Can Insurance Payouts Prevent a Poverty Trap? Evidence from Randomized Experiments in Northern Kenya[1]

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Abstract

Index insurance is an attractive means to mitigate weather-related shocks. However, little is known about the direct impact of insurance payouts on long-term consequences. Using random distribution of discount coupons as exogenous variations, this paper identifies causal impacts of Index-Based Livestock Insurance payouts on livestock wealth in a pastoral-dominant society of northern Kenya. In this region, the presence of asset-based poverty traps, represented by bifurcated herd size dynamics, was established in the previous literature. Since falling into a poverty trap zone leads to chronic poverty, maintaining herd size through insurance payouts could be helpful. Our results show that households with payouts are significantly less likely to sell and slaughter their livestock. Further subsample analysis suggests that the effects on households below the poverty trap threshold are mostly similar to the full sample results. These results suggest that insurance payouts contribute to escape from a poverty trap.

Software: Stata

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I. Introduction

Poor households in developing countries are highly vulnerable to weather-related risks. Since private insurance markets cannot function well in the presence of asymmetric information, those poor households have developed informal coping strategies, such as community mutual assistance and individual self-insurance (Morduch, 1999). However, it is recognized that these informal insurance schemes cannot completely offset losses from aggregate shocks (Fafchamps et al., 1998; Morduch 1999; Kazianga and Udry, 2006; Barret, 2011).[2] Uninsured risk not only affects household welfare now, but also has long-term negative impacts (Dercon, 2004), because both ex-ante risk mitigation and ex-post risk coping strategies are often costly (Morduch, 1995). When households face weather shocks, protecting assets becomes especially important if there exists a poverty trap based on the asset level. Under the poverty trap hypothesis, there are multiple-equilibria of assets over time, where households become poorer as time goes on if the asset level drops below a critical threshold. Uninsured shocks can thus trap vulnerable households in impoverished positions for a long time.

To support farmers and pastoralists in developing countries against weather risk and chronic negative impacts through poverty traps, index insurance has been recently introduced in developing countries. To overcome inherent problems of traditional insurance, including moral hazard and adverse selection under asymmetric information, and high cost of loss verification, payments of index insurance are determined not by actual losses, but by exogenous publicly observable index like rainfall, temperature or vegetation levels (Miranda and Farrin, 2012). Although there might be a potential problem of basis risk, which is the difference between actual loss and loss predicted by the index, previous literature shows that index insurance benefits poor households through two channels (Hill et al., 2019). One is the effect on ex-ante resource allocation (which we will call the "risk management effect"), which enables agricultural households to invest in higher risk, but higher return activities (e.g., Cole et al., 2017). The other is compensating ex-post losses through indemnity payouts (which we will call the "payout effect"), which helps agricultural households recover from shocks relatively quickly (e.g., Bertram-Huemmer and Kraehnert, 2018). While the number of studies on the impacts of index insurance is growing, still less is known about the aforementioned payout effect, as the existing studies mostly focus only on the ex-ante risk management effect (Chantarat et al., 2017; Jensen et al., 2017; Bertram-Huemmer and Kraehnert, 2018; Janzen et al., 2018).

This paper fills that research gap with focus on an index-based livestock insurance (IBLI) project launched in northern Kenya in 2010, which aims to protect livestock－the most important asset in the region －against droughts. Since pastoralist livelihoods in the region depend largely on livestock production, they are vulnerable to frequent and catastrophic droughts that lead to massive livestock death. Such a massive livestock loss has a particularly important welfare implication in this region as the presence of a poverty trap based on the number of livestock holdings is established in the previous literature (e.g., Lybbert et al.,

[2] Jack and Suri (2014) report that mobile money makes possible risk sharing with distant places recently in Kenya. They find that consumptions of the mobile-money users were not affected much by shocks.

2004). However, under the coverage of index insurance, victims of the drought might have been able to mitigate the downside shock through receiving indemnity payouts. Therefore, the most important question the present paper addresses is: "Can receiving insurance payouts prevent households from slipping down a poverty trap zone when households experience the drought?" Based on the poverty trap hypothesis, this paper examines the effect of IBLI payouts, apart from risk management effect, on livestock assets after the drought.

