The Subjective Well-being Effects of Imperfect Insurance that Doesn't Pay Out

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Abstract

In this paper we estimate the effects of an imperfect insurance coverage on subjective well-being of a poor, rural population, by exploring whether insurance in force improves subjective well-being and whether insurance that lapsed but did not pay out leads to ex post buyer's remorse. Exploiting randomization of incentives to purchase a newly introduced index-based livestock insurance product, we establish that even a product that did not pay out generates significant gains in well-being, on average, and that the result is robust to a host of alternative estimation approaches. We also establish that those who purchase insurance that does not pay out experience buyer's remorse, although the magnitude of this effect is considerably smaller than that of possessing insurance, so that even an agent who can reasonably anticipate subsequent buyer's remorse in the event that no indemnity is triggered will find it rational to purchase the product.

Keywords: Ethiopia, index insurance, pastoralists, subjective well-being, vignettes

JEL code: D60, I32, O16

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1. Introduction

It is widely believed that most people are risk averse (Kahneman and Tversky, 1979; Rosenzweig & Wolpin, 1993; Rosenzweig & Binswanger, 1993). In theory, actuarially fair insurance should improve welfare regardless of whether there is a payoff because the expected utility of the insured wealth/asset is at least as high as without insurance. But most insurance products are not priced at an actuarially fair value. Presumably insurance companies can add 'loadings' (i.e., a mark-up) to a policy premium, making the insurance actuarially unfair, and still sell the product because risk averse people value the peace of mind that comes from truncating their risk exposure. One implication, of course, is that assessing the welfare gains from insurance cannot be done in expected benefit terms. Therefore, analysts typically use either relative weak tests of stochastic dominance or impose strong assumptions about utility functions to assess whether people gain from insurance purchase. Another implication is that, if insurance is imperfectly understood or people err in purchasing decisions, they may regret buying a policy. That is perhaps especially true if the insurance term passes without an indemnity payout, so that they lost their premium and, with the benefit of perfect hindsight, recognize that they would have been financially better off had they not bought insurance coverage after all.

In this paper we take a novel approach to estimating the impact of insurance on a poor, rural population, exploring whether imperfect insurance coverage improves subjective well-being. Furthermore, we exploit the panel nature of the data and the fact that no indemnity payments occurred during the survey period to test for ex post buyer's remorse. Exploiting randomization of incentives to purchase the newly introduced index-based livestock insurance product, we establish that even a product that did not pay out generates significant gains in well-being, on average, and that the result is robust to a host of alternative estimation approaches. We also establish that those who purchase insurance that does not pay out experience buyer's remorse, although the magnitude of this effect is considerably smaller than that of possessing insurance, so that even an agent who can reasonably anticipate subsequent buyer's remorse in the event that no indemnity is triggered will find it rational to purchase the product.

These questions matter because there is currently a huge push to expand insurance offerings in the developing world, where uninsured risk exposure is thought not just to cause welfare losses but also to distort behavior and trap some people in poverty. Rozensweig and Binswanger (1993) find that risk aversion influences the composition of asset portfolios of farmers in India, where farmers in riskier environments trade high profits for lower variance. They also find that the efficiency loss associated with risk mitigation is higher for poorer farmers. Carter and Barrett (2006) and Barrett and Carter (2013) show that uninsured risk may lead to asset losses that push households below a critical asset threshold from which they may not recover. Ex-post risk coping strategies can also have adverse inter-generational consequences. Jacoby (1994) and Beegle, Dehejia and Gatti (2006) report that following income shocks families withdraw their children from school and have them work within the household to substitute for adult labor or in outside labor markets to supplement household income.

Despite widespread acceptance of the claim that uninsured risk exposure harms poor farmers, there has been rather little empirical evidence demonstrating that holding insurance generates welfare gains for rural households in the developing world.[1] Indeed, low uptake of index insurance products introduced across a range of countries over the past decade hints that would-be purchasers believe insurance does not deliver welfare gains (Giné, Townsend, and Vickery, 2008; Cole, Giné, Tobacman, Topalova, Townsend, and Vickery, 2013).[2] Yet, if we believe in decreasing absolute risk aversion the poor stand to gain most from insurance. This puzzle motivates our main research question in this paper: does index insurance lead to welfare gains among a poor rural population?

We tackle this question using novel data from southern Ethiopia. An index based livestock insurance (IBLI) product has been offered in pastoralist areas in the Borana zone of Oromia region, Ethiopia since August 2012. IBLI, like all index insurance products, offers imperfect coverage of individual losses because it indemnifies only an index that is presumed correlated with area average losses, i.e., it is subject to (typically unobservable) basis risk. There are solid reasons to suspect that such a product might not benefit people and that it might be especially subject to buyer's remorse as people come to recognize the imperfect nature of the coverage. A baseline household survey was conducted in March 2012, and second and third rounds of data were collected from the same households in March 2013 and March 2014. We use inter-temporal variation in households' self-reported subjective well-being (SWB), comparing insured and uninsured households using randomized inducements to purchase IBLI in what is an essentially difference in difference framework, to identify the causal effects of IBLI uptake on SWB. To address potential selection problems in insurance purchase we exploit features of IBLI's encouragement design, which includes randomized distribution of premium discount coupons and randomized exposure to different information treatments about the new product, to instrument for IBLI uptake. We then estimate an ordered logit model of SWB using as a function of instrumented IBLI uptake, both current and lapsed, and a rich set of community and household-level controls. As a robustness check, we address concerns that interpersonal comparisons using subjective data might not be valid by benchmarking subjective responses to hypothetical vignettes (Beegle et al. 2011).

We find that although people experience buyer's remorse for insurance that did not pay out, they also experience a much greater boost to their SWB. These results are robust to alternatives ways of approaching the elusive measurement of SWB. The clear implication is that IBLI indeed generates benefits in the form of peace of mind to purchasers of insurance who purely lose money on the policy. Moreover, even though they do experience buyer's remorse when they

[1] Jensen, Barrett and Mude (2014a) is a recent exception.

[2] Gine et al. (2008) report that take-up rate of a rainfall insurance product in Andhra Pradesh, India was very low, at just 4.6 percent. They argue this might reflect the short history of the product. Similarly, Cole et al. (2013) find that the take up rate of livestock insurance among the untreated general population in Andhra Pradesh and Gujarat, India, is close to zero.

realize that they lost money on policy purchase, that effect is significantly smaller than the magnitude of holding insurance, so in expectation, this population is better off insured than uninsured.

The remainder of the paper is organized as follows. The next section presents the study setting and discusses IBLI and its contract design. Section 3 discusses the sampling and experimental design and reports summary statistics of the data. Section 4 presents our two-stage estimation strategy. Section 5 reports our results. Section 6 presents a range of robustness checks. Section 7 concludes.

2. Study setting and IBLI

Borana zone is a vast pastoralist land mass consisting mainly of arid and semi-arid ago-ecological zones with a bimodal rainfall pattern. The major ethnic group in our sample are Borana Oromos, who reside in lowlands. Traditionally, Borana Oromos relied on a system of mobile pastoralism as the primary source of income and sustenance, with limited cereals cultivation for own consumption. Cyclical movement of livestock in search of forage and water characterizes the livestock production system in the zone (Berhanu, 2011).

In our study sample, which covers all eight *woredas*[3] of Borana zone (Figure 1), livelihood strategies are changing rapidly; indeed, some households' traditional migratory pastoralism strategy has collapsed. There are widespread concerns than more frequent drought, perhaps associated with climate change, is making pastoralism a more tenuous enterprise (Barrett and Santos 2014). In 2012, asked to reflect on their main source of income five years ago, over 78 percent of households reported livestock keeping and 13 percent of households had crop cultivation as their primary source of income. In 2012, however, the household income shares of livestock and crop cultivation had fallen to 56 percent and 8 percent, respectively. The percentage of households who reported food aid as a main source of livelihood had gone up to 13 percent from a baseline of 3 percent five years before. The most common explanation of such shifts and seemingly growing dependence on relief food distribution is overwhelmingly herd losses due to drought.

