GRIPS Discussion Paper 19-07

Can Insurance Payouts Prevent a Poverty Trap? Evidence from Randomized Experiments in Northern Kenya

Yuma Noritomo
Kazushi Takahashi

June 2019

National Graduate Institute for Policy Studies
7-22-1 Roppongi, Minato-ku,
Tokyo, Japan 106-8677

Can Insurance Payouts Prevent a Poverty Trap?
Evidence from Randomized Experiments in Northern Kenya

Yuma Noritomo[a]* and Kazushi Takahashi[b]

[a] Graduate School of Economics, The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo, 113-0033, Japan

[b] National Graduate Institute for Policy Studies, 7-22-1, Roppongi, Minato-ku, Tokyo, 106-0032, Japan

*Corresponding author. Email: y-noritomo@g.ecc.u-tokyo.ac.jp

Abstract

Index-based insurance can have welfare-enhancing effects through two pathways: by mitigating weather-related shocks through payouts and by inducing policyholders to take greater yet more profitable risks. Most studies fail to distinguish between these two. Thus, we know little about which effects dominate and their long-term welfare implications. Using a random distribution of discount coupons and drought events that trigger payouts as exogenous variations, this study aims to identify both the ex ante risk-management and ex post payout effects of index insurance in a pastoral-dominant society of northern Kenya, where the presence of asset-based poverty traps, represented by bifurcated herd-size dynamics, has been established in the literature. We find the following: (1) Both risk-management and payout effects contribute to reducing the probability of distress sales of livestock; (2) payout effects also lead to a reduced slaughter of livestock; (3) while payout effects remain robust in a subsample of poorer households below the poverty trap threshold, risk-management effects do not. Overall, our results suggest that insurance payouts assist people in escaping from poverty traps more effectively than do behavioural changes accompanied by insurance purchases.

Keywords: index insurance, risk management, pastoralist, poverty trap, Kenya
JEL classification: O12, I32, G22, Q14

1. Introduction

Poor households in developing countries are highly vulnerable to weather-related risks. Since private insurance markets do not function well in the presence of asymmetric information, poor households have developed informal risk-management strategies, such as community mutual assistance and individual self-insurance. However, it is recognized that these informal insurance schemes cannot completely offset losses from aggregate shocks (Barret, 2011; Fafchamps et al., 1998; Kazianga and Udry, 2006; Morduch 1995, 1999; Townsend, 1994).[1] Uninsured risks have particularly important welfare implications in the face of a potential poverty trap based on asset level: shocks that push households' asset level below a critical threshold force them into a downward spiral to extreme poverty from which they cannot escape over an extended period of time (Barnett et al., 2008; Carter and Barrett, 2006; Lybbert et al., 2004).

To help farmers and pastoralists cope with weather risk and the chronic negative impacts of poverty traps, index insurance has been recently introduced in various developing countries (Barnett et al., 2008; Jensen et al., 2018; Miranda and Farrin, 2012; Smith, 2016; Takahashi et al., 2016). To overcome the inherent problems of conventional indemnity insurance such as moral hazard and adverse selection, as well as the high cost of loss verification, index insurance payouts are determined not by actual losses but by publicly observable exogenous indexes like rainfall, temperature, or vegetation levels (Cole et al., 2017; Gine et al. 2007; Miranda and Farrin, 2012). While the demand for index insurance is generally still low, the literature reveals that index insurance can benefit poor households through two channels (Bertram-Huemmer and Kraehnert, 2018; Cole et al., 2017; Hill et al., 2019; Matsuda et al., 2019). One is the effect on ex ante

[1] Jack and Suri (2014) report that mobile money has recently made risk-sharing with distant places possible in Kenya. They find that consumptions among mobile-money users was not significantly affected by shocks.

resource allocation (hereafter ‘risk-management effect’), which enables rural households to invest in higher risk/higher return activities. The other is the compensation for ex post losses through payouts (hereafter ‘payout effect’), which helps rural households recover from shocks relatively quickly. The number of studies on the impacts of index insurance is growing, but less is known about the payout effect, as most studies focus exclusively on the ex ante risk-management effect or fail to distinguish between them (Cai et al., 2015; Cole et al.,2017; Hill and Viczeisza, 2012; Karlan et al., 2014).

This study aims to fill that research gap by identifying the relative importance of ex ante risk-management and ex post payout effects for welfare enhancement among the poor. The study draws on an index-based livestock insurance (IBLI) project in an area of northern Kenya where the vast majority of dwellers depend on livestock production for their livelihood. Index-based livestock insurance was introduced in 2010 to protect livestock – the most important asset – against drought in this region, where the presence of a poverty trap based on the number of livestock holdings has been established in the literature (e.g. Lybbert et al., 2004; Santos and Barrett, 2011).

We focus on the impact of IBLI sales on wealth and investment in livestock because of its importance for livelihoods in our research area; we consider factors such as total herd size, the probability of livestock selling, livestock slaughtering, and investments in vaccinations and veterinary services, along with total household income and food expenditure. To address potential problems caused by a self-selection of insurance uptake in our causal inferences, we use randomly distributed discount coupons as an instrument and employ the instrumental variable (IV) approach. To distinguish between the ex ante risk-management and ex post payout effects, we exploit the longitudinal nature of our data, which cover several post-insurance coverage periods (i.e.

2010–2012) with and without payouts. We assess the direct impact of payouts assuming that the existence of payouts is exogenous once endogenous uptake is controlled for, which is plausible given that payouts for the index insurance product under study are triggered based on a predetermined vegetation index that is exogenous to households' decisions. Moreover, motivated by Janzen and Carter (2019) and Matsuda et al. (2019), who study the differential benefits of index insurance between the asset-poor and -rich, we conduct a subsample analysis on poor households whose initial herd size is below the critical poverty trap threshold established for our survey region by the literature in order to draw policy implications regarding the nexus between insurance uptake and long-term poverty.

Our empirical findings are as follows. While we find no direct evidence that households with payouts increase their herd size, we find that they are significantly less likely to reduce their livestock through distress sales or slaughter after a shock. Our results do not suggest that such decreases in selling and slaughter are associated with reduced food consumption or increased dependence on friends or relatives. We also find that those who purchase IBLI reduce their livestock sales even without payouts through the ex ante risk-management effect. Finally, we find that, while ex post payout effects remain robust in a subsample of poorer households below the poverty trap threshold, risk-management effects do not. Overall, our results suggest that insurance payouts play a more important role than behavioural changes induced by insurance uptake in moving the poor away from a poverty trap.

