The Effect of Index-based Livestock Insurance on Pastoralists' Saving Behavior: Empirical Evidence from Borena Zone, Ethiopia

Tnsue Gebrekidan (Ph.D.)

Ethiopian Civil Service University

Abstract

Because of climate change, agriculture in developing countries has become a riskier business. When weather shocks strike, in the absence of formal agricultural insurance markets, farmers often tap into their precautionary savings which is the quickest form of ex-post self-insurance to buffer consumption and/or restock herds. However, it may not be enough to cope with systematic shocks. Recently, index-based livestock insurance is getting growing attention to deal with systematic agricultural risks. In this paper, we employ descriptive and multiple regressions to estimate the causal effects of index-based livestock insurance on the saving behavior of the Borena pastoralists which is less studied and has remained unclear yet, using three round household level panel data. Our estimations result show that cash saving behavior of the pastoral households is significantly and positively influenced by the insurance uptake. This finding suggests that the insurance can increase the likelihood of cash savings as it can enable insured households to offtake their herds at speculated market prices. Likewise, since the insured have risk-averting behavior and the insurance does not provide coverage against losses due to idiosyncratic risks, they may tend to save precautionary cash.

Keywords*:* Index-based livestock insurance, Saving, Borena

Introduction

Agricultural risks have long been the main preoccupation of rural households' economies (Carter & Lybbert, 2012). Particularly, agrarians in sub-Sahara African countries which are heavily relied on rain-fed agriculture, face prolonged and severe drought-induced production risks (Ngigi, Ulrike & Birner, 2015) typically turned into consumption shocks. The incidence and severity of the shocks may vary among regions or from time to time-based on the respective country's agroecological setup, agricultural policy, and economic status. In 1984, a horrible famine that occurred in Ethiopia took several human and livestock lives into death and migration. With a special reference to this and many other

frequent drought occurrences, Ethiopia is labeled as a prime example of the most susceptible country to drought (Conway & Schipper, 2011). Furthermore, the precipitation shock is characterized by narrow intervals, and the weather condition is projected to get warmer in the future (Conway & Schipper, 2011).

A study by Chantarat, Mude, Barrett, & Carter, (2013) reveals strong evidence of poverty traps in the arid and semi-arid areas of the East African countries, and it is also true for Ethiopia, particularly in the Borena zone which covers vast pastoral land mass with inhabitants mostly relied on mobile pastoralism in search of forage and water for their herds. In the zone, drought is a primary source of risk for the loss of posture, water, animal mortality, and reduced market prices (Tadesse & Brans, 2012). The area is characterized by a very erratic rainfall pattern with an annual average of less than 500 millimeters (mm) and herding is the sole source of income for the growing inhabitants (Berhanu & Fayissa, 2010). Hurst et al, (2012) point out that a frequent drought has been triggering a large herd loss and putting the human population under pressure, although many traditional risks coping strategies have been used by different stakeholders and the pastoralist themselves.

In the absence of formal agricultural insurance markets; self-insurance, community-based arrangements, and peripheral aid are the most commonly used risk coping strategies in the area. Poor households usually cope with their economic shocks by tapping into their savings, borrowings from money lenders, cutting consumption**,** or distressful assets selling perhaps productive livestock or other assets, often partake in ruinous results and they are short-term risk copping mechanisms (Hurst et al, 2012; Tadesse & Brans, 2012; WFP, 2010). Specifically, saving is the most common form of ex-post self-insurance to assure consumption over time. The advantage of using saving especially cash saving as a risk coping strategy is its liquidity to draw upon quickly in a time when there is no time to sell assets, the price of an asset getting cheaper due to distressful sales, and/ or when there is no asset to sell (Tadesse & Brans, 2012). Despite the use of these strategies, many pieces of evidence suggest that it is insufficient and difficult to fully cope covariate risk of drought which often damages a large size of grassland, and as the household's and the specific community's self-insuring capacity is usually inadequate (Morsink, Clarke, & Mapfumo, 2016; Udry, 1994). As a result, the household habitually faces difficulties to recover into their former financial positions after the shock, and even they experience slower economic growth for a decade (Dercon, 2004).

Recently, Index-based livestock insurance (IBLI) is gaining widespread and growing acceptance by the poor rural households who typically have no access to formal insurance markets to deal with uninsured covariate weather risks (Chantarat, Mude, & Barrett, 2017). Researchers, policymakers, and development agencies are also giving it an ever-more important focus to it as an alternative tool for reducing the financial vulnerability of agricultural households usually aftershock (Barnett, Barrett, & Skees, 2008; Barnett & Mahul, 2007; Chantarat et al., 2017). Because, it indemnifies against named peril, usually loss of livestock due to loss of vegetation coverage, measured based on a realized communal vegetation index instead of individual loss. The vegetation coverage index serves as a proxy for predicted livestock mortality index (herd loss), and it is estimated using remotely sensed satellite data known as Normalized Difference Vegetation Index (NDVI) about an objectively pre-specified threshold (Jensen, Barrett, & Mude, 2017a; Leblois & Quirion, 2013; Takahashi, Ikegami, Sheahan, & Barrett, 2016; Ye, Li, Gao, Wang, & Yi, 2017).