To identify the impact of IBLI payouts on livestock wealth, this paper uses four-year panel surveys from 2009 to 2012. To overcome the challenge of self-selection of insurance uptake, we use randomly distributed discount coupons as an instrument. Based on the instrumental variable (IV) approach, we first analyze the average impacts of payouts on household livestock wealth after the shock. In addition, motivated by Janzen et al. (2018) who study the differential benefits of index insurance between asset poor and rich, we conduct subsample analysis on poor households, whose initial herd size is below the critical threshold of the poverty trap presented by the previous literature in our survey region.

Our empirical findings are summarized as follows. While we do not find direct evidence that households with payouts increase their herd size, results show that they are significantly less likely to sell and slaughter their livestock. Our results do not support that reduction of selling and slaughtering livestock causes to reduce consumption and increase transfer received from friends or relatives. We also find that those who purchase IBLI reduce to sell their livestock even without payouts through the ex-ante risk management effect. Further subsample analysis shows that the payout effect on poor households is similar to the results of full sample analysis.

Our contributions to the existing literature are twofold. Firstly, to the best of our knowledge, this study is the first to empirically distinguish an ex-post payout effect of index insurance from ex-ante risk management effect. Since a handful of previous studies on ex-post effects classifies sample households only into the insured and uninsured, the results of ex-post effect may include both risk management and payout effects. It is not clear that the benefits such as increased income come from promoting high-return activities through risk management effect or compensating for the losses through payout effect after shocks. By highlighting impacts of insurance uptake with and without payouts, this paper shows that IBLI helps avoid reducing livestock through both promoting investment and compensating losses by indemnity payouts. Secondly, our study is one of the first studies to examine the impact of index insurance in relation to poverty traps (Chantarat et al., 2017; Janzen and Carter, 2018). This paper verifies the hypothesis that payouts of index insurance can prevent pastoralist households from trapping into a vicious cycle of poverty when a shock happens through prompting households to reduce their distress sales and slaughter.

The rest of the paper is organized as follows. Section II provides the brief review of the literature about index insurance impacts. Section III discusses a conceptual framework of a poverty trap hypothesis. Section IV describes our research setting and data. Section V provides our empirical models to estimate the causal impact of the insurance payouts. Section VI provides results of the estimation. Section VII concludes.

II. Review of Existing Studies on the Impact of Index Insurance

There have been growing studies on the benefits of index insurance in developing countries, which highlight two channels of positive impacts on households against risk: ex-ante risk management and ex-post payout effects.

Most of the existing literature focused on risk management effect on ex-ante farmers' investment decisions. A common response to uninsured risk is to allocate limited resources to lower profit opportunities in order to reduce exposure to risk (Rosenzweig and Binswanger, 1993). A main conclusion drawn from the studies of risk management effect is that index insurance encourages investment in higher risk activities with higher expected profits. Growing studies reveal the existence of the risk management effect by using data of various products including crops, livestock, tobacco, and cotton, in different countries (Hill and Viczeisza, 2012; Mobarak and Rosenzweig, 2012; Cai et al., 2015; Cai, 2016; Elabed and Carter, 2014; Miura and Sakurai, 2015). 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 farm profits. In the context of a pastoral society, Jensen et al. (2017) show households with IBLI coverage in northern Kenya increase investments in livestock health.