Our contribution to the literature is twofold. First, to the best of our knowledge, this study is the first to empirically distinguish the ex post payout effect of index insurance from the ex ante risk-management effect. Since a handful of studies on ex post effects classify their sample households only into insured and uninsured types, the results of the ex post effect may include both risk-management and payout effects (Hill et al., 2019; Janzen and Carter, 2019; Jensen et al., 2017). It is thus not clear whether benefits such as increased income stem from promoting high-return activities through the risk-management effect or from compensating losses through the payout effect after shocks occur. By isolating the impacts of insurance coverage periods with and without payouts, this study shows that IBLI helps prevent livestock reduction by both promoting investment and compensating losses via payouts, with the stronger effect being the latter. Second, our study is one of the first to examine the impact of index insurance in relation to poverty traps (Barnett et al., 2008; Chantarat et al., 2017; Janzen and Carter, 2019). The study verifies the hypothesis that index insurance payouts can help prevent pastoralist households from being trapped in a vicious cycle of poverty when a shock happens by prompting households to reduce their distress sales and livestock slaughter.

The rest of the paper is organized as follows. Section 2 briefly reviews the literature on index insurance impacts. Section 3 outlines the conceptual framework for the study's poverty trap hypothesis. Section 4 describes our research setting and data. Section 5 describes the empirical models used to estimate the causal impact of insurance payouts. Section 6 provides the results of the estimation. Finally, Section 7 concludes the paper.

2. Literature Review on Impacts of Index Insurance

There have been growing studies on the benefits of index insurance in developing countries. These highlight two channels by which households are protected against weather risk: ex ante risk management and ex post payout effects.

Most of the literature has focused on risk-management effects on farmers' ex ante investment decisions. A common response to uninsured risk is to allocate limited resources to lower profit opportunities in order to reduce exposure to risk (Morduch 1995, 1999; Rosenzweig and Binswanger, 1993). Studies have generally concluded that index insurance encourages investment in higher risk activities that generate higher expected profits for various products, including crops, livestock, tobacco, and cotton (Cai, 2016; Cai et al., 2015; Elabed and Carter, 2014; Hill and Viczeisza, 2012; Miura and Sakurai, 2015; Mobarak and Rosenzweig, 2012). For example, Cole et al. (2017) find that insurance provision induces farmers to allocate more agricultural inputs to higher-return but rainfall-sensitive cash crops. Karlan et al. (2014) show that mitigating risk by providing index-based insurance leads rural Ghanaian farmers to invest more in their farms and increase their expected profits. Jensen et al. (2017) show that households with IBLI coverage in northern Kenya increase investments in livestock health.

While many studies have examined the ex ante risk-management effect, few papers have studied the ex post impacts, such as the impact of receiving payouts on household welfare after a shock. Among these few, Jensen et al. (2017) find that households with IBLI in northern Kenya reduce their distress sales of livestock during droughts and increase their income per adult equivalent. Janzen and Carter (2019) also study IBLI in northern Kenya and find that poorer households reduce their destabilizing food consumption, while richer households reduce their asset sales, both of which can be seen as serious long-term economic repercussions. Bertram-Huemmer and Kraehnert (2018) indicate that Mongolian households that receive IBLI payments have faster rates of recovery from shock-induced asset losses, including in herd size, than comparable uninsured households have one to three years after the shock but that the effect disappears after four years. Hill et al. (2019) study the benefits of index crop insurance in Bangladesh and find that index insurance leads farmers to obtain higher yields and higher rice production through the provision and payouts of index insurance.

However, these studies may fail to isolate the ex post payout effect from the ex ante risk-management effect; the positive results for insurance products may thus include both. We identify the clean payout impacts on household wealth and welfare by focusing on the actual recipients of payouts besides those insured by IBLI.

3. Conceptual Framework of Poverty Trap Hypothesis

Several studies point out the existence of poverty traps based on herd size as measured by tropical livestock units (TLUs) in pastoral-dominant societies, including in our survey region (Barrett et al., 2006; Carter et al., 2007; Chantarat et al., 2017; Lybbert et al., 2004; Toth 2015).[1] This is characterized by the bifurcated dynamics of livestock holdings with multiple equilibria, whereby household livestock assets above a certain threshold reach a high equilibrium while those below reach a low level.

Figure 1 shows a conceptual framework on herd dynamics measured by TLUs at time t and t+1, with the presence of poverty traps. The diagonal degree line represents the point at which herd size at time t+1 is expected to be the same as the herd size at time t. If the herd size at time t is above the diagonal line, it grows over time until it reaches a high steady state; otherwise, it shrinks and eventually reaches a low steady state. In this framework, slipping into a poverty trap zone through temporal livestock losses can lead to chronic poverty.

Following Chantarat et al. (2017), we assume the threshold TLU value in our

[1] One TLU is equivalent to 1 cattle, 0.7 camel, or 10 sheep/goats. One TLU in a typical season is approximately equal to 20000 KSh. (Jensen et al., 2018)

survey region to be 15 per household, similar to the value used in previous studies on neighbouring communities in Ethiopia (Barret et al., 2006; Lybbert et al., 2004; Santos and Barrett, 2011).[2] In this setting, it is important for households with or less than 15 TLUs to increase their TLUs to climb out of the poverty trap and reach a high equilibrium.

4. Research Setting and Data

We use data drawn from the Marsabit district in northern Kenya covering 16 sub-locations: Dakabaricha, Dirib Gombo, Sagante, Bubisa, El Gade, Kalacha, Turbi, Karare, Kargi, Kurkum, Logologo, Illaut, Lontolio, Loyangakani, Ngurunit, and South Horr. The Marsabit district is typical of Africa's arid and semi-arid areas, where pastoral systems are dominant. A total of 924 sample households were randomly chosen in proportion to the number of households in each sub-location (Ikegami and Sheahan, 2017). Animal husbandry has long been a key element of economic and cultural identity in this area. The major species of livestock pastoralists in this region own are cattle, camels, goats, and sheep. In northern Kenya, there are usually two major rainy seasons per year. One is a long rainy season from March to May followed by a long dry season from June to September. The other is a short rainy season from October to December followed by a short dry season from January to February.