Traditional Borana law, *sera,* provides for the poor's right to assistance, which includes two types of social insurance: compulsory restocking schemes, or temporary wealth transfers. Under the former, an obligatory annual wealth redistribution scheme called *busa gonofa* requires the rich to restock the needy for livestock losses due to natural causes (such as drought and animal disease) based on assessments done at sub-clan level (Berhanu, 2011). This is complemented by the temporary wealth transfer scheme *dabare,* a semi-obligatory cattle loan system that allows poor households to borrow and care for cattle from wealthy households in exchange for use rights to the animals' milk for consumption or sale. With the consent of the livestock owner, the

[3] *Woreda* is the third-level administrative divisions in Ethiopia, below region and zone. The eight *woredas* of Borana *zone* are Arero, Dhas, Dillo, Dire, Moyale, Teltele, Ybello and Miyo.

dabare holder may keep newborn male animals. At any moment, the *dabare* animal is subject to recall by the owner (Cossins and Upton, 1987). Such arrangements can be either inter- or intra-clan. Intra-clan requests are deemed compulsory while inter-clan request for *dabare* animal is dependent on the will of the loaner. However, denials of inter-clan request could lead to social sanctions (Taye, 2002) [4].

These traditional, indigenous social insurance mechanisms have declined in recent times. As a result of the strains on the resources of the community, *busa gonofa* and *dubare* are, when available at all, reserved for those with limited outside options (Berhanu, 2011). When this decline of social insurance institutions meets the lack of diversification in the asset portfolio of Borana pastoralists, which consists almost entirely of livestock, the effects of droughts can be catastrophic. Desta and Coppock (2002), for example, find that droughts in 1983-1985 and 1991-1993 in Borana resulted in the deaths of 37-42 percent of all cattle. Lybbert et al. (2004) estimate livestock losses in drought years can be as high as 35 percent of aggregate herd. Further, much of the risk pastoralists face is covariate, in the sense that the community collectively experiences the same drought. As a result, informal community networks are unable to effectively mitigate the effects of shocks (Lybbert et al., 2004, Santos and Barrett 2011).

High loss rates and significant covariate risk suggest that formal insurance might effectively transfer drought risk out of the system to underwriters in Addis Ababa or international reinsurance markets, thereby cushioning pastoralists against catastrophic herd loss shocks. However, conventional indemnity insurance can be prohibitively costly to establish and sustain in this environment. Droughts that trigger payouts could wipeout under-diversified insurers. Moral hazard and adverse selection problems and associated high monitoring costs, as well as high transaction costs in infrastructure-poor areas compound the challenges of delivering standard insurance products.

IBLI was developed for precisely such environments, originally designed for and successfully piloted in the neighboring region of northern Kenya (Chantarat et al. 2013). IBLI is an index insurance product that makes indemnity payouts based on an observable, exogenous index of rangeland conditions, as reflected in Normalized Difference Vegetation Index (NDVI) measures generated by remote sensors on satellite platforms. An IBLI policy provides indemnity payouts when pasture vegetation falls below a contractually stipulated threshold level that reflects the onset of drought conditions that typically lead to excess livestock mortality (Chantarat et al. 2013). The premium level and index differs across *woredas* but are the same for all purchasers within the *woreda*, irrespective of individual loss experience.

Because insurance premiums are determined by the risk of drought in each *woreda*, insurance premiums are higher where the risk of livestock mortality is higher. *Woreda* premium rates are then applied to the value of herd that a purchaser chooses to insure in order to establish the total

[4] See Cossins & Upton (1987), and Taye (2002) for a detailed discussion of the traditional social support institutions of the Borana community.

amount households must pay for IBLI coverage. The insurance premium is proportional to the estimated value of the animal insured (cattle=Birr 5,000, camel=Birr 15,000, goats and sheep (shoats)=700). As shown in Table 1, the premium is highest for camel in Miyo and Moyale *woredas*, and lowest for shoats in Arero.

There are four seasons in Borana: long rainy – *gana* (March-May), long dry – *adolessa* (June-September), short rainy – *hagaya* (October-November), and short dry - *bona hagaya* (December-February) seasons. IBLI insurance contracts are sold during two sales periods (SP): January – February and August – September, each ending before the next rainy season starts. Contracts cover a full 12 month period. For example, the coverage of a contract sold in January 2014 spans March 2014 – February 2015, while one sold in August 2013 covered October 2013 – September 2014. So households can augment coverage from one SP to the next. Index readings for each sales period are announced to policy holders at the end the season (see Figure 2 for details).

A major challenge of IBLI is that substantial basis risk could leave livestock loss uninsured due to imperfect correlation between the drought predicted by the index and drought experienced at the household level, which may affect uptake (Jensen, Barrett and Mude 2014a,b). Animal losses due to covariate shocks that are not covered by IBLI such as animal disease unrelated to rangeland conditions, and idiosyncratic shocks such predation or injury are not uncommon.

To date, there has been no indemnity payment on the Borena IBLI contracts, which were introduced shortly after the catastrophic drought of 2011. Households who purchased IBLI are therefore materially worse off since they paid premium but have not received indemnity payouts. In the 2013 and 2014 survey rounds after IBLI was marketed (described in more detail below), the average out-of-pocket payment for IBLI amounted to Birr 641 and Birr 609, respectively, equivalent to 8 percent and 6 percent of annual cash income respectively. In money metric terms, IBLI contract holders are clearly worse off from purchasing insurance. [5] But given risk aversion, they may nonetheless be better off in broader well-being terms. Are they? That is the central question we aim to answer with the data described in the next section.

3. Data

A population survey was designed and fielded initially in February-March 2012. That baseline occurred before IBLI was developed and no survey respondents had yet been exposed to training or marketing of IBLI. After the baseline, in August-September 2012 (SP1), the first IBLI contracts were sold to pastoralists in the study area. In January-February 2013 (SP2), the March 2013-February 2014 contracts were offered, followed by a follow-up survey of the original sample households in March-April 2013. Contracts sales were repeated in the August-September 2013 and January-February 2014 IBLI sales periods between survey rounds 2 (R2) and 3 (R3). A

[5] Note that cash income could be endogenous to the IBLI purchase decision. Households may sell off livestock to insure the remaining herd, or engage in other cash income generating activities to pay the insurance premium. This, however, does not change the simple descriptive fact they are materially worse off for buying IBLI.

third round survey was then conducted in March 2014 among the same respondents as the first two survey rounds.

Sampling was clustered at the *reera*[6] level. *Reera*s were purposively selected based on availability of population lists collected for other Borana surveys in 2011. Inaccessible *reera*s were excluded for logistical reasons. New study sites were added to maximize geographic distribution, variation in market access, and agro-ecological variation across all eight *woreda*s of Borana *zone* (IBLI, 2014). In selected *reera*s, development agents (DAs) compiled household lists, which were then used to randomly draw sample households. In each *reera*, households were clustered into livestock terciles and a tercile-balanced stratified sample of households was randomly drawn using the rule that in each *reera* a sample of 15 percent of households would be drawn provided it yielded a minimum of 25 households. When this condition was not satisfied in a *reera*, neighboring *reera*s were combined to form a bigger study site, making a total of 17 study sites distributed across 8 *woreda*s (IBLI, 2014).

The survey collected data on a broad range of household characteristics, demographic variables, livestock and other assets, livelihood activities, consumption, social networks, expectations and subjective well-being from a sample of 516 households, of which 476 were re-interviewed in R2. In R2, in addition to the 476 households surveyed in R1, 32 new replacement households were surveyed from the original list compiled by DAs. Replacement households were chosen from the same study site and TLU class[7] as the households they replaced. If a replacement could not be found in the same TLU class, one in the adjacent TLU class was picked. Out of the 508 households surveyed in R2, 498 were re-surveyed in R3, and an additional 14 replacements also interviewed. In R3 attempts were made to re-interview households who were sampled in R1 but missed in R2. As a result, out of the 14 replacements, 10 were original R1 households and 4 were new households. Over the three data rounds, a total of 552 unique households – 516 original households, 32 replacements in R2, and 4 new replacements in R3 – were surveyed. One household with missing subjective well-being measures was dropped from the sample, leaving a final estimation sample of 551 panel groups, consisting of 469 households who were surveyed in all three rounds, 48 households surveyed in two rounds (10 in R1 and R2, 7 in R1 and R3, and 31 in R2 and R3), and 34 households surveyed in a single round. Following the launch of IBLI, in R2 and R3 the survey also included a module of IBLI uptake and awareness.