While the ex-ante risk management effect of index insurance is important, only few papers assess ex-post impacts through the payout effect, i.e., how household welfares are affected by receiving indemnity payouts after the shocks (Chantarat et al., 2017; Jensen et al., 2017; Janzen et al., 2018; Bertram-Huemmer and Kraehnert, 2018). Among those, Jensen et al. (2017) find that households with IBLI in northern Kenya reduce distress sales of livestock during droughts and increase income per adult equivalent. Bertram-Huemmer and Kraehnert (2018) indicate that the payments of IBLI in Mongolia have a large positive effect on faster recovery from shock-induced asset losses including herd size than comparable uninsured households one to three years after the shock, but the effect disappears after four years. Tnsue et al. (2018) find that purchase of IBLI significantly reduces herd offtake, which is a major risk coping strategy for pastoralists and could lead to difficulties in recovering after the shock, in Borena zone of Ethiopia neighboring area of our sites. Janzen et al. (2018) also focus on IBLI in northern Kenya and find that asset poorer households reduce destabilizing food consumption, while richer households reduce selling assets, both of which can be seen as serious long-term economic repercussions. Hill et al. (2019) study the benefits of index 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 fail to assess the ex-post payout effect alone since the results may include both risk management effect and payout effect. In this paper, we identify clean payout impacts on household wealth and welfare by focusing on actual receipt of payouts besides insured by IBLI.

III. Conceptual Framework of Poverty Trap Hypothesis

Several studies show that there is a poverty trap based on the herd size measured by Tropical Livestock

Units (TLUs) in pastoral dominant societies including our survey region (Lybbert et al., 2004; Barrett et al., 2006; Carter et al., 2007; Toth 2015; Chantarat et al., 2017) , which guides our paper.[3] This is explained by the bifurcated dynamics of livestock holdings, meaning that household livestock assets above a certain threshold reach a high equilibrium while those below reach a low level.

Figure 1 shows our conceptual framework based on the previous literature. This represents a relationship between the household livestock holdings, measured by TLUs, at time t and t+1. The diagonal degree line represents a point at which herd size at time t+1 is expected to be the same as herd size at time t. If the herd size at time t is above the diagonal line, it grows larger and larger until reaching a high steady state, otherwise it shrinks and eventually reaches a low steady state. In this theory, slipping down to a poverty trap zone through temporal livestock losses brings the chronical impoverished situations in the future.

Following discussions of Chantarat et al. (2017) on the poverty trap hypothesis in our region, we assume the threshold value of TLUs to be 15 per household, which is consistent with previous studies on neighboring communities (Lybbert et al., 2004; Barret et al., 2006; Santos and Barrett, 2011).[4] In this setting, it is important for households with less than 15 TLUs to increase their TLUs to escape from the poverty trap, and reach to a high equilibrium.

IV. Research Setting and Data

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

Although livestock is a key means of income, they also come with risks. In particular, pastoralists are often exposed to remarkable risks due to the frequent and terrible droughts. When there is little rain, especially over two rainy seasons in a row, catastrophic herd losses are likely to happen (Chantarat et al., 2017). In this region, there were 28 major droughts for the last 100 years, 4 of which occurred in the last

[3] 1 TLU is equivalent to 1 cattle, 0.7 camel or 10 sheep/goats. 1 TLU in a typical season is approximately equal to 20000 KSh. (Janzen et al., 2018)

[4] Note that these studies conclude the critical threshold in some range because the actual position is unknown. Lybbert et al. (2004) estimate a threshold of ten to fifteen, Barret et al. (2006) ten to twelve, Santos and Barrett, (2011) seven to ten TLUs per households. Therefore, we check another threshold value, 12 TLUs per household, as the sensitivity check of our analysis.

10 years (Ikegami and Sheahan, 2017). Once drought happens, pastoralists suffer high livestock mortality because of the decrease in vegetation which their livestock eat. Lybbert et al. (2004) report that during the cycle of drought and recovery, livestock mortality rate can be massive up to 50-80% for cattle and 30% for sheep and goats.

