your income to be in the next month if it were a bad month? _____

18. Indicate the best and the worst years in terms of earning for your household (Tick in Table below)

Year	2013	2014	2015	2016	2017
I earned the BEST income in					
I earned the WORST income in					

19. What is your main business? (1) Farming (2) Petty trade (3) other non-farming activities (indicate)_____

[13] 1=married 2=single 3=divorced/separated 4=widowed

[14] Years of schooling

[15] Include income (1) income from farming (crop sells, livestock or livestock product sells) (2) off-farming income (labor work, sells of firewood, charcoal, building materials, etc) (3) non-farm income (salaried employment, business income, rental income, remittances, pension, etc)

20. Please provide me with information related to your crop production in last cropping season in table below

Type of crop/vegetables/fruits	Quantity produced (*quintal*)	High-risk high-return inputs used					
		Fertilizer		Modern seed		Pesticide/herbicide	
		Amount (Kg)	Value (Br)	Amount (Kg)	Value (Br)	Amount (Kg)	Value (Br)
Maize							
Teff							
Sorghum							
Wheat							
Barely							

21. What is your total (in qarxi) (a) cultivated land size? _____ (b) irrigated land size? _____

22. How much of your cultivated land is (a) owned _____ (b) leased in?_____

23. Saving, access to credit and credit rationing

(f) Do you have some saving? _____1) Yes 2) No

(g) Do you have any outstanding loan? _____ (1) Yes (2) No

(h) Did you apply for a bank loan over the last year?_____ (1) Yes (2) No

(i) Has your application been accepted?_____ (1) Yes (2) No

(j) Over the last year, did you always repay your loan on time? _____ (1) Yes (2) No

24. Please provide me with your estimated average weekly food[16] consumption costs_____

25. Please provide me with information on the extent to which you are relying on (monetary or non-monetary) assistance from informal insurance arrangements during shocks (e.g., death a family member, draft oxen)

Informal insurance arrangement	Amount of financial receipts in Birr over 12 months	Amount of contribution in Birr over 12 months
Family, relatives or friends		
Iddir		
Iqquib or SACCOs		
farmers' group		
Daboo/Jige		
Women association		
Busa gonofa-livestock transfers		
Youth Union		

[16] Include your expenditure maize, teff, wheat, barley, sorghum, rice, pasta, macaroni, lentils, beans, peas, potato, tomato, cabbage, oil, sugar, salt, coffee, drinks, cigarette, khat

26. Would you prefer to buy the standard insurance at Birr 100 or the IOU insurance at Birr[17] 106?

A. Standard for Birr 100 *(go to question 17)*

B. IOU for Birr 106 (*go to question152)*

27. Would you prefer to buy the standard insurance at Birr 100 or the IOU insurance at Birr 113?

A. Standard for Birr 100 *(go to question 18)*

B. IOU for Birr 113 (go to question 16)

28. Would you prefer to buy the standard insurance at Birr 100 or the IOU insurance at Birr 120?

A. Standard for Birr 100

B. IOU for Birr 120

29. Would you prefer to buy the standard insurance at Birr 100 or the IOU insurance at Birr 100?

A. Standard for Birr 100

B. IOU for Birr 100

30. Would you prefer to buy the standard insurance at Birr 100 or the IOU insurance at Birr 99?

A. Standard for Birr 100

B. IOU for Birr 99

31. Assume that you have received ETB 5000. Next, you have the choice between participating or not participating in a lottery. In the lottery, a coin is flipped. If it comes up heads, you need to pay Birr 2000 from the 5000 you just received, and you would go home with Birr 3000. If it comes up tails, you can keep your Birr 5000. You can also decide to not participate in this lottery, but instead pay a fixed amount. What is the largest amount, of the Birr 5000, you would be willing to pay so that you do not have to participate in the lottery?