Although livestock is a key means of income generation, it comes with risks. In particular, pastoralists are often exposed to considerable risks due to frequent and severe droughts. Catastrophic herd losses are likely when rainfall is unexpectedly low, especially over two rainy seasons in a row (Chantarat et al., 2017). In this region, 28 major droughts

[2] Note that these studies set various critical thresholds because the actual positions are unknown. Lybbert et al. (2004) estimate a threshold of 10 to 15, Barret et al. (2006) 10 to 12, Santos and Barrett (2011) seven to 10 TLUs per household.

have occurred over the last 100 years, four of which occurred in the last 10 years (Ikegami and Sheahan, 2017). Pastoralists suffer high livestock mortality during droughts because of the reduced vegetation, which their livestock eat. Lybbert et al. (2004) report that, during the cycle of drought and recovery, livestock mortality rates can reach as high as 50%–80% for cattle and 30% for sheep and goats.

Pastoralists facing a drought may sell their livestock, reduce consumption, or borrow money as a short-term coping strategy to mitigate shocks (Hazell et al., 2010). For example, Ngigi et al. (2015) show that climatic shocks negatively affect households' livestock holdings through livestock sales and death. However, livestock sales may not fully compensate for losses in the face of covariate shocks because everyone is trying to sell livestock at the same time, thus reducing prices (Barrett et al., 2003; Fafchamps et al., 1998). Following the poverty trap hypothesis, livestock reduction can cause households to slip into the poverty trap zone and then into long-term poverty (Chantarat et al., 2017). Therefore, maintaining herd sizes against shocks is extremely important for avoiding the poverty trap in the long run.

To help pastoralists manage devastating drought-related livestock mortality and hence long-term welfare losses, an IBLI pilot project was launched in the Marsabit district of northern Kenya in January 2010. IBLI uses the normalized differenced vegetation index (NDVI), a numerical indicator for vegetation availability recorded by satellite, as an index with which to predict livestock mortality rates. Since the IBLI in our study was carefully developed through longitudinal household-level herd data and NDVI, the basis risk – deviation of actual loss from loss predicted by index – could be minimized (Chantarat et al., 2012). One unique aspect of our IBLI is that discount coupons, which allow households to purchase IBLI cheaply, are distributed randomly.

Table 1 reports the timeline of events related to this study. IBLI has been sold twice a year (August–September and January–February) since 2010. To purchase IBLI, households choose how many TLUs they want to insure for a given period.[3] The insurance premium, which is determined by regional livestock mortality risks, depends on the household's sub-location. Payouts are triggered when the predicted livestock mortality index exceeds 15%, and the amount increases in proportion to the mortality index. This study focuses on the 2010–2011 East Africa drought, which caused high livestock mortality. In late 2010, rangelands began to decrease feed staff in areas that had gone without long rains. The average number of TLUs per household decreased rapidly during the drought.[4] To study the impacts of IBLI on livestock wealth after the drought, a pre-intervention baseline survey was carried out in October and November 2009, and follow-up surveys were implemented three times annually between 2010 and 2012. From 2009 to 2012, three IBLI sales occurred with uptake rates of about 26.7%, 13.5%, and 13.2% for the first, second, and third sales periods, respectively. Payouts were triggered once in the second sales period and given to policyholders one year after their purchase. However, only about 8.2% of households with IBLI coverage were able to receive payouts; the rest of the insured were not eligible because their NDVI did not fall below the trigger point.

Table 2 reports the baseline summary statistics for 2009. The average household size is 5.64, and 63% of household heads are male. The average age of the household head is 47.83. The household heads' average years of education is only 1.18 year. Most of the households (92%) own livestock, and the average TLU holdings are 21.32. The

---

[3] The first and second sales contracts covered from March to November, while the third covered from October to September of the following year.

[4] Our data show that average TLU holdings per household were 21.32 in 2009, 19.01 in 2010, 13.50 in 2011, and 11.43 in 2012.

average annual income is only 46,790 Kenyan shillings (KSh).[5] The average income share of livestock is 54%, meaning that their livelihood mostly depends on livestock activities. Some households use vaccination or other veterinarian services as investments in their livestock. Only 20% of households have savings. Their savings, weekly food consumption, and transfers received and sent total 6,880, 1,401, 2,287, and 654 KSh, respectively. The households' average social group membership (e.g. women's groups, youth groups) is 0.54.

To encourage households to purchase IBLI and generate exogenous variations in IBLI uptake, discount coupons were randomly distributed to sample households. In each sales period, 60% of the surveyed households were randomly chosen to receive the discount coupons offering a 10% to 60% discount on the first 15 TLUs insured.

To check the covariate balances according to the distribution of discount coupons, we compare key baseline household characteristics between the households that received discount coupons at least once and those that have never received them (see Table 3). As expected, few characteristics differ significantly between these two groups. Households that received coupons are less likely to be fully settled and more likely to have a female household head, less years of education, and more household members. Although discount coupons were randomly distributed and only few characteristics are significantly different, these variables jointly differ significantly between recipients and non-recipients ($F = 2.189$; $p < 0.01$). This imbalance may affect the estimation results. To avoid this problem, we include these household characteristics as control variables in the regressions below.

[5] 1 Kenyan shilling = 0.0097 USD in November 17, 2018 (https://www.xe.com/).

5. Estimation Strategy

To measure clean payout effects, this paper focuses on whether households received payouts or not, in addition to insured by IBLI. Since the decision to insure is highly likely to be endogenous and to depend on unobservable household characteristics, ordinary least squares (OLS) estimation may be biased. To mitigate these concerns, we employ an IV approach by using the average rate of the discount received as an instrument, which would be strongly correlated with the decision regarding IBLI uptake but would not be correlated with the error term because it is randomly distributed (Takahashi et al., 2016).

Using an IV approach, we estimate the local average treatment effect (LATE) of insurance uptake. We use the TLUs insured during the first, second, and third sales periods as key variables where policyholders in the second IBLI sales period are eligible to receive payouts.[6] We do not separately examine the impact of each IBLI uptake period because considering multiple endogenous variables (TLUs insured at each period) would lead to an over-complex estimation and fragile results. We consider the TLUs insured rather than the number of IBLIs purchased during the three sales periods because the former is more closely related to the magnitude of welfare gain and loss.[7] For the outcome variables, we rely on data drawn from the fourth-round survey to identify the short-term impacts of both risk-management and payout effects after the drought. We thus first predict the IBLI uptake of household i in sub-location j as follows:

$$TLUs\_insured_{ij,1st2nd3rd} = \alpha_0 + \alpha_1 \boldsymbol{Discount\_rate_{ij,1st2nd3rd}} + \alpha_2 X_{ij,1st} + \alpha_3 AREA_j + \epsilon_{ij} \quad (1)$$

[6] No first-period IBLI payout was triggered in any sub-location, and the third-period IBLI payouts happened after our observation period.