When pastoralists face a drought, they may sell their livestock, reduce consumption, or borrow money as a short-term coping strategy to mitigate shocks (WFP, 2010). For example, Ngigi et al. (2015) shows that climatic shocks negatively affect households' livestock holdings through livestock distress sales and death, although livestock sales do not effectively compensate for the loss in the face of shock because everyone tries to sell it at the same time, reducing its prices (Fafchamps et al., 1998; Barrett et al., 2003). Under the poverty trap hypothesis in our context, the reduction of livestock can cause households to be slipped down to the poverty trap zone, pushing households into impoverished states for a long period (Chantarat et al., 2017). Therefore, maintaining herd size against shocks is extremely important to avoid 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 Marsabit districts of northern Kenya in January 2010. IBLI uses a numerical indicator of vegetation availability recorded by satellite－Normalized Differenced Vegetation Index (NDVI)－as an index to predict livestock mortality rates. Since IBLI in our study was carefully developed through longitudinal household-level herd data and NDVI, the basis risk could be minimized (Chantarat et al., 2012). One unique design of our IBLI is that discount coupons, which allow households to purchase IBLI cheaper, are distributed randomly.

Table 1 reports the timeline of events related to this study. IBLI is sold over two periods a year (August-September and January-February) just before the two rainy seasons. To purchase IBLI, households choose how many TLUs they want to insure for a given period.[5] The insurance premium is different by sub-locations where households live. Indemnity payouts are triggered when predicted livestock mortality index exceeds a 15 percent, and the amount increases in proportion to predicted livestock mortality index. This paper focuses on the 2010-2011 East Africa drought, which caused great livestock mortality. In the late 2010, rangelands began to decrease feed staff without long rains. The average number of TLUs per household decreases rapidly through the drought.[6] To study the impacts of IBLI payouts on livestock wealth after the drought, a pre-intervention baseline survey was carried out (October - November in 2009) and the follow-up surveys were implemented annually. Our panel dataset includes various variables, for example, household basic demographic characteristics, livestock accounting, including offtake and slaughter, informal risk-sharing and IBLI contracts. From 2009 to 2012, there were three-time IBLI sales and an indemnity payout triggered at the second payout period. Of all households who purchased IBLI

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[5] 1st and 2nd sales contracts cover from March to November while 3rd sales contract covers from October to September (next year).

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

during the second payout period, about 8.2% was able to receive indemnity payouts.

Table 2 reports baseline summary statistics in 2009. The average household size is 5.64. 63% of household head is male. The average age of household head is 47.83. The average years of education of household head is only 1.18 years. Most of the households (92%) own livestock, and average TLU holdings are 21.32. The average annual income is only 46790 Kenyan Shillings (KSh).[7] The average income ratio of livestock is 54%, meaning that their livelihood mostly depends on livestock activities. Some households adopt vaccination and other veterinarian service as an investment for their livestock. Only 20% of households have savings. The amount of savings, weekly food consumption, receiving transfers and giving transfers total 6880, 1401, 2287, and 654 KSh, respectively. On average, households join 0.54 of social groups, for example, women's group or youth group.

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

In order to check covariate balances by the distribution of discount coupons, we compare key baseline household characteristics between households which have received discount coupons at least once and which have never (Table 3). As expected, only few characteristics are significantly different between these two groups. Households that received coupons are less likely to be fully settled, male household head, less years of education, and more members of households. Although discount coupons were randomly distributed and only few characteristics are significantly different, these variables are jointly significantly different between recipients and non-recipients (F=2.189). This imbalance may potentially affect estimation results. To avoid it, we include these household characteristics as control variables for the regressions below.

V. Estimation Strategy

To elicit a clean payout effect, this paper focuses on whether households actually received indemnity payouts or not, in addition to insured by IBLI. Since the decision to insure is highly likely to be endogenous and depend on unobservable household characteristics, the Ordinary Least Squares (OLS) estimation may be biased. To avoid it, we employ an IV approach by using the average amount of discount coupons received as an instrument, which would be strongly correlated with the decision to purchase IBLI, but would not be correlated with the error term in the following regression because it is randomly distributed.