Birr _____

[17] The price referencing questions follow a staircase procedure. First each respondent will be asked whether they would prefer to buy the standard IBI at 100 Birr today or the IOU at 106 Birr after 6 months. In case the respondent opted for the standard, in the second question the price of the IOU will be adjusted down to Birr 100. If, on the other hand, the respondent chooses the IOU, in the second question, the price of the IOU will be adjusted up to Birr 113, and then to Birr 120

C Additional tables

C.1 Balancing tests second round

Table A1a: Balance tests second randomization (Balance tests on socio-economic variables)

VARIABLES	age	Sex	Mstatus	Education	Famsize	Income	Drought dummy	BoughtI BIbefore
IOUMNC	-0.72	0.12	0.01	-0.01	0.35	116.18	-0.03	-0.02
	(1.188)	(0.092)	(0.029)	(0.437)	(0.348)	(350.212)	(0.050)	(0.050)
IOUMJLC	-0.89	0.13	0.02	0.30	0.16	-112.81	-0.02	0.00
	(1.101)	(0.086)	(0.030)	(0.435)	(0.323)	(186.383)	(0.050)	(0.054)
IOUNC	-2.08**	0.02	0.02	0.26	-0.28	-107.56	0.06*	-0.09**
	(0.723)	(0.065)	(0.024)	(0.345)	(0.250)	(320.429)	(0.029)	(0.032)
Constant	39.40**	0.47**	1.10**	1.91**	5.67**	854.30**	0.87**	0.12**
	(0.901)	(0.073)	(0.025)	(0.347)	(0.299)	(161.102)	(0.041)	(0.041)
Test IOUMNC=IOUMJLC	0.86	0.86	0.90	0.41	0.38	0.49	0.80	0.69
IOUMNC=IOUNC	0.19	0.20	0.88	0.51	0.01	0.60	0.02	0.02
IOUMJLC=IOUNC	0.21	0.11	0.97	0.93	0.04	0.99	0.04	0.02
Observations	8,579	8,579	8,579	8,579	8,579	8,579	8,579	8,579
Adjusted R-squared	0.002	0.010	-0.000	0.002	0.006	0.001	0.007	0.009

Linear regression results. Robust standard errors adjusted for clusters in iddirs in parentheses. ** p<0.01; * p<0.05. test refers to p-values of wald test. The constant reflects averages in the control group: IBI)

Table A1b: Balance tests second randomization (production variables and savings)

VARIABLES	Maize	Haricot	Teff	Sorghum	Wheat	Barely	Cultivationland	Savings
IOUMNC	1.73	0.04	-0.19	-0.01	-0.56	-0.17	-0.16	-0.06
	(1.177)	(0.088)	(0.367)	(0.090)	(1.588)	(0.126)	(0.884)	(0.066)
IOUMJLC	1.80	0.22	-0.08	0.08	3.41	-0.13	-0.61	-0.01
	(1.171)	(0.158)	(0.367)	(0.147)	(4.324)	(0.132)	(0.873)	(0.054)
IOUNC	0.38	-0.01	0.02	-0.09	-1.02	-0.11	0.14	0.02
	(0.702)	(0.063)	(0.326)	(0.066)	(1.112)	(0.125)	(0.492)	(0.034)
Constant	6.54**	0.21**	1.35**	0.19*	5.09**	0.29*	8.06**	1.79**
	(0.876)	(0.061)	(0.266)	(0.081)	(1.268)	(0.121)	(0.739)	(0.044)
Test IOUMNC=IOUMJLC	0.95	0.25	0.76	0.51	0.35	0.50	0.51	0.37
Test IOUMNC=IOUNC	0.26	0.53	0.37	0.16	0.72	0.37	0.76	0.24
Test IOUMJLC=IOUNC	0.24	0.13	0.81	0.20	0.30	0.79	0.44	0.63
Observations	8,579	8,579	8,579	8,579	8,579	8,579	8,579	8,579
Adjusted R-squared	0.003	0.001	-0.000	0.000	-0.000	0.000	0.002	0.005

Linear regression results. Robust standard errors adjusted for clusters in iddirs in parentheses. ** p<0.01; * p<0.05. Test refers to p-values wald tests. The constant reflects averages in the control group: IBI)

Tables A1a and A1b suggests that for almost all treatment groups there is balance, which provides confidence in the reliability of the randomization.