To enhance IBLI uptake and in order to provide an experimental treatment that could be used to identify the impacts of IBLI uptake statistically, various encouragement designs were randomly implemented in each of IBLI sales periods. These included distribution of premium discount coupons prior to all IBLI sales periods. Recipients of discount coupons were randomly assigned to discount categories that would allow them to purchase IBLI for up to 15 cattle (or equivalent value of other livestock species) at a discount below the unsubsidized policy premium. In each

[6] Reera is the fifth level administrative division in Ethiopia, below region, zone, *woreda*, and *kebele*..
[7] Households were classified into three livestock holding classes, from richest to poorest.

sales period, about 80 percent of sample households were randomly selected to receive discount coupons, of which 10 households received IBLI free of charge. The rest of the discount coupon recipients were evenly distributed across discount levels of 10%, 20%, 30%, 40%, 50%, 60%, 70%, and 80% (Table 3). This manufactured exogenous variation in the effective price faced by prospective buyers, and generated a randomized discrete reminder – the physical coupon – of the option to buy IBLI, thereby providing a plausible instrument for IBLI purchase decisions.

In addition, beyond basic briefings that described the IBLI product to all communities to which the product was marketed, alternative IBLI information treatments – through comic books and via audio tapes of a poem about IBLI recited in Oromifa by its author – were delivered to randomly selected sub-samples of respondents in SP1 and SP2.[8] The two information treatments – comic book and audio tape –were randomized among 50 percent of study sites, with no overlap in assignment. A control group received no additional extension services. The randomized assignment of households into extension treatments and of discount coupons with varying levels was implemented independently for each sales period. During the subsequent semi-annual sales periods, insurance was then offered and households chose whether to purchase IBLI coverage and, if so, how many tropical livestock units (TLUs)[9] to insure.

In SP1 and SP2, over one quarter of sample households received a combination of discount coupons and either comic book or audio tape treatments. In SP1, 412 households received discount coupons, of which 86 households also received comic book extension treatment and 66 households received audio tape extension treatment. A total of 108 households received additional information about IBLI via comic books and 86 households via audio tape. 62 households did not receive any treatment. In SP2, 411, 99, and 71 households were given discount coupon, comic book, and poet tape encouragement treatments, respectively. 82 households received discount coupon and comic book, and 56 households received discount coupon and poet tape. The information extension treatments were dropped in SP3 and SP4, and 408 households received discount coupons in each sales period.

Even though all sample households in our study sites had opportunities to insure against drought-related livestock loss, only 22 percent and 21 percent of households surveyed in R2 and R3, respectively, reported buying IBLI coverage. In both R2 and R3, IBLI purchases were particularly low in SP2. Of the 508 households surveyed in R2, 130 reported purchasing IBLI in SP1 and 94 in SP2. Similarly, of the 514 households surveyed in R3, 151 purchased IBLI in SP1, but only 62 in SP2. This difference might arise due to seasonal liquidity differences, although we

[8] In the comic book information treatment, a randomly selected sub-sample of respondents was provided with a caricature representation of the IBLI product prepared by the underwriter, Oromiya Insurance Company (OIC). The contents of the material were first read to the sample households, then they were encoruaged to look/read through it as many times as they wished. In the audio tape information treatment, DAs were asked to play a tape that explains IBLI in the local language to a randomly selected sub-sample of respondents [for more detail see ILRI 2014].

[9] Tropical livestock unit (TLU) is a unit of measurement used for describing the number of livestock of various species, gender, and age in relation to a common average metabolic weight, with 1 TLU = 1 cattle = 0.7 camels = 10 shoats. It is often used for aggregating livestock across species.

cannot be sure. The long (March-May) rainy season preceding the August-September sales period (SP1) typically means greater pasture and more favorable livestock market conditions.[10] Prospective IBLI buyers can more easily raise cash to purchase IBLI by selling off livestock on favorable terms during that period.

Table 4 reports summary statistics on key dependent and independent variables used in the study by insurance (columns 2-4) and treatment status (columns 5-7). The variable "Subjective well-being" in the top row is an ordinal scale of respondents' stated perception of their economic condition on a Likert scale ranging from 1 (low) to 5 (high) in responses to the question "On which step do you place your present economic condition?"

Each encouragement design variable takes the value one if the household was assigned to the specific encouragement treatment and zero otherwise. "Value of discount coupons" is the percentage discount that a household received if it were assigned to one of the nine discount categories during any one of the four sales periods. It takes vales between 0 (no discount) and 1 (100 percent discount) in an increment of 0.1, with the exception of 0.9 as a 90 percent discount was not part of the encouragement design. "Number of TLU owned" is a livestock wealth measure constructed by aggregating different livestock species owned by respondents. Non-livestock assets is the present value (in 1000 Birr) of assets such as furniture, household electronics, transportation equipment, farming implements, etc. Annual income is the sum of cash income, net transfers, food aid, and other non-food assistance, in 1000 Birr. "Expected TLU loss" is constructed households' response to the expected number of a specific livestock species they expect to die out of 20 units of each species. Gender of household head is a dummy variable taking the value one if the household head is male and zero if the head is female. Household size is the number of people who live in the same homestead including people who are away temporarily for less than eight months. "Non-working age household members" is defined as the sum of household member below the age of 15 or over 64 years old[11].

Under columns 2-4, the top two rows show that households who have purchased insurance in any one of the sales periods report higher subjective well-being compared to their counterparts who have had no IBLI coverage in any of the survey rounds. Rows 3-8 show that IBLI purchase is strongly positively correlated with the discount coupon and information treatments. In each sales period, about 90 percent of IBLI contract holders had received discount coupons.[12] Similarly, households who received information treatments (comic book or audio tape) were more likely to buy IBLI. As expected, higher discount rates are strongly associated with IBLI uptake. These

[10] Extended dry conditions are known to lead to stress sales and collapse of livestock markets, which in turn limits ability to raise the necessary liquidity to insure against shocks (Barrett et al. 2003, Lybbert et al. 2004).
[11] Please see Table A1 for detailed discussion on how these variables were constructed.
[12] Since survey rounds 2 and 3 were preceded by two sales periods each, a household who purchased IBLI in SP2 but had received discount coupon in SP1 is reported to have received discount coupon for the survey round, hence the slightly higher figures in Table 4.

simple descriptive statistics suggest that the random, exogenous assignment of discount coupons and information treatments could be good predictors of IBLI adoption.

Insured and uninsured households are not distinguishable on observable characteristics, with the exception of number of TLU owned. The value of non-livestock assets, annual income, expected livestock loss, gender and age of household head, household size and composition, and membership in various social groups vary little between those that purchased insurance and those who did not. This, however, does not rule out potential differences based on unobservable characteristics. Such differences, as long as they are time invariant, can be controlled for using panel data. Concerns that time varying characteristics may determine IBLI adoption nonetheless remain. We exploit the random assignment of treatments to address these concerns (discussed below in detail).

Columns 5-7 report pre-treatment balance in the experimental design. There is very little pre-treatment difference in subjective well-being, wealth, expected livestock loss, various household characteristics, and group membership between those who purchased insurance and those who did not, confirming that the randomization was successful. The discount coupon and information treatments, each strongly correlated with IBLI uptake, were indeed randomly assigned by any of the dependent or independent variables we use.

4. Estimation strategy

A key challenge in evaluating policy interventions where respondents can voluntarily "opt-in" is that selection into the program may not be random. Rather, participation could be systematically correlated with respondents' observable and unobservable characteristics. Indeed, IBLI uptake is very likely endogenous. In other words, peoples' subjective life satisfaction is likely correlated with their subjective assessment of risk, their planning horizons, and other unobserved factors that influence insurance uptake. The experimental design features of IBLI's impact evaluation, including randomized exposure to different extension treatments and randomized distribution of premium discount coupons, allow us to address the selection bias associated with insurance uptake choices. By first estimating selection into IBLI and then estimating the effect of estimated IBLI on SWB, we can derive causal estimates of IBLI's impact on SWB.