Consequently, IBLI charms certain advantages over the traditional single or multi-peril agricultural insurance. Unlike the traditional livestock insurance contract, in IBLI loss adjustment at the household's farm level is not required and indemnity payment is not made based on the household's actual losses. As a result, transaction costs, moral hazard, adverse selection, and information asymmetry are reduced, perhaps eliminated (Ahmed, 2003; Chantarat et al., 2017; Conway & Schipper, 2011; Dercon, 2004; Gebrehiwot, 2015; Hellmuth, Osgood, Hess, Moorhead, & Bhojwani, 2009; Hill, Hoddinott, & Kumar, 2011; Skees, 2008; Vedenov & Barnett, 2004; WFP, 2010)

Originally, IBLI was started in Marsabit county of northern Kenya at the beginning of 2010 as a pilot project. Two years later (mid of 2012), the product was introduced into the southernmost part of Ethiopia (Borena zone) as an evaluation and complement strategy to the neighboring Marsabit county (ILRI, 2016). When the IBLI was introduced into the zone, it was initiated by the International Livestock Research Institute (ILRI) in collaboration with Cornell University, and many other institutions and universities and implementing partner of Oromia Insurance Company (OIC) and Oromia Credits and Saving Share Company(Bageant & Barrett, 2017; ILRI, 2016).

However, the main drawback of IBLI is the presence of basis risk as it does not provide complete risk transfer as long as loss assessment is not made at individual livestock loss. Its

protection is delaminated against covariate risks that would cover an entire herd in a given geographical area (Ahmed, 2003; Vedenov & Barnett, 2004). If the shock is idiosyncratic, households usually turned to use the traditional coping strategies, and saving is the most commonly used self-defense mechanism albeit they have bought IBLI coverage. According to Skees, (2008), both savings and insurance are solutions that should be in place before the onset of any shocking event, if full protection is required. More specifically, cash saving is liquid and quick to draw upon loss events (Tadesse & Brans, 2012), and it is more efficient and cheap to manage small to moderate herd losses.

Despite the benefits of IBLI as a modern and cash savings as a traditional risk coping strategy, the possible effect of purchasing IBLI on the cash savings behavior of households is not yet researched to the best of our knowledge. Indeed, Cai, (2013) conducted an impact evaluation of insurance on households' production and financial decisions of tobacco production counties in Jiangxi province of China and infers that insurance provision reduces the household's saving behavior by more than 30%. When insurance reduces future income uncertainty and households anticipate better income to smooth their future consumption across periods, the precautionary saving will have less incentive and its trend tends to decrease. Conversely, it is also possible that insurance can affect saving positively if the purchase of insurance is subsidized as is justified (Cai, 2013). Therefore, with noble household level panel data from the Borena zone of Oromia Regional State of Ethiopia, this paper analyses the effect of IBLI on the saving behavior of pastoral households.

Research Setting and Methodology

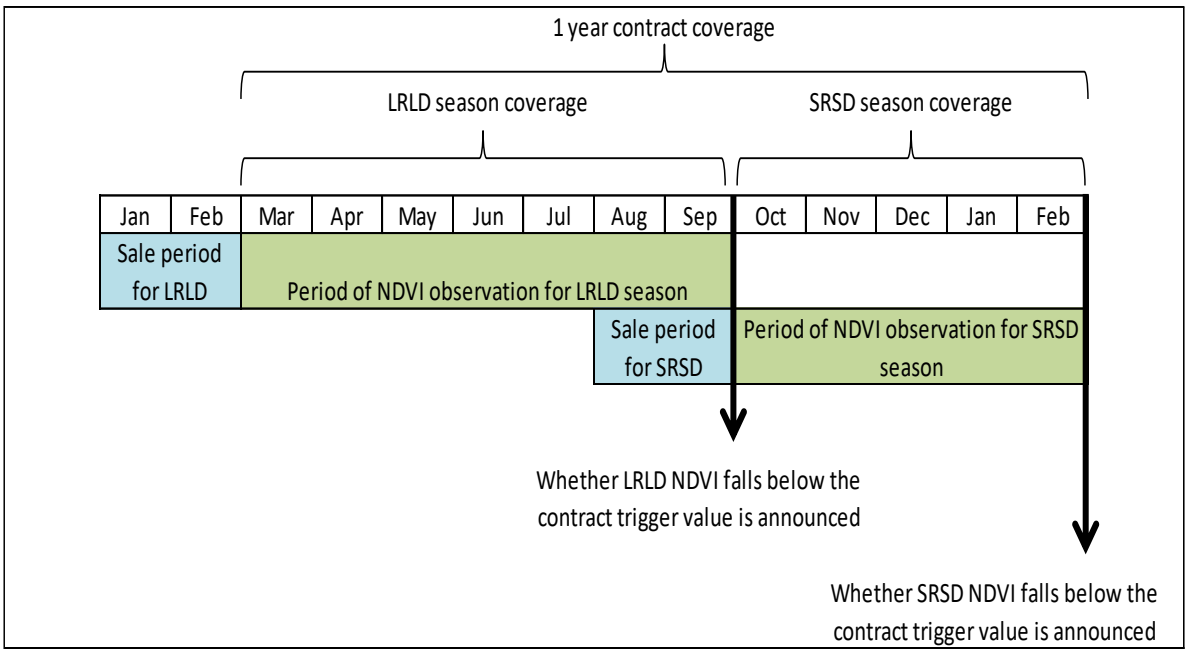
Study area

The study was conducted in Borana which is found at the southernmost point of the 13 zonal administration of the Oromia regional state of Ethiopia (Figure 1). It shares a long border with Kenya to the south, Guji zone to the north, Somali Regional state to the east, and Southern Nation Nationalities and Peoples Regional State (SNNP) to the west. The zone is a pastoral zone located in the arid and semi-arid lowlands vegetated predominantly with grass and bushland comprising eight woredas (administrative districts), namely: Arero, Dire, Dilo,

Teltele, Dhas, Moyale, Yabello, and Miyo; and 414 Reeras[1]. Topographically, it stretches in between 3°36 and 6°38′ north latitudes and 3°43 and 39°30′east longitudes, and between elevation points ranging from 1000m to the extreme southern border up to 1600m to the northeast above sea level with a total land area of about 95,000km^2 (McCarthy, Kamara, & Kirk, 2002). Yabello is the capital town of the zone which is 570 km far from Addis Ababa to the south.