[7] That said, our estimation results remain robust when we use the number of IBLI uptakes during the three sales periods instead of TLUs insured.

where $TLUs\_insured_{ij,1st2nd3rd}$ is the total quantity of TLUs insured during the three sales periods, $Discount\_rate_{ij,1st2nd3rd}$ is the average amount of discount coupons received in the three sales periods, $X_{ij,1st}$ is a vector of baseline household characteristics – such as assets, household size, savings, and risk preferences[8] – which can affect uptake, $AREA_j$ represents sub-location fixed effects, and ϵ_{ij} is the error term. We cluster all standard errors at the sub-location level, allowing the correlation of error terms at this level.

We then estimate the LATE of insurance and payouts on livestock assets and welfare outcomes in the round-four household survey using the following second-stage regression:

$$Y_{ij,4th} = \beta_0 + \beta_1 \widehat{TLUs\_insured}_{ij,1st2nd3rd} + \beta_2 \boldsymbol{PAYOUT_{ij,2nd}} + \beta_3 X_{ij,1st} + \beta_4 AREA_j + u_{ij} \quad (2)$$

where $Y_{ij,4th}$ represents the outcomes of livestock assets and welfare status related to the poverty trap hypothesis in the round-four household survey. $\widehat{TLUs\_insured}_{ij,1st2nd3rd}$ is the predicted TLUs insured obtained from the first-stage regression. $PAYOUT_{ij,\mathrm{2nd}}$ is the total amount of payouts received in the second payout period. $X_{ij,1st}$ and $AREA_j$ are again baseline household characteristics and sub-location fixed effects, respectively. u_{ij} is an error term. In this model, we assume that, conditional on the number of purchases of IBLI, payouts can be treated as exogenous because whether households

[8] To identify risk preferences, we conducted an experiment resembling a lottery that relies on a coin toss gamble in which risk and return are positively correlated. The respondents chose their preferences among six images of heads and tails sides; the possible heads–tails combinations were (A) 50 and 50, (B) 45 and 95, (C) 40 and 120, (D) 30 and 150, (E) 10 and 190, (F) 0 and 200 (KSh). Those who chose (E) and (F) are categorized as risk-taking, and those who chose (C) and (D) are categorized as risk-moderate. See Ikegami and Sheahan (2017) for details.

receive them is determined solely by the realized NDVI, which household behaviour cannot affect.

In this regression, the payout effect is β_2, whereas the risk-management effect is β_1 because this coefficient shows the net impact of IBLI uptake on outcomes when there is no payout. Any statistically significant effect of β_1 would indicate some change in preference or behaviour among the policyholders. Since the poverty trap hypothesis in our context is based on herd size, the effectiveness of payouts for avoiding the poverty trap is measured by β_2 on livestock-related outcomes such as herd size and the number of livestock offtake after the drought.

To link our analysis with the poverty trap hypothesis, as in Janzen and Carter (2019), we employ the same regressions above on a subsample of households with poor TLUs (TLUs < 15), as discussed in Section III.

6. Estimation Results

Table 4 reports the result of the first-stage regression. The result shows a causal impact of the average value of discount coupons received on the total TLUs insured in the three sales periods. More precisely, a 1% increase in discount rates significantly increases the total TLUs insured by 0.0816 in the three periods.

Table 5 shows the results of the second-stage regression. The coefficients of interest are those for payout/1000,[9] which capture ex post payout effects, and those for predicted TLUs insured, which capture ex ante risk-management effects. We first discuss the results of the former and then those of the latter.

As column (1) shows, we find no direct evidence that receiving payouts increases

[9] We divide the total amount of payouts by 1,000 for readability.

TLUs owned after the shock, which is in sharp contrast to Bertram-Huemmer and Kraehnert (2018), who suggest that IBLI payments significantly increase herd size in Mongolia. One possible explanation of our result is the small number of sample households that receive payouts, which may attenuate the impacts. Another possible explanation is the difference between the identification strategies used by the two studies: The previous results may include risk-management effects in addition to payout effects.

However, columns (2) and (3) report positive long-term implications for increasing herd sizes, showing that payouts significantly help pastoralist households avoid selling or slaughtering their livestock. These results are consistent with Gebrekidan et al. (2018), who reveal that purchasing IBLI significantly reduced the probability of herd offtake in the Borena zone of Ethiopia, which neighbours our survey region. Our results clearly suggest that receiving payouts helps maintain herd sizes when pastoralists suffer from drought.

Column (5) reports the payout effect on annual income after the drought. Although households with payouts are less likely to sell and slaughter their livestock, as discussed above, we find no evidence that their incomes increase.

While payouts seem to help maintain herd sizes, one potential concern may be that policyholders take other costly coping strategies against shocks. For example, those who suffer a drought may reduce consumption instead of selling their livestock, which may also jeopardize long-term welfare through loss of human capital (Hoddinott, 2006). However, such concerns seem inapplicable in our case. Columns (6), (7), and (8) report the payout effect on weekly food consumption, the amount of transfers given to friends or relatives, and the amount of transfers received from friends or relatives, respectively. There is no evidence that receiving payouts leads to significantly reduced consumption.

Nor do we find that payouts reduce reliance on others, as represented by transfers received. These results suggest that payouts prevent households from losing their livestock and do not cause them to take other costly risk-coping measures.

While payouts seem to have positive impacts on household livestock assets, we also find evidence of the risk-management effect on livestock assets, as reflected by the coefficient of predicted IBLI purchases. Our results show that the risk-management effect leads households to be less likely to sell their livestock, although we find no other significant effects.

In addition to the average treatment effects on the full sample of households, we also examine the effects on poor households by using only the subsamples.[10] Table 6 presents our estimation results for TLU-poor households.[11] The results are similar to those for the full sample analysis, but several findings are worth noting. First, the statistically significant payout effects on reducing livestock sales and slaughter remain, but they are larger in magnitude for the poor subsample than for the full sample. This difference implies that poor households gain more benefits from IBLI through the payout effect. Second, we find no risk-management effects on the probability of livestock selling, although we do find some positive risk-management effects on savings and TLU slaughtering.[12] These results support the view that insurance payouts are more helpful for escaping poverty traps in our context than are behavioural changes accompanied by insurance purchases.[13]

---

[10] We also examine the effects on rich households. Unlike for poorer households, payouts have limited impacts on welfare improvement for richer households, presumably because the damage from drought exceeds the compensation. For details, see Appendix Tables 1 and Table 2 for the results of the first- and second-stage regressions, respectively.