Using an IV approach, we estimate the local average treatment effect (LATE) of insurance uptake. We use 1st, 2nd and 3rd IBLI sales data for IBLI uptake where policyholders of 2nd IBLI sales period are eligible to receive payouts.[8] As for outcome variables, we rely on data from 4th round to see the short-term impacts of both risk management and payout effects. We first predict the IBLI uptake of household i, in

[7] 1 Kenyan Shilling = 0.0097 USD as of November 17, 2018 (https://www.xe.com/)

[8] 1st IBLI payouts were not triggered in any sub-locations, and 3rd IBLI payouts were happened after our observation period.

sub-location j in the following way:

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

where $IBLI_{ij,1st2nd3rd}$ is the number of uptake during three sales period, $Discount\_rate_{ij,1st2nd3rd}$ is the average amount of discount coupons received in the three sales period, $X_{ij,1st}$ is a vector of baseline household characteristics, such as assets, household size, savings and risk preferences[9], which can affect uptake, $AREA_j$ represents sub-location fixed effects and ϵ_{ij} is the error term.[10]

We then estimate LATE of insurance and payouts on livestock assets and welfare outcomes at round 4 household survey to examine both risk management and payout effects after the drought, by using the following second stage regression:

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

where $Y_{ij,4th}$ includes outcomes of livestock assets and welfare status related to the poverty trap hypothesis at round 4 household survey. $\widehat{IBLI}_{ij,1st2nd3rd}$ is the predicted number of purchasing IBLI obtained from the first stage regression. $PAYOUT_{ij,\mathrm{2nd}}$ is the total amount of indemnity payouts received in 2nd IBLI indemnity payouts.[11] $X_{ij,1st}$ and $AREA_j$ are again baseline household characteristics and sub-location fixed effect, respectively. u_{ij} is error term.

In this regression, we can see the payout effect as β_2, whereas the risk management effect as β_1 because this coefficient shows the net impact of IBLI uptake on outcomes when there is no payout. If there is any statistically significant effect of β_1, it would mean some changes in preference or behavior happen to the policyholders. Since poverty trap hypothesis in our context is based on the herd size, the effectiveness of payouts on 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 et al. (2018), we further employ the same regressions above by using subsample of households with poor TLUs (TLUs<15) discussed in section III. To check the sensitivity of our results, we also employ the same regressions with another possible threshold, 12 TLUs, which Lybbert et al. (2004) propose.

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9 To reveal the risk preferences, we conduct an experiment like a lottery which relies on a coin toss gamble where risk and return are positively correlated. The respondents choose their preferences among six images of head and tail sides; the heads and tails combination of (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 choose (E) and (F) are categorized as risk-taking, and (C) and (D) as risk-moderate. See Ikegami and Sheahan. (2017) in more details.

10 We cluster standard errors at the sub-location levels, allowing correlation of error terms in this level.

11 Conditional on the number of purchases of IBLI, payouts can be seen as an exogenous variable based on the index which household behavior cannot affect.

VI. Results

Table 4 reports the result of the first-stage regression. The result shows that there is a causal impact of the average value of discount coupons received on the number of purchasing IBLI among three sales periods. Precisely, one percent increase in discount rates significantly increase the number of purchasing IBLI by 0.0133 in three sales periods.

Table 5 shows the results of the second-stage regression. The most interesting variable to see payout effect is the coefficient of payout/1000.[12] As column (1) shows, we do not find direct evidence that receiving payouts increases TLUs owned after the shock, contrary to our expectation based on Bertram-Huemmer and Kraehnert. (2018), who suggest IBLI payments significantly increase herd size in Mongolia. One possible explanation of this is because payouts are limited in our sample. Another is the difference of the identification strategy in that their results may include risk management effect, in addition to payout effect.

However, columns (2) and (3) report positive long-term implications for increasing herd size that payouts significantly help pastoralist households not to sell and slaughter their livestock. These results are in accordance with findings by Janzen et al. (2018) and Jensen et al. (2017), both of which discuss IBLI effects on reducing distress sales of livestock after a shock in our survey region. These results are also consistent with Tnsue et al. (2018), who reveal that purchasing IBLI has significantly positive effect on reducing herd offtake in Borena zone of Ethiopia, neighboring our survey region. These results imply that receiving payouts help maintain their herd size when they suffer from droughts.

Column (5) reports 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 do not find evidence that their income becomes larger.