Our estimation strategy proceeds in two steps. Uptake of IBLI by household *i* in village *v* at time *t*, is estimated using a linear probability model as:

$$\begin{aligned}\Pr(\text{IBLI}_{ivt} = 1) = \ & \omega + \phi_1 Coupon_{iv1t} + \phi_2 Coupon_{iv2t} + \phi_3 Coupon_{iv(12)t} + \\ & \rho_1 Poem_{iv1t} + \rho_2 Poem_{iv2t} + \rho_3 Poem_{iv(12)t} + \rho_4 Comic_{iv1t} + \rho_5 Comic_{iv2t} + \\ & \rho_5 Comic_{iv(12)t} + \mu_1 Premium_{iv1t} + \mu_2 Premium_{iv2t} + \zeta x_{ivt} + \tau_{vt} + \psi_{ivt}\end{aligned} \quad (2)$$

The randomly assigned treatments include a dummy variable for receiving a randomly assigned premium discount coupon in either the first (August-September 2012) or the second (January-February 2013) sales period, dummy variables for receiving randomly assigned extension treatments in either audio tape or comic book form in either the first or second sales periods, and the continuous measure of the randomly discounted IBLI premium rate (which also includes spatial variation in pricing). These are all randomly assigned to households and should have no direct effect on SWB, only an indirect effect through their impact on inducing IBLI uptake. The lone possible exception is the variable, premium, since price variation has a (modest) income effect conditional on someone purchasing IBLI and thus could plausibly have some direct effect on SWB. A series of covariates, *x*, that may influence the uptake of IBLI are included as controls, including household herd size and income, gender, age and educational attainment of household head, and household composition.

By using the randomized coupon distribution and extension treatments to instrument for the purchase of IBLI coverage in the first stage estimation above, we can estimate the causal effect of IBLI on SWB in the following manner. In the second stage of our estimation, we incorporate household fixed effects (which control for, among other things, time invariant optimism or pessimism of individual respondents).

$$SWB_{ivt} = \alpha + \beta\, \widehat{IBLI}_{ivt} + \theta\, TLU_{ivt} + \delta` X_{ivt} + \gamma_i + \pi_{vt} + \varepsilon_{ivt} \qquad (3)$$

There are (at least) two possible ways in which IBLI coverage could influence SWB. The first effect is the gross nonmonetary benefits or costs associated with coverage, represented by the coefficient estimate on the instrumented IBLI variable, $\hat{\beta}$. Purchasing insurance may reduce stress about possible adverse outcomes, which could lead to higher levels of SWB ($\hat{\beta} > 0$). Conversely, if the basis risk on the product is high such that IBLI is more like a lottery ticket than a conventional indemnity insurance policy, IBLI could increase stress and reduce SWB ($\hat{\beta} < 0$).

The second influence on SWB arises from the net monetary benefit or cost of IBLI coverage on subjective well-being. If net income or wealth influences SWB, as many studies suggest (Frey and Stutzer 2001; Graham 2009), then IBLI will also affect SWB through the premium one pays for IBLI, which reduces net income or wealth, and any indemnity payment one receives in the event that the IBLI policy pays out, which increases net income or wealth, *ceteris paribus*. This effect will be captured by the coefficient estimate on the wealth variable (TLU), $\hat{\theta}$, multiplied by the net flow of funds associated with the period-specific net indemnity payments (indemnity payments minus premium payments) associated with the predicted IBLI uptake volume, converted into TLU units at prevailing livestock prices, $\widehat{PREM}$.

We therefore estimate the aggregate effect of IBLI on SWB as:

$$\Delta\widehat{SWB}_{ivt} = \hat{\beta}\,\widehat{IBLI}_{ivt} + \hat{\theta}\,\widehat{PREM}_{ivt} \tag{4}$$

The point estimate β reflects the SWB benefit of a unit of free IBLI with no indemnity payment. Given that during the two periods observed there were no indemnity payments but respondents paid for IBLI, our estimates provide a lower bound, reflecting the SWB associated with insurance coverage in the absence of any payout, i.e., a period in which insurance represents an unambiguous financial loss. A finding that $\Delta\widehat{SWB}_{ivt} > 0 | \widehat{PREM}_{ivt} < 0$ would therefore represent a strong finding with respect to the welfare effects of index insurance in this setting. We could equally solve for the actuarially fair premium in SWB terms (i.e., where $\Delta\widehat{SWB}_{ivt} = 0$) as

$$\widehat{PREM}^{*}_{ivt} = -\frac{\hat{\beta}\widehat{IBLI}_{ivt}}{\hat{\theta}}. \tag{5}$$

This estimate would be useful if subsidies of IBLI are considered by government or donors that wish to cover only the insurers' loading that might otherwise discourage uptake.

5. Results

The results of the first stage linear probability[13] selection equation using panel fixed effects model are reported in Table 5. Model 1 presents the basic model with just randomized discount coupon, information treatments, and discount amounts in SP1 and SP2 used to explain IBLI uptake. Model 2 includes a broad range of household characteristics, wealth measures, expectations of livestock loss, and membership in informal insurance networks, in addition to all of the variables in Model 1. Model 2 also includes period-*reera* fixed effects to control for time-varying unobserved variables that may influence IBLI uptake. The results of both models show that randomized treatments had positive effect on IBLI uptake and thus serve as suitable instruments. Receiving discount coupon and the amount of the coupon are especially strong predictors of uptake. Besides the price of effect of discount coupon, which is captured by the coefficients of "value of discount", the discount coupon has informational value. Conditional on the amount of discount received and other covariates, receiving a discount coupon has a positive effect on IBLI uptake. Sargan and Basmann overidentification tests fail reject the null hypothesis that the instruments are valid. The Wald test for joint significance of all instruments also strongly rejects the null of jointly insignificant instruments.

[13] A linear probability model avoids the "forbidden regression" problem associated with using logit or probit estimators in the first stage of instrumental variables (IV) approaches (see Wooldridge, 2002; Angrist & Pischke, 2008).

IBLI uptake is negatively correlated with income. This is perhaps because higher income enhances a household's capacity to better manage exposure to drought shocks, and provides self-insurance against future risks. Similarly, access to alternative insurance appears to reduce IBLI uptake. Households whose heads are members of *Iqub*s – traditional saving institutions – are less likely to purchase IBLI. Household demographic characteristics have very little effect on uptake. The variable, premium is positively, although weakly, correlated with uptake in the second sales period The premium is uniform within each *woreda*, to reflect that different *woreda*s have different likelihoods of drought. Households in the higher premium *woreda*s are more likely to face drought and therefore, appear to be slightly more likely to buy IBLI.

Table 6 reports second stage ordered logit regression results of the effects of IBLI uptake on SWB. Since randomized discount coupon distribution and information treatments were used as instruments for the potentially IBLI uptake in stage one, the coefficient on "predicted IBLI uptake" measures the causal effect of IBLI on SWB. We find that IBLI has a strong positive causal effect on SWB, suggesting that people are comforted by insurance coverage. Our results are robust to inclusion of income, wealth, a range of demographic and household characteristics, and household composition.

The variable "Purchased IBLI in R2 but not in R3" is a dummy variable that takes value 1 if a household surveyed in R3 had IBLI coverage in R2 but not in R3, and 0 otherwise. Having had IBLI coverage in R2, these households had the opportunity to purchase IBLI in the two sales periods prior to R3, but they chose not to. A negative coefficient on "Purchased IBLI in R2 but not in R3" represents buyers' remorse after the insurance had lapsed. We find that this coefficient is indeed negative and statistically significant in all three models. The magnitude of the coefficient is smaller than that of "predicted IBLI uptake", suggesting that people are comforted by insurance coverage, but once they realize that they did not need insurance, they wish they had not purchased it. Importantly, the fact that the negative effect of a policy that has lapsed is less than a policy in force means that people feel that their insurance purchase is beneficial even if it doesn't pay out, a point we return to in our conclusion.