[11] Similar to the average results above, discount coupons statistically increase demand among households with smaller TLUs for IBLI. See Appendix Table 3 for the first-stage regression of IBLI demand for poor households.

[12] Our further analysis of TLU slaughter reveals that its most significant cause is for use in ceremonies or to be hospitable to guests.

[13] To test the sensitivity of our results, we also employed the same regressions with another threshold, 12 TLUs, which Lybbert et al. (2004) propose. The results, available upon request, are similar to those for the subsample

7. Conclusion

Index insurance has attracted increasing attention as a weather-related risk-mitigation device in developing countries. Previous studies show that purchasing index insurance leads households to invest in higher-risk and higher-return activities (e.g. Cole et al., 2017). However, little is known about the direct impacts of insurance payouts on household welfare. Using a random distribution of discount coupons and exogenous drought-induced payouts as exogenous variables, this study identifies the causal ex ante risk-management and ex post payout effects of IBLI on livestock assets in the pastoral-dominant region of northern Kenya, where the presence of poverty traps based on herd sizes has been established in the literature.

Our results reveal the existence of payout effects that help households avoid poverty traps. While we find no direct evidence that payouts significantly increase herd sizes, households with payouts are significantly less likely to sell and slaughter their livestock, which is consistent with Jensen et al. (2017), Janzen and Carter (2019), and Gebrekidan et al. (2018). Our results do not indicate that payout effects lead to reduced consumption or increased transfers received from relatives or friends. While we also find that ex ante risk management causes the insured to be less likely to sell livestock, it has no other significant effect. Further subsample analysis shows that the aforementioned payout effects remain robust, whereas the risk-management effects disappear for poor households.

Two implications can be drawn from our findings. First, index insurance can help households through payouts after a shock, in addition to the ex ante risk-management

analysis above.

effects found in the literature. Second, index insurance may have positive impacts on long-term poverty, given that payouts help households maintain their herd sizes in areas where the poverty trap hypothesis has been based on herd size.

We acknowledge that our analysis has several limitations. First, some of the effects may not be statistically significant because the number of households who received payouts were limited. Contrary to Bertram-Huemmer and Kraehnert (2018), who find that IBLI has significantly positive impacts on herd size, we find no evidence that IBLI increases herd size through either risk-management or payout effects. Second, while our results provide suggestive evidence of the impact of IBLI against poverty traps, we cannot conclude that payouts actually have significant effects on long-term consequences. Although maintaining livestock is of significant value in our setting, we are not sure whether current payouts could shift the long-term steady state from lower to higher. Future research should examine long-term datasets and examine whether payouts actually prevent the poverty trap.

Acknowledgement

This paper would not have been possible without the thorough and clean dataset provided by the Index Based Livestock Insurance (IBLI) for Northern Kenya's Arid and Semi-arid Lands: The Marsabit Pilot. project supported by the International Livestock Research Institute (ILRI), Cornell University, the BASIS Research Program at the University of California, Davis, and Syracuse University, in collaboration with an evolving set of implementing partners (Equity Bank, UAP Insurance Company, APA Insurance Company, and Takaful Insurance of Africa). All views and interpretations expressed in this manuscript are those of the authors and not necessarily those of the supporting or cooperating institutions.

Reference

Barnett, B.J., C.B. Barrett, and J.R. Skees (2008) ‘Poverty Traps and Index-Based Risk Transfer Products’, *World Development*, 36(10): 1766-1785.

Barrett, C.B. (2011) ‘Covariate Catastrophic Risk Management in the Developing World: Discussion’, *American Journal of Agricultural Economics*, 93(2): 512–513

Barrett, C.B., F. Chabari, D.V. Bailey, P.D. Little and D. L. Coppock (2003) ‘Livestock Pricing in the Northern Kenyan Rangelands’, *Journal of African Economies*, 12 (2): 127–155

Barrett, C.B., P.P. Marenya, J. McPeak, B. Minten, F. Murithi, W. Oluoch-Kosura, F. Place, J.C. Randrianarisoa, J. Rasambainarivo, and J. Wanglia (2006) ‘Welfare dynamics in rural Kenya and Madagascar’, *Journal of Development Studies*, 42(2): 248–277

Bertram-Huemmer, V., and K. Kraehnert (2018) ‘Does index insurance help households recover from disaster? Evidence from IBLI Mongolia’, *American Journal of Agricultural Economics*, 100(1):145–171.

Cai, H., Y. Chen, H. Fang, and L.-A. Zhou (2015) ‘The Effect of Microinsurance on Economic Activities: Evidence from a Randomized Field Experiment’, *Review of Economics and Statistics*, 97(2): 287-300

Cai, J. (2016) ‘The Impact of Insurance Provision on Household Production and Financial Decisions’, *American Economic Journal: Economic Policy*, 8(2): 44-88.

Carter, M.R., and C.B. Barrett (2006) ‘The Economics of Poverty Traps and Persistent Poverty: An Asset-Based Approach’, *Journal of Development Studies* 42(2): 178-199.

Carter, M.R., P.D. Little, T. Mogues, and W. Negatu (2007) ‘Poverty traps and natural disasters in Ethiopia and Honduras’, *World Development*, 35(5): 835–856.

Chantarat, S., A.G. Mude, C.B. Barrett, M.R. Carter (2012) ‘Designing Index-Based Livestock Insurance for Managing Asset Risk in Northern Kenya’, *Journal of Risk and Insurance*, 80(1): 205-237.

Chantarat, S, A.G. Mude, C.B. Barrett, and C.G. Turveyc (2017) ‘Welfare Impacts of Index Insurance in the Presence of a Poverty Trap’, *World Development,* 94: 119–138.

Cole, S., X. Giné, and J. Vickery (2017) ‘How does risk management influence production decisions? Evidence from a field experiment’, *The Review of Financial Studies*, 30(6): 1935–1970.