Bi-modal type precipitation distribution is prominent in Borena rangelands with annual average rainfall ranging from 353 to 873 mm. The zone receives 60% of its rainfall between April and May which is called *'Ganna'* and 30% of the rainfall from October to November called '*Hagayya*'. It is also home to more than 350,000 human inhabitants and about one million livestock populations (OXFAM, 2014). In the area, herd migration from one to another place in search of forage and water is common especially during the two dry seasons, i.e., the long dry season (June to September) and the short dry season (December to March) (figure 1).

Figure 1. Figure 1. Time structure and design of IBLI contract in Borena



Source: Adopted from IBLI survey codebook in Ikegami & Sheahan, (2016)

Data type and source

[1]Reera is the fifth level of administrative division in Ethiopia. Next to the national administration the largest administrative division in the country is called regional governmental state followed by zonal administrations, woreda, Kebelle and Reera respectively.

Our analysis uses a noble households level panel dataset collected by the International Livestock Research Institute (ILRI) as part of its research and development project under IBLI in collaboration with Cornell University, University of Sydney, the BASIS Research Program at the University of California at Davis, Syracuse University, and the Institute of Developing Economies (IDE)-JETRO[2]. The data was collected annually (baseline and four IBLI sales periods (SP)) in three rounds between 2012 and 2014. After the baseline survey was conducted in march 2012, IBLI was sold twice a year throughout the two survey rounds exactly before the two rainy seasons (*'Ganna'* and '*Hagayya*') (*see Figure 1*)and the insurance coverage periods lasts for one year. The insurance clause allows one indemnity pay-out after each dry season (two insurance pay-out schedules per annum) (*see* Table 1).

Table 1. IBLI sales period and sample

Year	Month	Period	Round	Sample
2012	March	Baseline	One	515
2012 &2013	August-September 2012	SP 1	Two	506
	January-February 2013	SP 2		
2012&2013	August-September 2013	SP 3	Three	514
	January-February 2014	SP 4		

During the pilot survey and basic IBLI product design, Oromia Insurance Company (OIC) and Oromia Credits and Saving Share Company (OCSSCO) participated as an implementing partners. The data were collected using a questionnaire administered by SurveyBe software, and a qualitative interview assisted with interviewing software which is designed to conduct many validation checks and detect errors.

Sampling framework

To capture the geographic, agro-ecological, and socio-economic disparities among the Borena pastoralists; sampling was clustered at the Reera level within the eight Woredas in the zone. From the total number of Reeras, 24 Reeras (six percent) were purposively selected based on the availability of population, aggregate livestock ownership, and access to logistics. List and detailed information about each targeted population was obtained from each Reeras household roster with the help of local government development agents (DAs). While sampling from each Reera, a minimum rule of 25 sample households rule using proportional random sampling

[2]The survey data and codebook along interview questions are publically available at: http://livestockinsurance.wordpress.com/ibli-southern-ethiopia/)

method after stratification was used to ensure a representative enough sample. 15 percent of Reeras which did not meet the 25 household minimum requirement were merged with neighboring Reera into a single sampling unit making a total of 17 sampling units. Before the public announcement and commercializing of IBLI (baseline), 528 households were included but only 515 households were interviewed due to logistical reasons. Although the number of households who are consistently interviewed across the three rounds is only 465, new households were incorporated into the sample to replace lost households in rounds two and three. Accordingly, 506 and 514 sample households were interviewed in rounds two and three, respectively.

Empirical estimation strategy

As mentioned above, this study attempts to estimate the effect of IBLI on the saving behavior of the Borena pastoral households. We are interested not only in estimating the effect of IBLI on whether it changes the household behavior to have cash savings or not but also, in its effect on the amount of savings. Given that saving behaviors are only observed for a subset of the sampled households because those households who did not have savings reported zero savings. Therefore, estimating the parameters using the simple least squares model would give biased and inconsistent results (Heckman & Jan, 1979; Wooldridge, 2002). When we use a linear model to estimate limited dependant variables with many zero values, it usually gives a negative prediction. Besides, these zero observations did not allow us to take natural logarithms (Wooldrige, 2013).

According to our panel data, the saving behavior of the households falls on corner solution outcomes. The outcomes take a value of respective zeros for those who did not save, and a value of strictly positive values for those who do have cash savings. In this context, the Standard Heckman selection model seems as an appropriate approach, but it is mainly designed for only incidental truncation where the zeros value is unobserved values. Therefore, we were required to use a two-step approach to examine the impacts of IBLI on the household's (i) saving (S) behavior over the panel years is important. In this case, using censored and truncated regression models (equation 1) which are considered close cousins to the corner solution model also seems an efficient estimator.

$$S_{it} = \begin{cases} S_i^* \quad if\ S_i^* > Z \\ Z \quad if\ S_i^* \leq Z \end{cases} \tag{1}$$

Where, Z is the lower end of the dependent variable, i.e., zero saving in our case which is called censored sample.