Although payouts seem to help maintain their herd size, one potential concern may be that policyholders take other costly coping strategies against shocks. For example, victims of a drought may cut consumption instead of selling their livestock, which may also bring long-term negative impacts through loss of human capital (Hoddinott, 2006). Surely, keeping herd size is important, but other investments are also important. Columns (6), (7), and (8) report the payout effect on weekly food consumption, the amount of transfer given to friends or relatives, and the amount of transfer received from friends or relatives, respectively. There is no evidence that receiving payouts significantly lead to reduce consumption. We also do not find that payouts reduce transfer given or increase transfer received. These results suggest that indemnity payouts prevent households from losing their livestock while they do not cause to take other negative long-term strategies.

While payouts seem to have positive impacts on household livestock assets, we also find supporting evidence of the existence of risk management effect, interpreted by the coefficient of predicted IBLI purchases, on livestock assets and household welfare. Our results show that risk management effect

[12] We divide total amount of payouts by 1000 to make it easy to see the results.

leads households to be less likely to sell their livestock, although we do not find any other significant effects.

In addition to the treatment effects on full sample households, we examine the effects on poor households by using only subsamples.[13] Table 6 presents our estimation results for TLU poor households.[14] The results of payout effect are almost similar to the full sample analysis above but several findings are worth noting. Firstly, the magnitude of payout effects on reducing livestock selling and slaughtering seem to be larger than the full sample results above. This implies that poor households gain more benefits from index insurance through the payout effect. Secondly, we find risk management effects on the number of TLUs slaughtering and saving amount, which are different from full sample analysis above. Increased TLUs slaughtering may be because households without the damage of drought have the responsibility of helping other people who are suffering.[15] Saving, which is presented in column (9), is increased possibly through the risk management effect of high return activities.

The sensitivity check with another threshold is shown in Table 7. Those results are mostly similar with the subsample analysis above.[16]

VII. Conclusion

Index insurance has attracted much attention as a weather-related risk mitigating means in developing countries. Previous studies reveal 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 impact of insurance payouts on welfare after the shocks with few exceptions (Jensen et al., 2017; Janzen et al., 2018; Bertram-Huemmer and Kraehnert, 2018; Chantarat et al., 2017). Using random distribution of discount coupons as exogenous variations, this paper identifies causal impacts of Index-Based Livestock Insurance payouts on livestock assets in pastoral-dominant society of northern Kenya, where the presence of poverty traps based on the herd size was established in the previous literature.

Our results suggest that indemnity payouts help households avoid poverty traps. While we do not find direct evidence that payouts significantly increase their herd size, households with payouts are significantly less likely to sell and slaughter their livestock, which is consistent with Jensen et al. (2017), Janzen et al. (2018), and Tnsue et al. (2018). Our results do not support that this causes to reduce consumption or increase transfers received from relatives or friends. Further analysis with subsample of poor households shows similar results to full sample analysis, except for that purchase of IBLI does not promote high-return investment for poor households.

Two implications can be drawn from our findings. Firstly, index insurance can help households

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[13] We also examine the effects on rich households. See the results of first stage and second stage regressions on Appendix Table 1 and Appendix Table 2.

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

[15] Our further analysis of slaughtering TLUs suggests that the most significant reason is to provide ceremonies or be hospitable to their gusts. See Appendix Table 4.

[16] See Appendix Table 5, the first stage regression of IBLI demand for poor households by using TLUs=12 as a threshold.

through indemnity payouts after a shock, in addition to ex-ante risk management effect studied by the rich literature. Secondly, index insurance may have positive impacts on long-term poverty, given that payouts help households maintain their herd size where the poverty trap hypothesis based on herd size was found.

We admit that our analysis has several limitations. Firstly, some possible effects may not be statistically significant since the number of households who received indemnity payouts were limited. Contrast to Bertram-Huemmer and Kraehnert (2018), who find that IBLI has significant positive impact on herd size, we do not find evidence that IBLI increases herd size through either risk management or payout effect. Secondly, 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 keeping livestock is important in our setting, we are not perfectly sure whether payouts now will lead bifurcated asset dynamics in the future. For future work, it is critical to examine the long-term data to directly conclude whether payouts actually prevent a poverty trap.