Elabed, G., and M.R. Carter (2014) Ex-ante impacts of agricultural insurance: Evidence from a field experiment in Mali, University of California at Davis

Fafchamps, M., C. Udry and K. Czukas (1998) ‘Drought and saving in West Africa: are livestock a buffer stock?’, *Journal of Development Economics*, 55(2): 273-305

Giné, X., R. Townsend, and J. Vickery (2007) Patterns of rainfall insurance participation in rural India, World Bank, Policy Research Working Paper 4408,

https://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-4408
Hazell, P., Anderson, J., Balzer, N., Hastrup Clemmensen, A., Hess, U., Rispoli, F. (2010) Potential for Scale and Sustainability in Weather Index Insurance for Agriculture and Rural Livelihoods, International Fund for Agricultural Development and World Food Programme, Rome, https://documents.wfp.org/stellent/groups/public/documents/newsroom/wfp281391.pdf?_ga=2.262128525.1004642470.1548487681-1757974141.1548487681
Hill, R.V. and A. Viceisza (2012) 'A field experiment on the impact of weather shocks and insurance on risky investment', *Experimental Economics,* 15(2): 341-371.
Hill, R.V., N. Kumar, N. Magnan, S. Makhija, F. Nicola, D.J. Spielman, and P.S. Ward (2019) 'Ex ante and ex post effects of hybrid index insurance in Bangladesh', *Journal of Development Economics,*136: 1-17
Hoddinott, J. (2006) 'Shocks and Their Consequences across and within Households in Rural Zimbabwe', *The Journal of Development Studies*, 42(2): 301-321
Ikegami, M. and M. Sheahan (2017) Index Based Livestock Insurance (IBLI) 'Marsabit Household Survey Codebook', International Livestock Research Institute.
Jack W. and T. Suri (2014) 'Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution', *American Economic Review*, 104(1): 183-223
Janzen, S. and M.R. Carter (2019) 'After the drought: The impact of microinsurance on consumption smoothing and asset protection', *American Journal of Agricultural Economics,* forthcoming
Jensen, N.D., C.B. Barrett, A.G. Mude (2017) 'Cash transfers and index insurance: a comparative impact analysis from northern Kenya', *Journal of Development Economics,* 129: 14–28.
Jensen, N.D., A.G. Mude and C.B. Barrett (2018) 'How basis risk and spatiotemporal adverse selection influence demand for index insurance: Evidence from northern Kenya', *Food Policy*, 74: 172-198.
Karlan, D., R. Osei, I. Osei-Akoto and C. Udry (2014) 'Agricultural decisions after relaxing credit and risk constraints', *The Quarterly Journal of Economics*, 129(2): 597-652
Kazianga, H. and C. Udry (2006) 'Consumption smoothing? Livestock, insurance and drought in rural Burkina Faso', *Journal of Development Economics*, 79(2): 413-446
Lybbert, T.J., C.B. Barrett, S. Desta, and L. Coppock (2004) 'Stochastic wealth dynamics and risk management among a poor population', *The Economic Journal*, 114(498): 750–777
Matsuda, A., K. Takahashi, and M. Ikegami (2019) 'Direct and Indirect Impacts of Index-Based Livestock Insurance in Southern Ethiopia', unpublished paper.

Miranda, M.J. and K. Farrin (2012) 'Index insurance for developing countries', *Applied Economic Perspectives and Policy*, 34(3): 391–427

Miura, K. and T. Sakurai (2015) The Impact of Formal Insurance Provision on Farmer Behavior: Evidence from Rural Zambia. Hitotsubashi University PRIMCED Discussion Paper Series, No. 67.

Mobarak, A.M. and M. Rosenzweig (2012) Selling Formal Insurance to the Informally Insured. Yale Economics Department Working Paper No. 97.

Morduch, J. (1995) 'Income smoothing and consumption smoothing', *Journal of Economic Perspectives*, 9(3):103-114

Morduch, J. (1999) 'Between the state and the market: Can informal insurance patch the safety net?', *The World Bank Research Observer*, 14(2): 187-207.

Ngigi, M., U. Mueller and B. Regin (2015) The role of livestock portfolios and group-based approaches for building resilience in the face of accelerating climate change: An asset-based panel data analysis from rural Kenya, ZEF Discussion Papers on Development Policy, No. 205.

Rosenzweig, M., H.P. Binswanger (1993) 'Wealth, Weather Risk and the Composition and Profitability of Agricultural Investments', *Economic Journal*, January 103(416): 56– 78.

Santos, P. and C.B. Barrett (2011) 'Persistent poverty and informal credit', *Journal of Development Economics*, 96(2): 337–347

Smith, V.H. (2016) 'Producer Insurance and Risk Management Options for Smallholder Farmers', *World Bank Research Observer*, 31(2): 271-289.

Gebrekidan, T., G. Yixin, B. Sheng, J. Wang, Z. Chi and K. Lyu (2018) 'Effect of index-based livestock insurance on herd offtake: Evidence from the Borena zone of southern Ethiopia' Climate Risk Management, https://doi.org/10.1016/j.crm.2018.10.003

Takahashi, K., M. Ikegami, M. Sheahan, and C.B Barrett (2016) 'Drivers of Index-Based Livestock Insurance Demand in Southern Ethiopia', *World Development*, 78: 324–340

Toth, R. (2015) 'Traps and thresholds in pastoralist mobility', *American Journal of Agricultural Economics*, 97(1): 315–332

Townsend, R.M. (1994) 'Risk and Insurance in Village India', *Econometrica*, 62: 539-591.