C.2 Wald tests

Table A3: Wald tests comparing impact treatments on uptake

p-value Wald tests first round	p-value Wald tests second round
IBIM=IOUMC;0.07	IOUMNC=IOUMJLC:0.23
IBIM=IOUM:0.01	IOUMNC=IOUNC:0.0001
IBIM=IOUC:0.55	IOUMJLC=IOUNC:0.002
IBIM=IOU:0.27	
IOUMC=IOUM:0.40	
IOUMC=IOUC:0.02	
IOUMC=IOU:0.49	
IOUM=IOUC:0.01	
IOUM=IOU:0.12	
IOUC=IOU:0.01	

C.3 Financial literacy round 2

Table A4: Financial literacy (round 2)

VARIABLES	Cognitive ability	Financial Literacy	IBI understanding
IOUMNC	0.10	0.05	-0.09
	(0.221)	(0.184)	(0.176)
IOUMJLC	0.14	-0.16	-0.10
	(0.227)	(0.165)	(0.162)
IOUNC	0.23	0.05	-0.10
	(0.150)	(0.123)	(0.121)
Constant (IBI)	4.29	1.97	3.70
	(0.173)***	(0.144)***	(0.128)***
Observations	8,579	8,579	8,579
Adjusted R-squared	0.001	0.006	0.000
Test IOUMNC=IOUMJLC	0.85	0.14	0.92
Test IOUMNC=IOUNC	0.57	0.98	0.96
Test IOUMJLC=IOUNC	0.70	0.16	0.97

Cluster Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1. Test refers to p-values Wald tests of equality.

C.4 Enumerators

Table A5: profile of the field staff

No.	Name	Responsibility	Kebele/district	Academic qualification
1.	Jemal Mohammad	Supervisor	Arsi negele	MSc
2.	Taye Gue	enumerator	Kersa Ilala	MSc
3.	Moata	enumerator	Gubata Arjo	MSc
4.	Sisay	enumerator	Rafu Hargissa	MSc
5.	Gabita	enumerator	Hadha Boso	MSc
6.	Abiyu Isayas	Supervisor	Adami Tullu	BSc
7.	Kedir Bekata	enumerator	Anano Shisho	BSc
8.	Mohammad Guye	enumerator	Habule Gutumuma	BSc
9.	Aman Jaleto	enumerator	Hurufa Lole	BSc
10.	Feyisa	enumerator	Halagu gulanta Boqe	BSc
11.	Abu	enumerator	Halagu gulanta Boqe	BSc
12.	Endale	Supervisor		BSc
13.	Delu	enumerator		BSc
14.	Lencho	enumerator		BSc
15.	Mohammad	enumerator		BSc
16.	Mohammed	enumerator		BSc
17.	Beshir Shaku	Data entry		MSc in statistics and econometrics
18.	Dhufera	Data entry		MSc in statistics and econometrics
19.	Temesgen K Belissa	Coordinator	All the 3 districts	PhD candidate

D. Report on IOU stakeholder Workshop

Our IOU research team including Francesco and Temesgen have organized a stakeholder workshop at Elilly International Hotel in Addis Ababa, Ethiopia, on 4 September 2017. Participants were higher official OIC staff, a microinsurance expert from Kifiya Financial Technology, researchers from Haramaya University, development agents and agricultural officers from the project sites including Bora, Adami Tullu and Arsi Negele districts in south-eastern Ethiopia. The workshop was with two overarching aims. The first aim was to present the various stakeholders about the philosophy, overall activities and major outcomes of the IOU insurance project. The second aim was to have a thorough discussion, constructive comments and inputs for a way forward for the Phase 2 of the project. Four presentations were made: two from the IOU research team and two from the firm side (see the attached PPTs). Participants have appreciated the various innovative features of the IOU project.

First, the majority of the speakers have appreciated our coax of the traditional social insurance iddirs with the market-based micro-insurance for crops. Both the OIC and Kifiya Financial Technology delegates addressed that the role of iddirs to provide effective insurance mechanisms for members through both agricultural insurance and micro health insurance is their target. Second, participants also appreciated the innovation in IOU insurance that overcomes the liquidity problems of smallholder farmers in Ethiopia. Supporting our study, participants explained that farmers in Ethiopia faces liquidity problems during the insurance sells windows of OIC. Thus, providing them a mechanism that allows them to buy on contract basis and make them to repay back was very much helpful. Thirdly, apart from the innovation in the IOU product and the iddir channel for promotion of the insurance idea, the way we trained the iddir leaders then the iddir leaders trained their members was also considered as an innovative training of trainers (TOT) approach. Similarly, the use of various contract structures to minimize the potential defaults arising from premium postponement was also considered as another innovative feature.