However, the truncated sample has a greater loss of information (less information) than censoring, because it does not observe any information about those households who report zero savings. Instead, Censored regression models are more appropriate when the dependent variable has an observation of partly zero and partly continuous but strictly positive outcomes at one or more points(Wooldridge, 2002). The likelihood function for the standard censored regression with zeros and positive continuous values can be given as follows:

- $\boldsymbol{S_{it}} = \sum_{\mathbf{0}} \left[1 - \Phi\left(\frac{\boldsymbol{x_i\beta}}{\boldsymbol{\sigma}}\right)\right] + \sum_1 [\phi[y_i - x_i\beta/\sigma) * 1/\sigma]$ (2)

Where, '0' indicates the summation of the zero savings (S_{it}) by the sample households (i) over time (t), and '+' indicates the summation of positive observation. ϕ (.) and Φ denote the standard normal probability density functions (PDF) and cumulative distribution function (CDF) respectively. x_i denotes the vector of observed household characteristics explaining the amount saved such as demographic and socioeconomic characteristics of sample households including IBLI uptake which is our main variable of interest in this study. β represents the corresponding vector of parameters to be estimated, and y_i denotes an observed level of savings.

Based on this context, we use the Tobit model in a combination of two models; the probit model to estimate the household's decision whether to save or not ($\text{pro}\, S_{it} > 0 = \Phi(x_i\beta)$ and truncated regression model to estimate the household's decision on the amount of savings ($E(S_{it}|S_{it}) = x_i\beta + \sigma\lambda(\frac{x_i\beta}{\sigma})$. To figure out the extent of IBLI's effect on the saving behavior of the households, the marginal effect of the censored and truncated sample is estimated. Heckman's two-step approach is also used as an alternative model by first estimating the household's bivariate decision of saving using the probit model ($\text{pro}(S_{it} = 1) = \Phi(w'\Upsilon)$; and then, the regression for the selected sample ($E(\Upsilon|S_i = 1) = x_i\beta + \rho\sigma\lambda(w'\Upsilon)$ is estimated in the second step. From the probit model, we derive the inverse mills ratio (IMR) to control selection bias and obtain unbiased results (Wooldridge 2003).

Estimation Results and Interpretations

Summary Statistics

Table 2 exhibits a summary of some average differences between insured and uninsured households on selected variables such as basic demographic, socio-economic, and institutional characteristics. Following the baseline survey round where IBLI was not marketed, the insurance policies were sold twice (semi-annually) in each round, and the data was collected for each sales period. Indeed, it is observed that some buyers augmented their IBLI coverage further by buying additional policies and some policyholders also lapsed their policy after a year. However, we pooled the household data of each sale into one round panel of each survey year, because the insurance policies were sold for one full year. Since the first round, about 30% of the sampled households had bought IBLI coverage which is relatively higher than most index-based insurance projects in their pilot stages (Takahashi et al., 2016) but the uptake rate was reduced to about 18% in the third round. Throughout the three survey rounds, only 24.76% of the sample households bought insurance: 52.89% and 47.11% bought in rounds two and three respectively. Although coverage was given for one year and there were two potential indemnity pay-outs in a year, there were no indemnity pay-outs along the three-round panel periods.

Before looking at the behavioral factors that may explain the pattern of cash savings, it is important to address the proportion of savers and non-savers and then the mean difference in the amount of cash savings between the insureds and uninsured households. Accordingly, the average saving rate along the three survey rounds is found to be only 44.10% which is much lower than the saving rate in round two (57.94%) and round three (52.72%). This relatively low rate is due to a very low cash saving rate (21.94%) since the baseline survey time than in the follow-up surveys (before the introduction of IBLI). 46.24% of the sampled households keep their money at home: insured (41.60%) and uninsured (46.26%); and 40.76% insured and 36.22% uninsured household saves in savings and credit cooperatives (SACCO) respectively conjecturing that both insured and uninsured households have weak acquaintance with the modern financial institution, but it is much low in the uninsured households. Only about 6% of the sample households save their cash in a formal savings bank, and there is no apparent difference in this regard between the insured and uninsured households.

The total cash saving of insured households, on average, is found to be Birr 1004.32 which is higher by Birr 233.02 than the average savings of the uninsured herders at less than 10% level of significance. Unlike our expectation and Cai, (2013), this result shows the presence of a significant and positive correlation between IBLI and saving. It was perceived that households

with higher cash savings are fewer risk averters, but the correlation is found to be positive. This result infers that many households still use precautionary cash saving as a risk coping strategy because the IBLI does not provide coverage against idiosyncratic risk but only against systematic shocks.