Figure 1: Poverty Trap Hypothesis

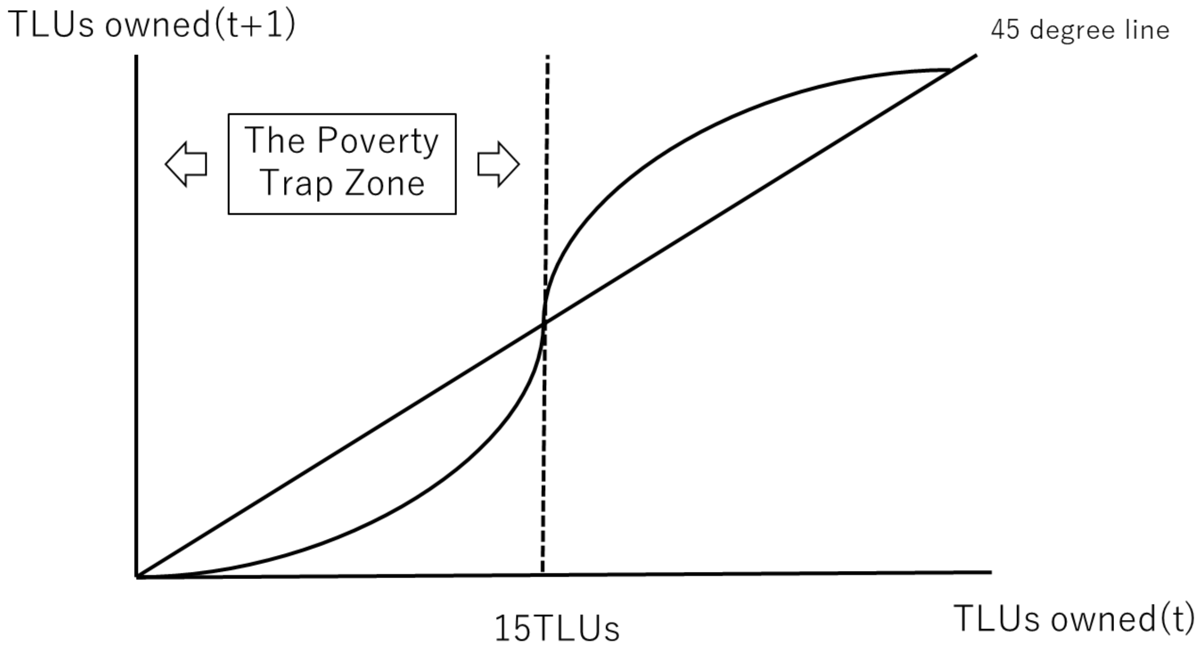

Table 1: Timeline of IBLI Events

October-November 2009	Household survey round 1
January-February 2010	1st IBLI sales period (without payouts)
October-November 2010	Household survey round 2
January-February 2011	2nd IBLI sales period (with payouts)
August-September 2011	3rd IBLI sales period (Payouts occurred after Household survey round 4)
October-November 2011	Household survey round 3
October-November 2011	1st IBLI indemnity payout period (No payouts because index was not triggered)
March-April 2012	2nd IBLI indemnity payout period
October-November 2012	Household survey round 4

Table 2: Baseline Household Characteristics

	Mean	SD	Max	Min
Household characteristics				
Household size	5.64	2.38	15	1
Household head information				
Male head dummy (=1 if household head is male)	0.63	0.48	1	0
Age of head	47.83	18.38	98	18
Education of head (Years)	1.18	3.3	16	0
Household Economy				
Livestock own dummy (=1 if household own camels, cattle, goats, and sheep)	0.92	0.26	1	0
Owned livestock (TLUs)	21.32	31.07	359.3	0
Annual household income (KSh)	46790	1021301	1602000	0
Income ratio of livestock (Income from livestock/income)	0.54	0.46	1	0
Vaccinations and other veterinarian services (KSh)	762	1864	36000	0
Saving dummy (=1 if household have savings)	0.2	0.4	1	0
Saving amount (KSh)	6880	58545	1500000	0
Weekly food consumption (KSh)	1401	8312	11280	10
Transfer received amount (KSh)	2287	9202	202000	0
Transfer given amount (KSh)	654	31670	55300	0
Social groups (number of social groups participating in)	0.54	0.8	4	0

Table 3: Balancing Tests

	By Discount Coupon		
	No coupon	Received coupon	Difference in means
Permanently settled (dummy=1 if true)	0.310	0.224	0.086*
	[0.046]	[0.015]	
Age of household head	45.640	48.106	-2.466
	[1.739]	[0.650]	
Age of household head squares	2382.500	2655.639	-273.139
	[195.413]	[73.463]	
Gender of household head (dummy=1 if head is male)	0.780	0.607	0.173***
	[0.042]	[0.017]	
Years of education of household head	2.200	1.057	1.143***
	[0.433]	[0.110]	
Household size	5.250	5.690	-0.440*
	[0.271]	[0.082]	
Risk-taking (dummy=1 if risk-taking)	0.340	0.273	0.067
	[0.048]	[0.016]	
Risk-moderate (dummy=1 if risk moderate)	0.360	0.445	-0.085
	[0.048]	[0.017]	
Amount of savings (KSh)	4954.000	7117.614	-2163.614
	[2303.545]	[2163.365]	
Number of TLUs owned	22.580	21.169	1.411
	[2.847]	[1.104]	
Value of non-livestock asset (KSh)	53252.930	40826.305	12426.625
	[36963.260]	[12407.064]	
Cultivating land (acre)	0.000	0.001	-0.001
	[0.000]	[0.000]	
Muslim (dummy=1 if true)	0.300	0.229	0.071
	[0.046]	[0.015]	
Catholic (dummy=1 if true)	0.290	0.303	-0.013
	[0.046]	[0.016]	
Traditional (dummy=1 if true)	0.270	0.313	-0.043
	[0.045]	[0.016]	

Social groups (Number of groups participating in)	0.490	0.541	-0.051
	[0.076]	[0.028]	
Observations	100	809	
F-test of joint significance (F-stat)			2.189***
Observations			909

Note: Standard errors and standard errors of the difference in means are reported in brackets. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 4: First-stage Regression on Demand for IBLI

	(1)
VARIABLES	TLUs insured
Average percentage of discount coupons received	0.0816***
	(0.0246)
Constant	-0.704
	(0.828)
Area fixed effect	Yes
Observations	909
Adj R-squared	0.173
F-stat	410.18

Note: Clustered standard errors at sub-location level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Controls include Number of TLUs owned, a dummy variable for fully settled, household size, years of education of head, age of head, age of head squared, gender of head, a dummy variable for risk-taking, a dummy variable for risk-moderate, the amount of savings (KSh), the amount of non-livestock asset (KSh), the ratio of livestock related-income per income, cultivated lands (acre), number of group memberships, a dummy variable for Catholic, a dummy variable for Anglican, a dummy variable for other Christian, a dummy variable for Muslim, and a dummy variable for traditional religion.