Participants were also raised various questions. The first question raised by the CEO of OIC, Mr. Asfaw Banti was whether iddirs are legally registered societies to contract with. Participants from the field level answered that there is government social affairs office in every kebele and district in Ethiopia that monitors the formation and functioning iddirs. However, iddirs are not legally registered institutions at national level. The issue of high payouts including Birr 1.8 million during 2016 and Birr 5.23 million in 2017 was also explained by the CEO of OIC. Since such payouts are excessively higher than the premium collected the company explained that the microinsurance department may not be profitable. So, they consider it as a business of tomorrow, most of the smallholders, their cooperatives and unions are shareholders of OIC. So, working with smallholders is always the target of OIC. So, it is proposed on the workshop that making OIC to operate at no loss is necessary through different mechanisms including underwriting premium, or subsidizing or reinsuring excess risk by donors. From the perspective of Kifiya Financial technology, the issues raised include combining the survey data with what they call the Geonetcast data. The issue of scaling up the IOU was indicated by all speakers. The most important ways explained include lobbying governments and regulatory bodies to

support the intervention, soliciting funds from donors, and making a forum to bring all the necessary stakeholders to discuss on such issue and come to a consensus.

On the way forward we explained that after the 1st intervention, we get small funding from 3ie (International Initiative for Impact Evaluation). With our learning from Phase I, 3ie has invited us to write a proposal for Phase II, an intervention that can stay for 5-6 years in an area. Now, we need your constructive inputs and comments on this workshop for the Phase II intervention and our subsequent planned activities. With your input and support, we are envisioned to research on innovative insurance solutions as sustainable pro-poor climate risk management strategy. We need more collaboration and much more support from the researchers, and the industry given the multifaceted nature of climate risk management, and the need for effective innovation.

From the firm side (product owner side) again they propose the issue of rainfall and NDVI, rainfall and yield as well as yield and NDVI correlations to be studied and taken into account for minimizing basis risk. Diversification of the microinsurance products towards micro-health insurance, multi-peril insurance (that also insures pests, excessive rainfall) as well as livestock insurance and modernizing the funereal insurance role of iddirs. It was also addressed that diversification includes product diversification as well as diversification in terms of geographical coverage. OIC addresses in this perspective that time and other financial resources are required for full diversification. Participants from OIC also raised that new product development and demand assessment is also important

In Phase 2, in order to provide the geographic diversification, we need to cover 50 kebeles in which 10 iddirs can be covered. Kifiya Financial Technology will help us to identify the 50 kebeles in diversified agro-ecological zones that can provide full spatial variation in occurrence of risks. We need to select districts on purposive sampling basis within 300 km radius from Addis Ababa

Addressing the ‘no premium no coverage except for government institutions’ directive. OIC staff explained that this is for conventional insurance, not precisely meant for microinsurance. Kifiya financial technology will provide OIC with latest products including the vegetation index crop insurance (VICI) for all future interventions. People who will be on board from all institutions were indicated: From OIC a person responsible to the microinsurance department and Mr. Habtamu Wakwoya, from Haramaya University, Megersa Debela and from Kifiya Megersa Mirressa are delegates.

Regarding the budgetary issues OIC staff raised the issue that some budget of the project is required at their office for administration costs. As a reason what OIC often raises is that it currently charges a pure premium which is only 15 percent of the payout. This revenue is not adequate to cover all administration costs, but charging the smallholders beyond this further discourages the uptake which is even quite low. In addition, the microinsurance activity of OIC (e.g., selling the conventional insurance products) is undertaken through agents, namely, cooperatives and cooperative unions that often ask about 5% of the total premium collected for their administration costs. At the start, during 2013-2014, financing all project administration and logistic costs were initiated by the Japan International Cooperation Agency (JICA) which funds all capacity building costs of OIC to promote microinsurance for crops. However, after 2014,

JICA has stopped funding these costs. Hence, covering these costs from its own source has become a major operational impediment for OIC. Except this, OIC is very enthusiastic and has a full willingness to implement our products for a full scale impact evaluation. OIC will write the letter of support explaining how the IOU product will be used in the future.

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