The full subjective well-being effect of IBLI is presented in Table 7. The aggregate coefficient $\Delta\widehat{SWB}_{ivt}$ is positive and statistically significant at 1 percent level of significance. The point estimate suggests that insuring a TLU increases SWB by 0.205 points. That is, assuming constant marginal effect of IBLI, insuring 5 TLUs moves households up a scale on the SWB ladder, from, for example, "very bad" to "bad" or "good" to "very good", on average. Noting that the average TLU owned in our study area is around 20, our result suggests that a full coverage would lift the average (representative) household from the lowest SWB category to the highest.

We also find that given IBLI is yet to payout in Borana, the actuarially fair premium is around 51 Birr, which is significantly less than the average premium per TLU[14] (938 Birr in R2 and 790 Birr in R3) currently in effect.

6. Robustness checks

Below, we complete several robustness checks to test how sensitive our findings are to various specifications. Subjective measures of welfare are becoming increasingly popular but can be challenging to use (Kruegar and Schkade 2008). Responses may not be stable across questions within a survey and different respondents may have reference points when answering a subjective question**.** First, we test the robustness of the phrasing of our subjective well-being question by estimating responses to a similar question. Second, we test for any latent heterogeneity, which could render interpersonal comparisons of subjective welfare problematic.

First, we estimate the model using alternative SWB measure – SWB relative to Borana pastoralists. The "SWB relative to Borana pastoralists" variable is similar to "reference free SWB", but respondents are asked to gauge their life relative to other Borana pastoralists. This anchoring of well-being question decreases the likelihood that different respondents may have different reference groups in mind when responding (Ravallion 2012). Households were asked "in general, how do you rate your living conditions compared to those of other Borana pastoralists" on a scale of 1 (much worse) to 5 (much better)." Appendix Table A5 indicates that results using the anchored well-being question are consistent with the results in Table 6.

Second, interpersonal comparisons using subjective welfare data can be challenging since there is a potential for unobserved heterogeneity in respondents' reference points. An individual's reference point may itself depend on socio-economic conditions, or other observable and unobservable characteristics. Such latent heterogeneity in subjective well-being measures may render interpersonal comparisons meaningless and invalidate inference from subjective welfare regressions (Beegle, Himelein, and Ravallion, 2012; Ravallion, Himelein, and Beegle, 2013; King, Murray, Salomon, and Tandon, 2004).

King et al. (2004), King and Wand (2007) suggest a way of correcting for latent heterogeneity problems that involves measuring the interpersonal incomparability of responses itself. Respondents are asked to assess their own circumstances relative to a set of hypothetical individuals described by short vignettes on the same scale. Responses to the hypothetical vignettes are then used to construct an interpersonally comparable welfare measure as respondents' reference points have been exogenously standardized. The validity of this approach relies on two key assumptions: response consistency, and vignette equivalence. Response consistency requires that each respondent use response categories for a particular concept in the same way when self-assessing as when assessing hypothetical individuals. Vignette equivalence

[14] In calculating insurance premium per TLU, the same weight is used for cattle, camel and shoats. That is, our weight doesn't reflect the size of each livestock species in households' stock, or in their insured stock.

is the assumption that each respondent perceive the level of the variable represented by a particular vignette on the same uni-dimensional scale. That is, the variable being measured by vignettes should have a consistent meaning among respondents (King et al. 2004).

Following King et al. (2004), measured SWB are corrected using a simple non-parametric approach. Let's for notational ease momentarily suppress the village and temporal dimensions of the data. Suppose SWB_i is the categorical self-assessment for respondent i (i=1,…, n) , and V_{ij} be the categorical survey response for respondent i on vignette j (j=1,.., J). For respondents with identical vignette ordering (i.e. $V_{i,j-1} < V_{ij}$) the vignette adjusted measure of subjective well-being is given as

$$\widehat{SWB_i} = \begin{cases} 1 & \text{if } SWB_i < V_{i1} \\ 2 & \text{if } SWB_i = V_{i1} \\ 3 & \text{if } V_{i1} < SWB_i < V_{i2} \\ . & . \\ . & . \\ 2J+1 & \text{if } SWB_i > V_{iJ}. \end{cases} \quad (1)$$

Tables A2-A4 in the appendix present cross tabulations and the correlation matrix of SWB measures and vignette corrected SWB measures. Vignette-corrected SWB measures largely mirror SWB, particularly at the lower end of the scale. Vignette correction shifts a mass of observations from the middle of the distribution to the upper half, producing a more even distribution. Figures A1-A2 make this more apparent. Examining vignette corrected SWB and SWB relative to Borana pastoralists (Tables A6 and A7), we again find results that are consistent with our Table 6 results.

7. Conclusion

Studies of subjective well-being (SWB) have exploded in recent years, as has research on index insurance policies introduced into rural areas of the developing world. To date, much of the focus in the SWB literature has been on the relationship between subjective well-being and income or assets, or between subjective well-being and personality traits in developed countries. There is limited understanding of how institutional attributes, access to services, or policy-related issues influence subjective well-being, if at all. This is particularly true in low-income countries (Fafchamps and Shilpi 2008). We are unaware of any literature linking policy-related variables, such as uptake of index based livestock insurance (IBLI), with changes in SWB. Policies such as IBLI, which reduces drought-related risk faced by pastoralists, have the potential not only to impact material well-being (e.g., by replacing lost assets and reducing adverse coping behaviors, as documented by Janzen and Carter 2013), but also to improve subjective well-being, that is a broader indicator of how people's life satisfaction.

Commercially provided insurance, such as IBLI, intrinsically involves a tradeoff between material and non-material well-being if it priced above actuarially fair rates so as to ensure a profit margin for the underwriter. Theory suggests that actuarially fair insurance is welfare enhancing, regardless of whether or not it pays out, because most people are risk averse and insurance mitigates risk. But when insurance is not actuarially fair, and perhaps especially if it is highly imperfect, as is inevitably the case with index insurance products subject to basis risk, the expected loss (because premiums over time exceed expected indemnity payments) and the buyers' remorse that might result from a purchaser realizing ex post that she did not need coverage as no insurable loss occurred, might outweigh the oft-assumed benefits of insurance.

We use three rounds of annual household panel data collected between 2012 and 2014 in southern Ethiopia, with randomization of encouragements to buy the product, to estimate the causal effect of IBLI insurance on SWB. We also identify buyer's remorse effect exploiting the fact that some households had purchased in the second survey round and dropped coverage in the third round. We find that IBLI purchase has a positive and statistically significant effect on SWB. We also find statistically significant evidence of a buyers' remorse effect. The negative buyer's remorse effect is considerably smaller in magnitude than the positive effect of insurance coverage, however, suggesting that people the comfort people derive from insurance coverage more than compensates for any regret they suffer once they realize they did not need coverage, so that IBLI purchase is ex ante optimal, on average, in our survey sample. Even an imperfect insurance policy that does not pay out can leave a poor rural population better off.