Table 2. Descriptive statistics

Variable	Total Sample	Never purchase IBLI(A)	Purchase IBLI at least in one sales period(B)	p-value	Mean difference (B-A)
% Saving*(yes=1)*	44.10	37.37	62.63	(0.0) ****	25.26
	(0.01)	(0.01)	(0.03)		(0.03)
Saving Amount (in Birr)	828.99	771.30	1004.32	(0.06) *	233.02
	(66.22)	(76.33)	(132.87)		(153.23)
Monthly non-food consumption (in Birr)	679.55	667.04	717.58	(0.07) *	50.55
	(15.27)	(17.54)	(31.02)		(35.64)
Monthly food consumption (in Birr)	1940.16	1969.99	1849.50	(0.69)	-120.48
	(136.33)	(172.45)	(169.21)		(241.6)
Monthly Consumption (in Birr)	2619.71	2637.02	2567.09	(0.61)	-69.93
	(137.59)	(173.69)	(174.04)		(245.88)
Herd size (#)	17.44	20.22	16.53	(0.01) ***	-3.69
	(0.54)	(1.25)	(0.58)		(1.38)
Family size (#)	6.65	6.64	6.71	(0.30)	0.077
	(0.07)	(0.08)	(0.12)		(0.12)
Expenditure on herd (in Birr)	698.92	665.82	799.5	(0.03) **	133.69
	(32.33)	(38.22)	(59.57)		(70.77)
borrowings (in Birr)	419.01	354.32	615.66	(0.00) ***	261.34
	(24.94)	(26.77)	(58.30)		(64.15)
Aid (in Birr)	275.486	304.8623	186.1974	(0.00) ****	-118.665
	(12.50)	(15.60)	(16.59)		(22.78)
Lending (*(yes=1)*)	38.76	33.54	54.73	(0.00) ***	21.19
Lending (in Birr)	450.09	402.92	593.46	(0.03) **	190.55
	(49.66)	(60.28)	(81.37)		(101.27)
%Education(1=literate)	15.85	15.86	15.79	(0.97)	-0.07
	(0.01)	(0.01)	(0.02)	(0.16)	(0.02)
%Settlement(saver=1)					
Fully settled	56.72	61.05	48.74		-12.31
Partially settled	39.14	33.71	49.16		15.45
Nomadic	4.14	5.24	2.10		-3.14
%Religion(saver=1)				(0.53)	
Traditional	81.98	82.00	81.93		-0.93
Muslim	5.47	5.01	6.30		1.29
Christian	12.56	12.98	11.76		-1.22
Herd sales((in Birr)	7802.84	7567.59	8527.16	(0.83)	959.57
	(349.34)	(356.72)	(907.86)		(349.34)
Herd offtake (#)	2.82	3.12	2.71	(0.07) *	-0.41
	(0.11)	(0.12)	(0.26)		(0.14)
Money received (in Birr)	1201.37	1051.41	1657.19	(0.01) **	605.78
	(89.36)	(65.81)	(299.57)		(306.71)

Money Given (in Birr)	937.50	811.79	1319.58	(0.00) ***	507.78
	(44.28)	(43.80)	(117.44)		(125.35)
Annual income (in Birr)	8882.63	8873.75	8909.60	(0.48)	35.84
	(268.66)	(306.32)	(558.26)		(636.78)

Source: Author's computation

Note:***,**,* means significant at 1%, 5%, and 10% probability levels, and respective numbers in parenthesis denote standard errors, X^2 -value for categorical variables, and t-value for continuous variables.

On another hand, income from herd sales spillover the IBLI by Birr 959.57 on average. Even though the mean difference is not statistically significant, IBI enables the insured household to generate relatively higher income (Birr 8527.16) than the uninsured households (Birr 7567.59) from livestock sales, perhaps, it could be another reason for the positive relationship between the saving and the IBLI. Indeed, the number of TLU off-taken by insured households is significantly fewer by 0.41TLU than the offtake by uninsured households though they had a higher stock of herd size (20.22TLU) which seems to contradict the result with the high amount of income from the herd sales. Possibly, the reason is that insured households have relatively higher confidence to sell their herd at speculated market price instead of selling distressfully as the uninsured household would do often due to uncertain herding seasons. As a result, the average annual household total income of insured households equals Birr 8909.60, while that of uninsured households is a bit lower, around Birr 8873.75, yet the mean difference is not statistically significant.

Another important finding is that IBLI reduces aid reliance of the insured households by 32.41% on average. The insured household receives average aid assistance of Birr 186.19 in each month of the survey period, whereas, the uninsured households received Birr 304.86 which is higher than the average aid (Birr 275.5) by Birr 118.7 in the study area. Unlike cash saving and income, aid is inversely correlated with IBLI uptake significantly at less than a 1% level of probability. This result induces that IBLI can help to reduce the fiscal budget that would go to food aid in the study area. Moreover, aid programs could not always be responsive enough especially to systematic drought shocks (Chantarat, Barrett, Andrew, & Turvey, 2007).

Although, cutting consumption is among the commonly used short-term risk coping mechanisms (Marther, Mueller, & Birner, 2015; WFP, 2010), no significant difference was found in the mean of the monthly average consumption between insured and uninsured households, except in non-food related consumptions. The insured household spends slightly higher money on non-food-related consumptions than the uninsured counterparts at less than a

10% level of significance. This homogeneous behavioral response suggests that the likelihood of consumption cut is mostly a post-shock strategy, but no acute shock was triggered during the survey rounds. Moreover, livestock loss due to idiosyncratic risks, such as disease outbreaks, predators, and theft could be an equal threat to insured and uninsured households. Thus, all households including the insured ones could be required to buffer such loss by cutting monthly consumption. As a result, the average difference in consumption between the insured and uninsured counterparts is very small.

Households with IBLI coverage spend Birr 799.5 on their herds, on average, which is higher than the spending by the uninsured counterparts by Birr 133.7. This infers that there is a positive relationship between a household's willingness to spend on the herd and insurance uptake. Moreover, the mean difference in the expenditure on herd between the insured and uninsured households is statistically significant at probably level of 5%. This finding is in line with Dercon (2007), Dercon (1996), and Hill, Hoddinott, and Kumar (2011) that the reason why uninsured households spend less than insured households is plausibly due to the conviction that investment in uninsured livestock is an irreversible investment.