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Figure 1: Poverty Trap Hypothesis

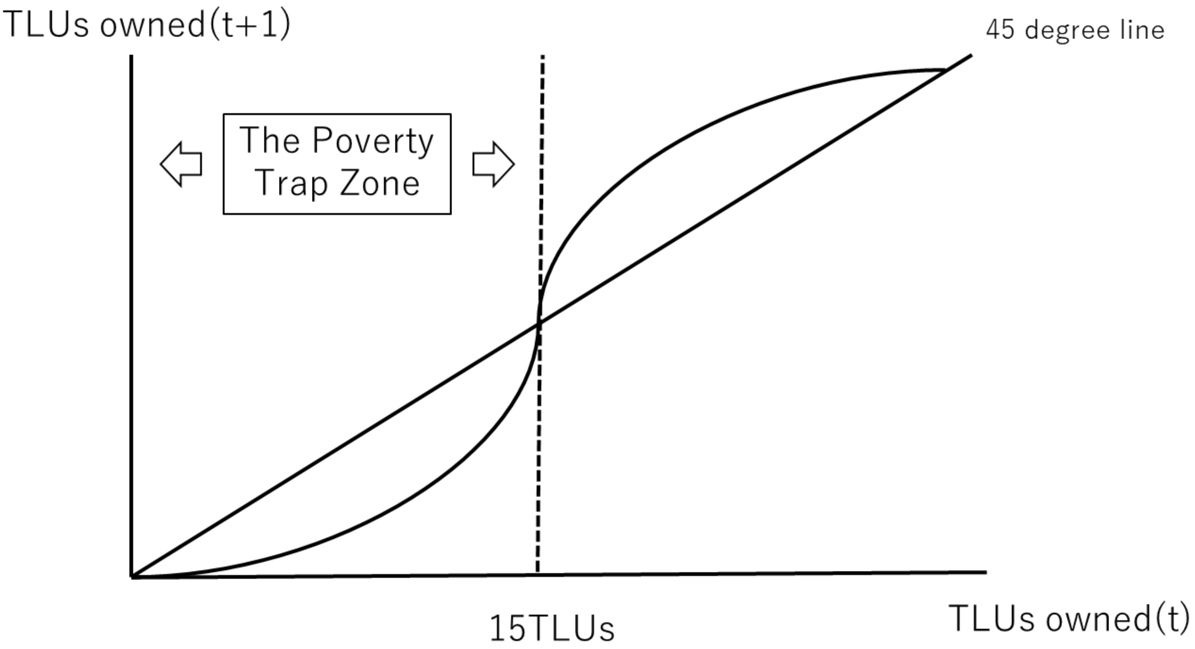

Table 1: Timeline of IBLI events

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 parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 4: First Stage Regression about Demand for IBLI

VARIABLES	(1) Number of IBLI purchase
Average percentage of discount coupons received	0.0133***
	(0.00230)
Constant	-0.0283
	(0.178)
Area fixed effect	Yes
Observations	909
Adj R-squared	0.221
F-stat	10.57

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, a dummy variable for traditional religion.

Table 5: Local Average Treatment Effect 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 IBLI purchases	1.969	-0.169**	0.134	-39.68	-23,795	13.56	1,286	-2,284	9,896
	(1.720)	(0.0739)	(0.0907)	(143.1)	(18,466)	(96.07)	(1,120)	(4,185)	(5,883)
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)	(1,337)	(12.66)	(260.0)	(651.8)	(720.7)
Constant	-8.313**	-0.120	0.162	-647.1***	-65,559**	-398.5*	2,560*	-4,726	-5,466
	(3.039)	(0.146)	(0.0993)	(153.7)	(30,185)	(199.9)	(1,324)	(3,314)	(9,053)
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, a dummy variable for traditional religion.