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Figures

Figure 1: Administrative *woredas* of Borana *zone*

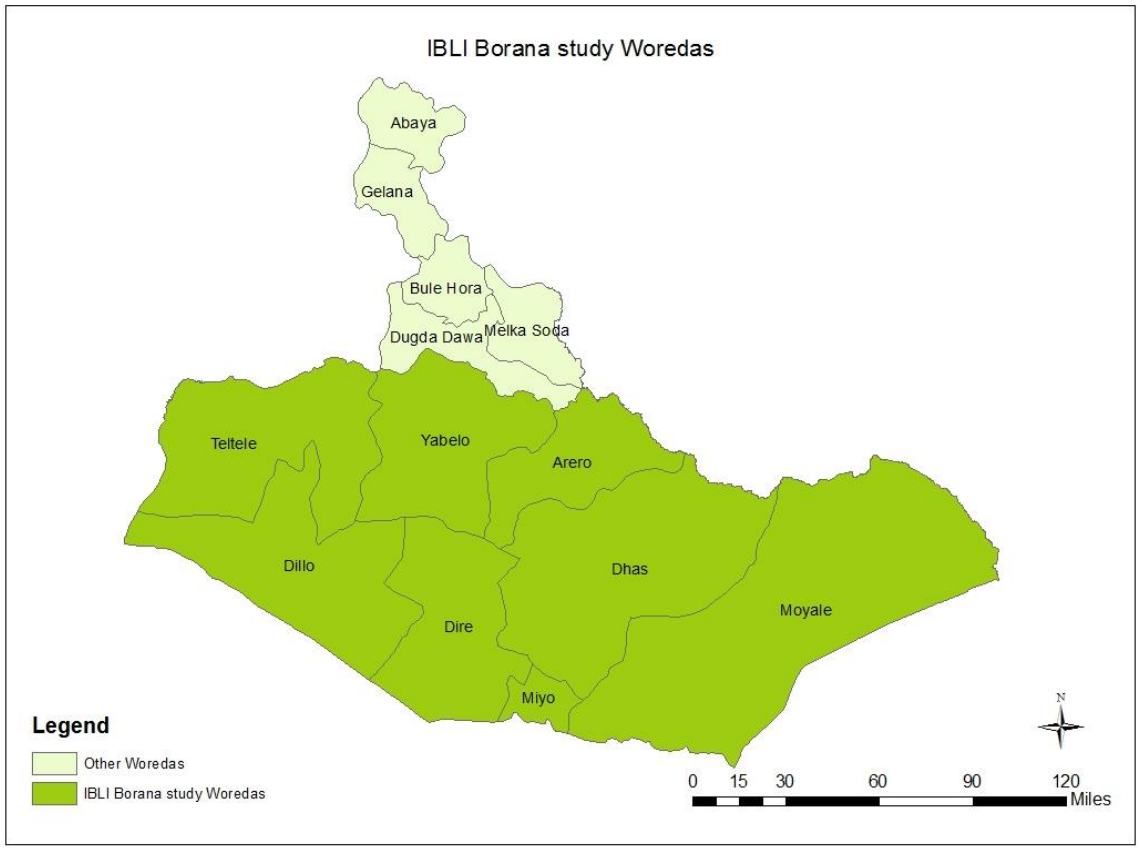
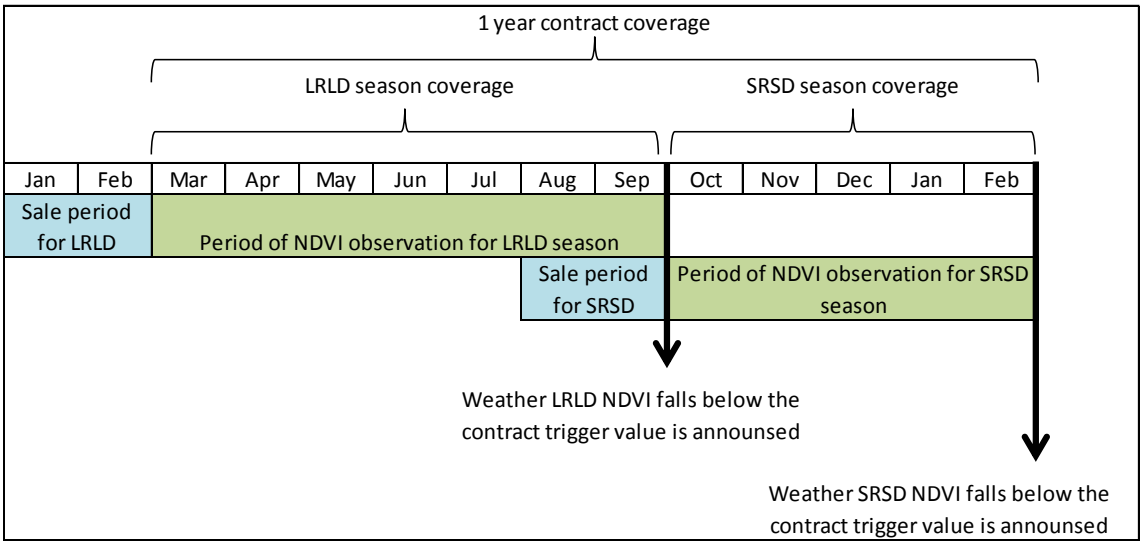


Figure 2: Temporal structure of IBLI contract



Chantarat et al. (2013)

Tables:

Table 1: Annual IBLI premium

	Amount of Premium (Birr)/unit insured							
	Aug-Sept 2012; Jan-Feb 2013; Aug-Sept 2013				Jan_Feb_2014			
Woreda		Cattle	Camel	Goat/ Sheep		Cattle	Camel	Goat/ Sheep
Dillo	9.75	487.5	1,463	68.3	8.6	516	860	68.8
Teltele	8.71	435.5	1,307	61.0	7.7	462	770	61.6
Yabello	7.54	377.0	1,131	52.8	6.7	402	670	53.6
Dire	9.49	474.5	1,424	66.4	8.4	504	840	67.2
Arero	8.58	429.0	1,287	60.1	7.6	456	760	60.8
Dehas	9.36	468.0	1,404	65.5	8.3	498	830	66.4
Miyo/Moyale	11.05	552.5	1,658	77.4	9.8	588	980	78.4

Source: ILRI, 2013

Table 2: Randomized Encouragement Design of IBLI

	August-September 2012				January-February 2013				August-September 2013				January-February 2014			
	Discount coupon	Comic book	Poet tape	None	Discount coupon	Comic book	Poet tape	None	Discount coupon	Comic book	Poet tape	None	Discount	Cartoon	Poet tape	None
Discount coupon	**412**				**411**				**408**				**408**			
	(79.8)				(79.8)				(80.3)				(80.3)			
Comic book	86	**108**			82	**99**										
	(16.7)	(20.93)			(15.9)	(19.2)										
Poet tape	66	0	**86**		56	0	**71**									
	(12.8)		(16.7)		(10.9)		(13.8)									
None	0	0	0	**62**	0	0	0	**66**								
				(12.0)				(12.8)								
Sample				**516**				**515**				**508**				**508**

Percentages in parentheses

Table 3: Distribution of discount coupons

Discount Rate (%)	Aug-Sep 2012		Jan-Feb 2013		Aug-Sep 2013		Jan-Feb 2014	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
0	104	20.2	104	20.2	100	19.7	99	19.5
10	48	9.3	48	9.3	48	9.4	49	9.6
20	48	9.3	47	9.1	47	9.3	47	9.3
30	49	9.5	50	9.7	48	9.4	48	9.4
40	54	10.5	54	10.5	55	10.8	54	10.6
50	48	9.3	47	9.1	47	9.3	47	9.3
60	47	9.1	47	9.1	47	9.3	48	9.4
70	52	10.1	52	10.1	50	9.8	50	9.8
80	57	11.0	57	11.1	57	11.2	56	11.0
100	10	1.9	10	1.9	10	2.0	10	2.0
Sample	516		515		508		508	

Table 4: Summary statistics

	By Insurance status			By Discount Coupon status		
	Insured	**Uninsured**	**Diff. in mean**	**Discount Coupon**	**No Discount Coupon**	**Diff. in mean**
Subjective well-being (SWB)	3.192	3.049	0.143**	3.095	3.115	-0. 021
	(0.041)	(0.036)	(0.056)	(0.032)	(0.051)	(0.059)
SWB relative to Borana pastoralists	3.250	3.138	0.112**	3.183	3.170	0.107
	(0.038)	(0.034)	(0.053)	(0.031)	(0.072)	(0.046)
Encouragement design						
Discount coupon	0.932	0.524	0.408***	-	-	-
	(0.013)	(0.020)	(0.027)			
Poet tape	0.110	0.039	0.071***	-	-	-
	(0.016)	(0.008)	(0.016)			
Cartoon	0.165	0.085	0.081***	-	-	-
	(0.019)	(0.011)	(0.020)			
Value of discount coupon (%) – SP1	0.353	0.164	0.188***	-	-	-
	(0.016)	(0.010)	(0.018)			
Value of discount coupon (%) – SP2	0.278	0.171	0.107***	-	-	-
	(0.016)	(0.011)	(0.082)			
Number of TLUs owned	20.592	17.323	3.269*	18.507	18.527	-0.020
	(1.671)	(1.050)	(1.874)	(0.973)	(1.925)	(1.937)
Non-livestock assets (‘000 Birr)	4.975	4.630	0.344	4.539	5.195	-0.655
	(0.480)	(0.460)	(0.702)	(0.314)	(0.815)	(0.723)
Annual income (‘000 Birr)	12.202	13.786	-1.585	13.508	12.534	0.974
	(0.791)	(0.994)	(1.425)	(0.963)	(0.693)	(1.474)
Expected number of TLU loss	13.077	12.989	-0.089	13.301	12.439	0.862
	(0.410)	(0.362)	(0.566)	(0.315)	(0.526)	(0.583)
Gender of household head (Male=1)	0.774	0.807	-0.033	0.790	0.807	-0.017
	(0.021)	(0.016)	(0.026)	(0.015)	(0.021)	(0.027)
Age of household head (years)	50.341	51.884	-1.542	50.583	52.897	2.315*
	(0.915)	(0.726)	(1.176)	(0.681)	(1.033)	(1.216)
Household size (#)	6.561	6.745	0.183	6.645	6.719	0.074
	(0.125)	(0.105)	(0.167)	(0.095)	(0.152)	(0.172)
Household composition						
Non-working age hh members (#)	3.619	3.754	0.134	3.721	3.656	0.066
	(0.090)	(0.071)	(0.115)	(0.066)	(0.103)	(0.119)
Female hh members (#)	3.276	3.330	0.055	3.267	3.393	-0.126
	(0.074)	(0.065)	(0.101)	(0.057)	(0.090)	(0.104)
Observations	380	636	1016	687	329	1016