The data revealed that insured households were more likely to borrow money (69.47%) than uninsured households (52.03%). In terms of average cash borrowing, the insured and uninsured households borrowed Birr 615.66 and Birr 354.32 respectively, with an average difference of Birr 261.30. This significant and positive relationship ($P<0.01$) between IBLI and loan uptaking perhaps comes from the motive that insured households have less risk of loan default as they can collect insurance payments which may restore them to their prior financial position aftershock if systematic drought triggers. Besides, the insured households had higher money transfers than the uninsured households: Birr 605.78 received, and Birr 507.78 given out, respectively. Presumably, this money transfers slipover IBLI is due to either the cash transfers relaxing liquidity constraints or/and the insurance transfers relaxing risk constraints, allowing the herding households to try new financial products. This result is in line with the finding which was obtained by comparing cash transfers and index insurance in Norther Kenya by Jensen, Barrett, & Mude (2017).

Larger family size, mobile herding (nomadic and partial settlement status), and religion (taking traditional belief as a reference) of the sample households who have savings were expected to have a negative relationship with IBLI uptake. In this regard, the settlement condition and insurance status of the herders was a non-linear relationship. The mean difference between

insured and uninsured in terms of religion was very immaterial. Households who purchase IBLI at least in one sales period had a slightly higher family size. However, statistically, the average difference in family size, settlement status, and religion between the insured and uninsured households was found insignificant.

Empirical statistics

Tables 4 and 5 exhibit the empirical estimation results of the effect of IBLI on the saving behavior of the sample households. Both tables present the panel data had 1,535 observations with 861 zero observations and 674 strictly positive observations for the dependent variable (savings), throughout the three survey rounds. In a situation where the panel data is partly continuous (strictly positive) and partly zero likelihood mass at some points, censored and truncated regression are generally applied, as explained in section 3.4. The censored sample is about the whole panel of households (1,535) including herders with zero saving and strictly positive savings, whereas, the truncated sample is about the sample households only with positive savings. As a result, Table 3 shows truncated sample had fewer observations (674) but a higher mean of savings (Birr 2636.79) than the cash saving (Birr 1157.78) by the total sample households. We, thus, examine the effect of IBLI on those households who have zero savings, and who choose to save and then decide how much to save using censored and truncated regressions in a combination with the Tobit model (Table 4), and the Heckman model (Table5), alternatively.

Table 3. Mean cash saving of censored and truncated sample

Dependent Variable	Mean (censored sample, y)	Mean (Truncated sample, y>0)
Cash Saving	1157.78	2636.79

Table 4 presents the Tobit maximum likelihood estimates of IBLI on saving behavior of the sample households herder. The pooled Ordinary Least Squares (OLS) regressions (column 3) show that when a household purchases IBLI, his/her saving increases by Birr 983.5. However, since more than half (861) of the sampled households didn't save during the survey period, parameters estimated using OLS would be biased and inconsistent. To resolve such problems, we use the standard Tobit model (column 3). Accordingly, the P-values of the Tobit model, Tobit marginal effect of the censored sample (column 4), and Tobit marginal effect of the truncated sample (column 5) show that IBLI uptake positively correlated with the saving behavior of the sample households significantly at less than 1per cent probably level. The

Tobit marginal effect of the censored samples shows that when a household purchases IBLI coverage for one more TLU, his/her saving increases by Birr 1146. Similarly, the marginal effects of the truncated sample also show that in households with positive savings —if he/she buys the IBLI policy for one more TLU, his/her cash saving increases by Birr 978.

The above results are inconsistent with the finding by Cai (2013) and our expectations. Cai (2013) evaluates the relationship between insurance and saving decisions of tobacco-producing farmers in Jiangxi province of China. In his assessment, he infers that insurance tends to reduce the saving behavior of tobacco farmers. Because, when household income uncertainty is avoided or reduced by insurance, households would tend to have less precautionary saving.

Following, his literature, the same result was expected in this study. At the same time, Cai's study has suggested that insurance can significantly change the saving behavior of framers positively if the purchase of the insurance coverage is subsidized. Fortunately, coupons were distributed during the IBLI pilot project of Borena which provided a discount on the premium ranging from 10 to 100 percent if the household purchased IBLI coverage for the first 15 TLU covered in each sales period. This incentive enables the insured households to significantly increase their saving by Birr 600 at less than a 10 percent level of probability. Therefore, subsidized IBLI can help farmers to boost their savings significantly. As discounted or subsidized premium is more likely to have a positive effect on the insured household's income, saving can be increased.

Coefficients that estimate TLU sales and herd size are positively correlated with the probability of cash saving, reflecting that households who have higher income primarily from herding business are more likely to have higher cash savings. Mostly, insured households may not sell their herds distressfully but rather at a speculated market price which allows them to maximize their sales. Moreover, households with a large number of herds are often challenged by both systematic and idiosyncratic risks of herd loss. Indeed, the IBLI clause is a protection against financial loss that would occur due to systematic herd loss, particularly due to drought in a given communal grazing area, but herd losses due to non-drought risks are extensive (Lybbert, Barrett, Desta, & Coppock, 2004) and not covered by IBLI. This finding, therefore, underscores the importance of self-insurance through savings particularly against non-systematic risks. The estimation of the marginal effect of IBLI on saving the censored of the Tobit model shows that when a household bought IBLI for one more TLU his/her cash saving increases by Birr 1146. Similarly, the estimation for the truncated samples also shows for individuals with positive

savings—if a household bought IBLI for one more TLU, he/she will have Birr 978.07 additional cash savings.