Table 5: Local Average Treatment Effect of IBLI on Outcomes

VARIABLES	(1) TLUs owned	(2) Probability of livestock selling	(3) TLUs slaughtering	(4) Vaccinations and veterinary services	(5) Household income	(6) Food consumption	(7) Transfer given	(8) Transfer received	(9) Saving amount
Predicted TLUs insured	0.322	-0.0277**	0.0219	-6.491	-3,892	2.218	210.3	-373.5	1,619
	(0.281)	(0.0121)	(0.0148)	(23.40)	(3,020)	(15.71)	(183.3)	(684.5)	(962.2)
Payout/1000	-0.120	-0.0265***	-0.00817**	-12.82	-1,664	14.94	56.83	557.2	-18.71
	(0.137)	(0.00803)	(0.00361)	(10.86)	-3,892	2.218	(260.0)	(651.8)	(720.7)
Constant	-8.141**	-0.135	0.173	-650.6***	-67,627**	-397.3*	2,671*	-4,924	-4,606
	(3.058)	(0.149)	(0.102)	(155.6)	(30,158)	(203.3)	(1,356)	(3,596)	(9,046)
Area fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	909	909	909	909	909	909	909	909	909
Adj R-squared	0.270	0.335	0.141	0.172	0.261	0.358	0.175	0.139	0.136

Note: Clustered standard errors at sub-location level are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. Controls include Number of TLUs owned, a dummy variable for fully settled, household size, years of education of head, age of head, age of head squared, gender of head, a dummy variable for risk-taking, a dummy variable for risk-moderate, the amount of savings (KSh), the amount of non-livestock asset (KSh), the ratio of livestock related-income per income, cultivated lands (acre), number of group memberships, a dummy variable for Catholic, a dummy variable for Anglican, a dummy variable for other Christian, a dummy variable for Muslim, and a dummy variable for traditional religion.

Table 6: Local Average Treatment Effect of IBLI: Subsample Analysis with TLUs < 15

VARIABLES	(1) TLUs owned	(2) Probability of livestock selling	(3) TLUs slaughtering	(4) Vaccinations and veterinary services	(5) Household income	(6) Food consumption	(7) Transfer given	(8) Transfer received	(9) Saving amount
Predicted TLUs insured	0.0424	-0.0228	0.0175**	26.01	3,743	3.910	353.2	375.2	2,736**
	(0.268)	(0.0151)	(0.00729)	(24.39)	(3,091)	(19.25)	(263.6)	(754.8)	(1,252)
Payout/1000	-0.166	-0.0329***	-0.00906***	-9.429	-3,288	18.79	-103.2	98.76	120.9
	(0.148)	(0.00838)	(0.00193)	(17.33)	(2,277)	(12.29)	(175.4)	(455.1)	(743.7)
Constant	-5.175*	-0.393**	0.0380	-609.2**	-62,969	-358.2	3,868**	-5,638	-8,445
	(2.514)	(0.162)	(0.103)	(220.2)	(39,401)	(250.2)	(1,739)	(5,860)	(10,646)
Area fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	549	549	549	549	549	549	549	549	549
Adj R-squared	0.284	0.286	0.103	0.145	0.354	0.357	0.161	0.120	0.142

Note: Clustered standard errors at sub-location level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Controls include Number of TLUs owned, a dummy variable for fully settled, household size, years of education of head, age of head, age of head squared, gender of head, a dummy variable for risk-taking, a dummy variable for risk-moderate, the amount of savings (KSh), the amount of non-livestock asset (KSh), the ratio of livestock related-income per income, cultivated lands (acre), number of group memberships, a dummy variable for Catholic, a dummy variable for Anglican, a dummy variable for other Christian, a dummy variable for Muslim, and a dummy variable for traditional religion.

Appendix Table 1: First-stage Regression about Subsample Demand for IBLI (TLUs ≧ 15)

	(1)
VARIABLES	TLUs insured
Average percentage of discount coupons received	0.0733**
	(0.0280)
Constant	-2.761*
	(1.343)
Area fixed effect	Yes
Observations	360
Adj R-squared	0.181

Note: Clustered standard errors at sub-location level are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. Controls include Number of TLUs owned, a dummy variable for fully settled, household size, years of education of head, age of head, age of head squared, gender of head, a dummy variable for risk-taking, a dummy variable for risk-moderate, the amount of savings (KSh), the amount of non-livestock asset (KSh), the ratio of livestock related-income per income, cultivated lands (acre), number of group memberships, a dummy variable for Catholic, a dummy variable for Anglican, a dummy variable for other Christian, a dummy variable for Muslim, and a dummy variable for traditional religion.

Appendix Table 2: Local Average Treatment Effect: Subsample Analysis with TLUs ≧ 15

VARIABLES	(1) TLUs owned	(2) Probability of livestock selling	(3) TLUs slaughtering	(4) Vaccinations and veterinary services	(5) Household income	(6) Food consumption	(7) Transfer given	(8) Transfer received	(9) Saving amount
Predicted TLUs insured	0.944	-0.0339	0.00957	-25.07	-16,865*	14.10	148.3	-1,326	-406.7
	(0.738)	(0.0226)	(0.0351)	(48.12)	(8,355)	(15.94)	(238.7)	(857.8)	(1,708)
Payout/1000	-0.871**	0.0358	0.0290	-42.18	-3,957	-40.86***	1,402***	3,064***	-6,455***
	(0.405)	(0.0225)	(0.0178)	(42.86)	(5,019)	(10.25)	(161.0)	(903.4)	(936.2)
Constant	-10.46*	0.178	0.360**	-364.5	-116,184*	-129.6	-169.3	-4,662	2,189
	(5.201)	(0.189)	(0.170)	(561.1)	(58,027)	(137.6)	(2,240)	(6,253)	(9,388)
Area fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	360	360	360	360	360	360	360	360	360
Adj R-squared	0.115	0.411	0.0839	0.219	0.204	0.391	0.306	0.248	0.131

Note: Clustered standard errors at sub-location level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Controls include Number of TLUs owned, a dummy variable for fully settled, household size, years of education of head, age of head, age of head squared, gender of head, a dummy variable for risk-taking, a dummy variable for risk-moderate, the amount of savings (KSh), the amount of non-livestock asset (KSh), the ratio of livestock related-income per income, cultivated lands (acre), number of group memberships, a dummy variable for Catholic, a dummy variable for Anglican, a dummy variable for other Christian, a dummy variable for Muslim, and a dummy variable for traditional religion.

Appendix Table 3: First-stage Regression about Subsample Demand for IBLI (TLUs < 15)

	(1)
VARIABLES	TLUs insured
Average percentage of discount coupons received	0.0895**
	(0.0315)
Constant	-0.514
	(0.966)
Area fixed effect	Yes
Observations	549
Adj R-squared	0.195

Note: Clustered standard errors at sub-location level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Controls include Number of TLUs owned, a dummy variable for fully settled, household size, years of education of head, age of head, age of head squared, gender of head, a dummy variable for risk-taking, a dummy variable for risk-moderate, the amount of savings (KSh), the amount of non-livestock asset (KSh), the ratio of livestock related-income per income, cultivated lands (acre), number of group memberships, a dummy variable for Catholic, a dummy variable for Anglican, a dummy variable for other Christian, a dummy variable for Muslim, and a dummy variable for traditional religion.