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

Table 5: Linear probability model estimates of IBLI uptake

Dependent variable: IBLI uptake	Model (1)	Model (2)
Discount: SP1 only	0.259***	0.256***
	(0.046)	(0.047)
Discount: SP2 only	0.267***	0.270***
	(0.046)	(0.046)
Discount: SP1 & SP2	0.206***	0.203***
	(0.047)	(0.046)
Value of discount (%) SP1	0.193***	0.196***
	(0.060)	(0.059)
Value of discount (%) SP2	0.018	0.025
	(0.060)	(0.059)
Poet tape: SP1 only	0.100	0.092
	(0.085)	(0.084)
Poet tape: SP2 only	0.193***	0.183***
	(0.061)	(0.057)
Poet tape: SP2 & SP2	0.044	0.040
	(0.080)	(0.077)
Comic book: SP1 only	0.096	0.087
	(0.063)	(0.063)
Comic book: SP2 only	0.024	0.031
	(0.070)	(0.072)
Comic book: SP2 & SP2	0.164**	0.169**
	(0.071)	(0.069)
IBLI premium: SP1	0.025	0.051
	(0.076)	(0.115)
IBLI premium: SP2	0.169*	0.134
	(0.087)	(0.119)
Expected TLUs loss		-0.001
		(0.001)
Annual Income (‘000 Birr)		-0.001***
		(0.000)
Number of TLUs owned		0.000
		(0.001)
Asset Index		-0.011
		(0.015)
Household head gender (Male=1)		-0.031
		(0.104)
Household head age		0.000
		(0.012)
Household age squared		-0.000
		(0.000)
Household size		0.071
		(0.066)
Household head highest grade achieved		-0.001

		(0.002)
Iqub membership		-0.086**
		(0.039)
Household composition	No	Yes
Constant	-0.009	0.131
	(0.019)	(0.391)
Wald weak instrument test (Kleibergen-Paap Wald F-test) – P-value	0.000	0.000
R-squared	0.406	0.418
Observations	1,535	1,532
Number of unique observations	551	551

Standard errors clustered at the panel round and reera level in parentheses

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

Note: controls for household composition include number of household members by age group and gender: all/male/female #members<=5, #mem>5&<=15,#mem>15&<=64, and #mem>=65.

Table 6: Stage 2- Ordered logit regression (SWB) estimates

Dependent variable: SWB	Model (1)	Model (2)	Model (3)
Predicted IBLI uptake	0.753***	0.601***	0.828***
	(0.251)	(0.199)	(0.290)
Number of TLU insured	0.010	-0.004	-0.004
	(0.012)	(0.008)	(0.009)
Purchased IBLI in R2 but not in R3	-0.528***	-0.516***	-0.260*
	(0.167)	(0.138)	(0.145)
Annual income (‘000 Birr)		0.002	0.002
		(0.005)	(0.004)
Number of TLU owned		0.030***	0.030***
		(0.006)	(0.007)
Asset Index		0.238***	0.224***
		(0.069)	(0.066)
Household head gender			0.378**
			(0.173)
Household head age			0.026
			(0.021)
Household head age squared			-0.000
			(0.000)
Household size			-0.085
			(0.192)
Household head grade			-0.022***
			(0.004)
sigma2_u	1.269***	0.446***	0.432***
	(0.228)	(0.143)	(0.138)
Observations	1,529	1,529	1,529
Number of groups (households)	550	550	550

Standard errors clustered at the reera level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Aggregate effect of IBLI on SWB and actuarially fair premium rates

Variables:	Coef.	Std. Err.	P>z
Change in SWB ($\Delta\widehat{SWB}_{ivt}$)	0.205***	0.072	0.004
Actuarially fair premium ($\widehat{PREM}^{*}_{ivt}$)	51.480	109.527	0.638

APPENDIX

Table A1: Variable definitions

General information	***Description***
Round 1	Baseline – conducted: March/April, 2012
Round 2	Conducted: March/April, 2013
Round 3	Conducted: March 2014
Sales period 1	August-September 2012; contract active- October 2012-September 2013; Encouragement design- discount coupon, poet tape, cartoon
Sales period 2	January-February 2013; contract active- March 2013-February 2014; Encouragement design- discount coupon, poet tape, cartoon
Sales period 3	August-September 2013; contract active- October 2013-September 2014; Encouragement design- discount coupon, poet tape, cartoon
Sales period 4	January-February 2014; contract active- March 2014-February 2015; Encouragement design- discount coupon only
Variable	***Definition***
Reference free SWB	This is a Likert scale of how people perceive their economic condition. It's the answer to the question "*On which step do you place your present economic conditions?*" 1=very bad; …; 5=very good
SWB relative to Borana pastoralists	It's the response the question "*In general, how do you rate your living conditions compared to those of other Borana pastoralists?*" 1=much worse; …; 5=much better
Expected SWB relative to current conditions	The response to the question "*Looking ahead, do you expect your futre living condition to be better worse than current conditions?"* 1=much worse; …; 5=much better
Value of discount coupon	The amount of discount received, in percentages. This ranges between 0 to 80%.
Number of TLU owned	This is a standardized measure of livestock holding. It is obtained by multiplying number of livestock by the relevant TLU conversion unit for each livestock type. The conversion units used are TLU=1 for cattle, TLU=1.4 for camel, and TLU=0.1 for shoats.
Non-Livestock assets	Value of non-livestock assets in Birr. It includes assets such as bed frame, mattress, chair, table, bicycle, motorcycle, car, cellphone, computer, television, radio, wheelbarrow, grind mill, axe, spade, sickle, hoe, watch, jewelry etc.
Expected TLU loss	This is constructed from a set of questions that ask responds how many of 20 livestock (by type) they expect to die in the coming year, and converting their response using TLU conversion units. The questions used are "*what is the number out of 20 X do you expect to die over the March 2013 to February 2014 period?*" X here stands for livestock types.
# of non-working age household members	This includes household members 14 years old and under and 65 years and above.
Iqub membership	Iqub is an informal saving and credit institution (arrangement). The variable takes value 1 if a household member is a member of Iqub, and 0 otherwise.
Insurance premium	Insurance premium per TLU. Insurance premium vary by livestock type and Woreda. Some household in the sample also received discount. To reflect this variation, premium is calculated as: (1-% discount)×(premium_cattle×1+premium_camel×1.4+premium_shoats×0.1)/2.5
Cash income	Includes cash income (in Birr) from sale of livestock and livestock products, crop sales, wages and salaries, business and trading (petty trading, motorcycle services etc), cash for work (bush clearing, pond digging etc), mining etc.