Table 4. Tobit model results against saving

Variables	Pooled OLS	Tobit (y*)	Tobit marginal effects for censored sample (y)	Tobit marginal effects for truncated sample (y|y>0)
IBLI	983.5**	3,561***	1146***	978.067***
	(464.9)	(807.0)	(259.9)	(220.71)
herd size	26.22**	33.82*	10.89*	9.289*
	(11.60)	(19.46)	(6.27)	(5.346)
Social network: Yes	1,006	3,412***	1293.07***	1030.154***
	(658.5)	(1,126)	(492.12)	(371.814)
Birr spent	0.101	0.784	0.252	0.215
non-food consumption	(0.325)	(0.549)	(0.177)	(0.151)
Birr spent	0.0591*	0.123**	0.039**	0.034**
food consumption	(0.0349)	(0.0595)	(0.019)	(0.0163)
Amount of Birr	414.3	2,924***	941.23***	803.093***
lent out	(412.4)	(735.3)	(235.91)	(200.858)
Birr from TLU sales	0.034***	0.048**	0 .015**	0.013*
	(0.012)	(0.020)	(0.006)	(0.005)
Birr received from other	0.654***	0.665***	0.214***	0.183***
party	(0.050)	(0.079)	(0.027)	(0.022)
Birr spend on livestock	0.150	0.317	0.102	0.0813
	(0.177)	(0.296)	(0.095)	(0.296)
Coupon discount (1=yes)	232.334*	600.23*	244.093*	129.173*
	(470.689)	(718.047)	(291.137)	(359.341)
Education (0=illustrated)	144.3	-475.3	-156.085	-131.984
	(533.3)	(950.1)	(318.139)	(266.68)
Aid received (1=yes)	-222.7	-733.3	-236.916	-201.804
	(397.7)	(727.0)	(235.593)	(200.38)
Housing amenities:	283.0	350.5	106.56	93.372
Remained the same	(502.6)	(921.9)	(276.746)	(243.96)
Worsened	1,676**	3,594***	1,328.05**	1,068.88***
	(731.1)	(1,305)	(512.32)	(401.763)
Constant	-1,359*	-9,381***		
	(792.8)	(1,467)		
Sigma		9,142***		

		(315.7)		
Observations	1,535	1,535	1,535	674
R-squared	0.240			

Source: Authors' computation

Note:***,**,* means significant at 1%, 5%, and 10% probability levels, and respective numbers in parenthesis denote standard errors

Other socio-economic characteristics coefficients presented in columns (2)-(5), such as membership in the social networks, lending-out higher amount of money, receiving cash transfers in the form of gifts or support, and worsened trend of the household's housing amenities are largely positive and statistically significant in changing the saving behavior of herd household. Particularly, social networks such as *Iddir* and *Iquib* are an endogenous sort of insurance program (mutual aid association) run by a community or a group of people to meet emergencies like livestock losses. Usually, members of the social networks regularly or eventually contribute (pool) often a predetermined amount of money to the group saving and/or sharing risks faced by any member of the group due to predetermined peril/s. Likewise, when an individual lends out money, it is expected to be returned and considered as saving for the lender. When a household's housing amenities are worsened from the past, it could be due to focusing to increase saving instead of spending on housing features.

Table 5 provides the maximum likelihood of Cragg's model two-step estimation (Probit model for the discrete decision of saving and Truncated regression model for the decision on how much to save (column 2-4)), and two-step Heckman model (column 5 and 6) for saving behavior of the Borena pastoralists. The coefficient of IBLI uptake is positively and significantly correlated with the saving behavior of the pastoral households. Unlike our expectation and the finding by Cai (2013), this result is in line with the estimation result of the Tobit model (Table 4) and descriptive statistics (Table 2). This could prove that insured households are much more aware of the importance of risk aversion, and they use precautionary cash saving to cope with risks not covered by IBLI (idiosyncratic risks), as a result. Since households are sensitive to the price of insurance, subsidy or the provision of the discount coupon could also boost liquidity, thereby, cash savings are increased. The Truncated regression (column 3) also shows that for the household with positive cash savings – if he/she buys IBLI coverage for one more TLU, he/she will have an additional Birr 483.68 (from the truncated regression) or an additional Birr 1296.45 (from the Heckman regression) in cash savings. Particularly, in column 5, we present the Heckman regression conditioned on the inverse Mills ratio to control for prospective selection effects. Accordingly, the IBLI uptake

increases the probability of cash saving by 54.1%, consistent with the former models in the paper.