Table 6: 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 IBLI purchases	0.293	-0.157	0.121**	179.7	25,858	27.02	2,441	2,592	18,903**
	(1.849)	(0.104)	(0.0504)	(168.5)	(21,357)	(133.0)	(1,821)	(5,215)	(8,651)
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	-5.192*	-0.384**	0.0308	-620.0**	-64,516	-359.8	3,722**	-5,793	-9,576
	(2.466)	(0.162)	(0.103)	(216.5)	(39,272)	(246.5)	(1,660)	(5,629)	(10,703)
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, a dummy variable for traditional religion.

Table 7: Sensitivity Check of Subsample Analysis (TLUs<12)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	TLUs owned	Probability of livestock selling	TLUs slaughtering	Vaccinations and veterinary services	Household income	Food consumption	Transfer given	Transfer received	Saving amount
Predicted IBLI purchases	-0.354	-0.147	0.0868	235.9	17,856	-11.02	3,230	3,158	22,575*
	(2.023)	(0.124)	(0.0782)	(191.8)	(16,283)	(164.8)	(2,496)	(5,329)	(12,040)
Payout/1000	-0.171	-0.0350***	-0.00822***	-18.04	-2,558	18.01	-153.4	54.51	-61.96
	(0.143)	(0.00834)	(0.00222)	(17.34)	(1,744)	(11.96)	(176.0)	(462.9)	(767.1)
Constant	-4.553	-0.322**	-0.0179	-676.4***	-51,759	-398.3	3,152*	-6,165	-16,083
	(3.078)	(0.152)	(0.110)	(208.1)	(37,516)	(273.5)	(1,614)	(6,317)	(13,406)
Area fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	492	492	492	492	492	492	492	492	492
Adj R-squared	0.245	0.278	0.0944	0.151	0.303	0.349	0.152	0.112	0.146

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, a dummy variable for traditional religion.

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

	(1)
VARIABLES	Number of IBLI purchase
Average percentage of discount coupons received	0.0135***
	(0.00303)
Constant	-0.186
	(0.298)
Area fixed effect	Yes
Observations	360
Adj R-squared	0.245

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, 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 IBLI purchases	5.133	-0.184	0.0520	-136.3	-91,708*	76.65	806.2	-7,208	-2,212
	(4.015)	(0.123)	(0.191)	(261.6)	(45,431)	(86.66)	(1,298)	(4,664)	(9,285)
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	-12.11*	0.237	0.344**	-320.7	-86,691*	-154.3	-428.6	-2,344	2,901
	(6.012)	(0.182)	(0.152)	(563.8)	(49,121)	(125.7)	(2,208)	(5,918)	(9,691)
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, a dummy variable for traditional religion.

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

	(1)
VARIABLES	Number of IBLI purchase
Average percentage of discount coupons received	0.0130***
	(0.00267)
Constant	-0.0145
	(0.172)
Area fixed effect	Yes
Observations	549
Adj R-squared	0.189

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, a dummy variable for traditional religion.

Appendix Table 4: Close Analysis for the Reasons of Slaughtering (TLU<15)

VARIABLES	(1) TLUs slaughtering for consumption	(2) TLUs slaughtering for ceremony or guests	(3) TLUs slaughtering due to the risk of death
Predicted IBLI purchases	0.0113	0.112**	-0.0248
	(0.0299)	(0.0492)	(0.0391)
Payout/1000	-0.00184*	-0.00572***	-0.000492
	(0.000989)	(0.00114)	(0.000832)
Constant	-0.0362	0.0971	0.00955
	(0.0235)	(0.0716)	(0.0308)
Area fixed effect	Yes	Yes	Yes
Observations	549	549	549
Adj R-squared	0.153	0.0318	0.0577

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, a dummy variable for traditional religion.

Appendix Table 5: Sensitivity Analysis about First Stage Regression (TLUs<12)

	(1)
VARIABLES	Number of IBLI purchase
Average percentage of discount coupons received	0.0125***
	(0.00251)
Constant	0.0229
	(0.206)
Area fixed effect	Yes
Observations	492
Adj R-squared	0.200

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, a dummy variable for traditional religion.