Net transfers	Is the value of annual net cash transfers (during the four seasons: long dry, long rainy, short dry and short rainy). It includes both cash and in kind transfers. It is the difference between transfers received and transfers given.
Value of food aid	It is the value of annual food aid (in Birr) received by households. It is calculated by multiplying the value of monthly food aid by the number of months food aid is received.
Non-food assistance	The value of annual non-food assistance (in Birr). It includes value of annual should feeding, supplementary feeding, income from employment program, and non-food aid. The value of non-food aid consists of non-food aid from government, NGOs, and PSNP program – eg. Water, fodder, vaccination, cash transfers via PSNP.
Annual Income	Is the sum of annual cash income, net transfers, food aid, and non-food assistance

Table A2: SWB and vignette corrected SWB

	Vignette corrected SWB							
SWB	1	2	3	4	5	6	7	Total
Very bad (1)	27	93	0	0	0	0	0	120
Bad (2)	31	30	115	74	15	0	0	265
Neither good nor bad (3)	65	22	147	224	221	5	5	689
Good (4)	29	7	23	85	183	34	9	370
Very good (5)	0	5	0	8	0	58	17	88
Total	152	157	285	391	419	97	31	1,532

Table A3: SWB relative to Borana pastoralists and vignette-corrected SWB relative to Borana

	Vignette corrected SWB_Borana							
SWB_Borana	1	2	3	4	5	6	7	Total
Much worse(1)	13	51	0	0	0	0	0	64
Worse(2)	28	32	145	88	21	0	1	315
Same(3)	67	19	154	181	194	5	6	626
Better(4)	31	15	27	92	266	59	13	503
Much better(5)	0	2	0	2	0	13	7	24
Total	139	119	326	363	481	77	27	1,532

Table A4: Correlation matrix of standard and vignette-corrected SWB measures

	SWB	SWB relative to Borana	Expected future SWB
Vignette corrected SWB	0.6014	0.3207	0.1976
	(0.00)	(0.00)	(0.00)
Vignette corrected SWB relative to Borana	0.2852	0.5123	0.1606
	(0.00)	(0.00)	(0.00)
Vignette corrected expected future SWB	0.2087	0.1821	0.6106
	(0.00)	(0.00)	(0.00)

p-values in brackets

Table A5: Ordered logit regression (SWB relative to Borana pastoralists)

Dependent variable: SWB relative to Borana	Model (1)	Model (2)	Model (3)
Predicted IBLI uptake	1.255***	1.233***	1.410***
	(0.270)	(0.233)	(0.317)
Number of TLU insured	0.017	0.004	0.004
	(0.026)	(0.018)	(0.019)
Purchased IBLI in R2 but not in R3	-0.301	-0.360*	-0.202
	(0.206)	(0.194)	(0.213)
Annual income (‘000 Birr)		0.002	0.002
		(0.002)	(0.002)
Number of TLU owned		0.019***	0.018***
		(0.003)	(0.003)
Asset Index		0.198***	0.187**
		(0.075)	(0.077)
Household head gender			0.113
			(0.131)
Household head age			0.005
			(0.016)
Household head age squared			-0.000
			(0.000)
Household size			-0.252*
			(0.140)
Household head highest grade			-0.013**
			(0.006)
sigma2_u	0.632***	0.244***	0.250***
	(0.122)	(0.094)	(0.097)
Observations	1,529	1,529	1,529
Number of groups (households)	550	550	550

Standard errors clustered at the reera level in parentheses

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

Table A6: Stage 2- Ordered logit regression estimates (vignette-corrected SWB)

Dependent variable: vignette-corrected SWB	Model (1)	Model (2)	Model (3)
Predicted IBLI uptake	0.994***	0.977***	1.201***
	(0.268)	(0.242)	(0.281)
Number of TLU insured	-0.012	-0.016	-0.018
	(0.012)	(0.012)	(0.013)
Purchased IBLI in R2 but not in R3	-0.568**	-0.593**	-0.446*
	(0.245)	(0.247)	(0.249)
Annual income (‘000 Birr)		0.003	0.004
		(0.005)	(0.005)
Number of TLU owned		0.013*	0.014*
		(0.007)	(0.007)
Asset Index		0.348***	0.331***
		(0.069)	(0.069)
Household head gender			0.658**
			(0.308)
Household head age			-0.036
			(0.031)
Household head age squared			0.000
			(0.000)
Household size			-0.033
			(0.287)
Household head highest grade			-0.011***
			(0.004)
sigma2_u	7.443***	6.919***	6.579***
	(1.262)	(1.112)	(1.044)
Observations	1,530	1,530	1,530
Number of groups (households)	550	550	550

Standard errors clustered at the reera level in parentheses

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

Table A7: Ordered logit regression estimates (vignette-corrected SWB relative to Borana pastoralists)

Dependent variable: vignette-corrected SWB relative to Borana	Model (1)	Model (2)	Model (3)
Predicted IBLI uptake	1.194***	1.162***	1.407***
	(0.330)	(0.322)	(0.347)
Number of TLU insured	-0.013	-0.015	-0.016
	(0.012)	(0.011)	(0.013)
Purchased IBLI in R2 but not In R3	-0.111	-0.132	0.048
	(0.239)	(0.238)	(0.233)
Annual income (‘000 Birr)		0.001	0.002
		(0.002)	(0.002)
Number of TLU owned		0.010**	0.011**
		(0.004)	(0.004)
Asset Index		0.128	0.107
		(0.093)	(0.090)
Household head gender			0.521*
			(0.308)
Household head age			-0.044
			(0.031)
Household head age squared			0.000
			(0.000)
Household size			-0.260
			(0.365)
Household head highest grade			-0.015**
			(0.006)
sigma2_u	7.770***	7.424***	7.210***
	(1.314)	(1.253)	(1.177)
Observations	1,530	1,530	1,530
Number of unique observations (hhid)	550	550	550

Standard errors clustered at the reera level in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure A1: SWB vs. vignette corrected SWB

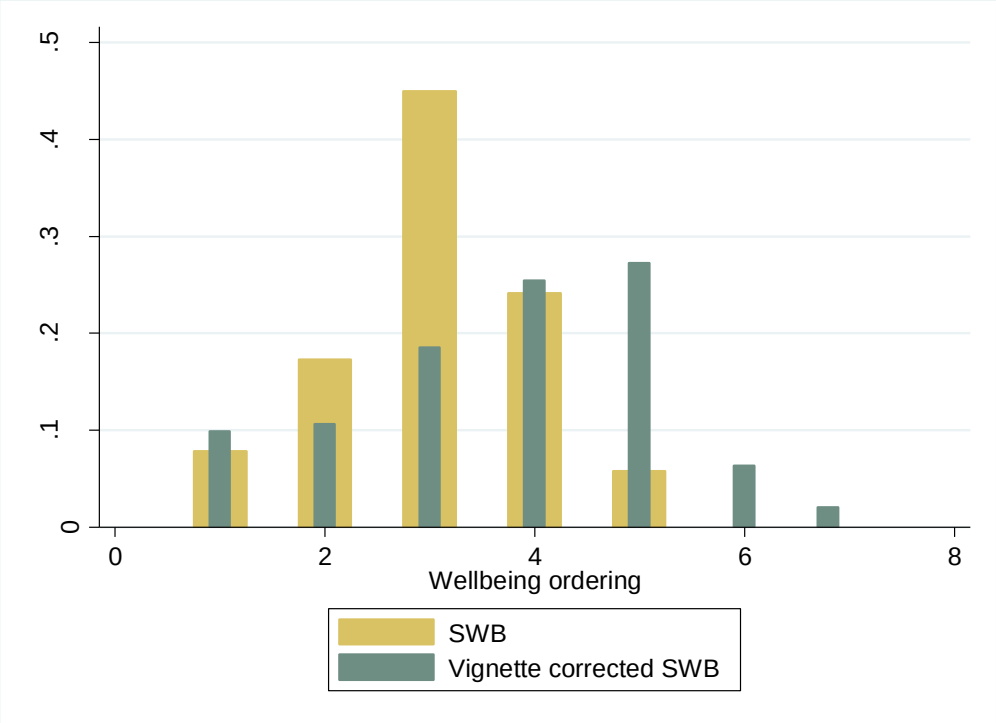


Figure A2: SWB relative to Borana pastoralists vs. vignette corrected SWB relative to Borana