Table 5. Truncated and Heckman regressions estimation result

Saving	Probit	Truncated regression	Truncated regression Marginal effect	Hackman regression	Hackman regression Marginal effect
IBLI	0.348***	1097.26**	483.677**	0.541***	1296.445***
	(0.113)	(894.43)	(394.502)	(0.102)	(386.848)
herd size	0.001	45.82**	20.199**	0.001	10.594
	(0.003)	(20.99)	(9.272)	(0.003)	(8.176)
Social network: Yes	0.659***	1444.7***	660.88***	0.490***	1372.455***
	(0.191)	(1234.00)	(585.72)	(0.147)	(566.648)
Non-food consumption	0.001	0 .011**	0.005	0.001**	0.293
	(0.000)	(0.576)	(0.254)	(0.007)	(0.222)
Food consumption	-0.001*	-0.128*	-0.056*	-0.001	-0.049**
	(0.001)	(0.073)	(0.032)	(0.001)	(0 .024)
Birr lent out	0.526***	614.16	270.72	0.468***	1106.82***
	(0.107)	(838.39)	(369.644)	(0.091)	(380.801)
Birr from TLU sales	0.003**	0.030**	0.014*	0.003**	0.014**
	(0.001)	(0.019)	(0.008)	(0.001)	(0.007)
Birr transfer received	0.002	0.682***	0.301***	0.001	0. 158**
	(0.002)	(0.076)	(0.034)	(0.001)	(0.067)
Birr spend on livestock	0.001	0.135	0.059	0.001	0.103
	(0.001)	(0.310)	(0.136)	(0.001)	(0.108)
Coupon discount rate	0.005***	31.684**	13.966**	0.005***	2.085*
	(0.002)	(14.838)	(6.552)	(0.002)	(7.797)
Education	-0.104	279.89	122.628	-0.104	-207.409
(0=illiterate)	(0.118)	(1082.62)	(471.461)	(0.118)	(374.775)
Aid received (1=yes)	-0.165*	245.870	108.444	-0.165*	-291.687
	(0.088)	(857.440)	(378.428)	(0.088)	(306.377)
Housing amenities:	0.009	528.617	225.754	0.009	124.363
Remained the same	(0.112)	(1077.6)	(455.531)	(0.112)	(330.859)
Worsened	0.321**	2957.80**	1373.407*	0.321	1386.936**
	(0.163)	(1500.754)	(715.702)	(0.163)	(541.613)
Constant	-0.724***	-1051.187		-0.724***	
	(0.178)	(1683.695)8		(0.178)	
Sigma		451.6***		14099.012*	
		(284.580)			
Lambda (Mills ratio)				14,099*	
				(10,266)	
Rho(correlation)				0.76	
Observations	1,535	674	674	1,535	1,535

Note:***,**,* means significant at 1%, 5%, and 10% probability levels, and respective numbers in parenthesis denote standard errors

Coefficient estimates of variables such as non-food expenditure, TLU sales, membership of the social network, cash transfer received, lending-out money, discount in premium payment (coupon), and worsened the condition of housing amenities show a positive association with the cash saving behavior of the households at statistically significant probability level along all models (column 2-6). Except for the relation between the food expenditure and cash savings, which is odd, the increase in cash savings due to an increase in the TLU sales, cash transfers received, and receiving a discount in premium is understandable and expected. The former relationship is inconsistent with our expectations may be due to the presence of direct interlinkage with an increment in annual income. Whereas, the coefficient of food consumption is negatively associated with cash savings as expected. The statistical implication of food consumption in expressing the relationship is significant along all models except Hackman regression (column 5). The coefficient of aid is also negative but not significant on the truncated regression and marginal effect of both truncated and Hackman regressions components of the equation.

We run the above Cragg's model two-step estimation (Table 5) as an alternative model to the Tobit model (Table 4) since an alternative model to the Tobit model is often worth considering that the Tobit model is much more restrictive. To prove this assumption, we test the Tobit model against Cragg's two-step estimation model: LR statistics = -2629.8248 while the critical value is $X^2_{13,\,0.01}$ = 27.688. This shows the superiority of Cragg's two-step specification and this test statistic proves that the former is much more restrictive. In this estimation, the latter approach is found to be a more flexible parameter and allows us to embody the two-step decision of whether to save and how much cash to save.

Conclusions

This manuscript provides an initial outlook on the effect of IBLI in curving the cash-saving behavior of herding households. When weather-related shocks strike, the households may choose to draw their precautionary saving to buffer consumption or restock herds. Moreover, cash saving is quick, cheap, and efficient to manage small to moderate herd losses but may not be enough to cope with systematic shocks. In dealing with such systematic shocks IBLI is gaining widespread and growing acceptance but its effect on the saving behavior of insured households is not studied, yet. Indeed, one study has proved that cash savings and conventional indemnity insurance are negatively correlated. However, the inter-relation between IBLI and

cash-saving behavior is not known. Thus, we evaluate the effect of IBLI on cash saving using both descriptive and empirical statics. We address the issue of zero-valued observations (zero saving) using the Tobit model (one-step model) furtherly elucidated by two-step models (Probit + truncated regression and Heckman model).

The estimation results of the empirical and the descriptive statistics imply that cash saving behavior of the pastoral households is significantly and positively influenced by IBLI uptake. This result is contrary to our expectation and to the argument that households with higher cash savings are less risk averters possibly due to subsequent reasons. First, as the insurance could reduce the household's fear and worry about their future herding, they may accumulate rational herd size and sell at speculated market price, thereby, increasing their cash savings, unlike those uninsured herders who often distressfully offtake their herds at a cheaper price. Second, as IBLI provides coverage only against systematic risks, the households may still use precautionary cash saving as a risk coping strategy against idiosyncratic risks. Finally, the discount coupons for premium payments provided during each sales period enable the insured households to significantly increase their cash savings.

In addition to the IBLI uptake, the estimated results show that socio-demographic characteristics such as social network, herd size, food, and non-food consumption, lending out money, TLU sales, cash transfer received, discount coupons, aid, and housing conditions were significant in explaining both the decision to save and amount of cash saving. Thus, marketing strategies of IBLI that considers these variables could attract new savers and help those who have saved to optimize amount their cash savings. Plausibly, one of the limitations of our study is that we only observe three-round panel data which is very short, and no insurance was paid out during the period. Thus, further research needs to be conducted taking a longer panel to understand the long-term effect of IBLI on the cash-saving behavior of the households.

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