The Impact of Receiving Indemnity Payout on Informal Risk Sharing

Chang Xu
The Ohio State University
xu.1348@osu.edu

Mario J. Miranda
The Ohio State University
miranda.4@osu.edu

Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2

Abstract: Recent research has proposed combining index insurance with informal group risk sharing to overcome the individual shortcomings of informal risk sharing and index insurance. If this complimentary relationship holds universally, it can potentially: 1. alleviate the low take-up rate puzzle faced by index insurance pilot programs; 2. improve the sustainability of informal risk sharing in the case of aggregate shocks. We specifically investigated the hypothesis that the availability of indemnity payment from index insurance will increase the involvement in informal risk sharing. We utilized the Index-Based Livelihood Insurance program piloted on pastoralists in Kenya and use the data provided by the International Livestock Research Institute. We found that, except for receiving cash, having received index insurance indemnity significantly increases the tendency to receive cash, receive in-kind transfer and give in-kind transfer as a gift from/to any other households.

1. Introduction

The pilot program of index insurance has faced the problem of low demand from farmers. For example, 4.6% in India ((Xavier Gine et al., 2008), 10%-18% in Kilimanjaro. The take-up rates estimated from WTP elicitation surveys are generally below 50%, even when the premium is set at the actuarially fair price. Among many reasons that contribute to the lack of demand, such as lack of trust (Patt, Peterson et al. 2009), financial illiteracy, liquidity constraint (Binswanger-Mkhize 2002), and alternatively available risk management tools, basis risk is thought to be a major one (Clarke 2011). Basis risk is the mismatch between the actual loss and the indemnity pay-out. Because the indemnity payout is based not on the actual individual outcome, but rather, on an objective index such as the rainfall level, the temperature degree, the area-based average, and vegetation index etc., it might be that a loss occurs but no payout is made according to the index, or the opposite, a payout is made to the insured while actually no loss occurs. Clarke (2011) derives a rational demand theory for index insurance using expected utility framework. He reasons that unlike the optimal demand for traditional indemnity insurance, which usually increases with risk aversion; the optimal demand for index insurance decreases with risk aversion.

Because downside contractual nonperformance worsens the worst possible scenario, an extreme risk-averse consumer would demand zero index insurance.

Literature has discussed methods to lower basis risk: improve the index, link with financial credit; provide gap insurance and multi-trigger (Guirkinger 2011; Carter 2011). It is suggested the MFI can approach insurance company first and then use index-based risk transfer products proceeds to pay off farmers to minimize basis risk (Skees and Barnett 2006). Build weather station in areas of proximity is also an option.

A potential way to mitigate basis risks, however, has not been explored previously, that is, to utilize the already existing informal risk sharing mechanisms within farmers. Informal risk sharing can potentially supplement index insurance by providing transfers when downside contractual nonperformance occurs. Recent research has proposed combining index insurance with informal group risk sharing (hereafter group index insurance) to overcome the individual shortcomings of both informal risk sharing and index insurance (Clarke 2011; Mobarak and Rosenzweig 2012; Dercon, Hill, Clarke, Outes-Leon and Seyoum Ta_esse 2014). Mobarak and Rosenzweig (2012) find complementarities between index insurance and group risk sharing. They find the demand for index insurance is higher for people who participate in informal risk sharing than those who do not. Dercon, Hill et al. (2014) conducted an experiment in Ethiopia and show that for informal groups, when group leaders are reminded the risk-sharing feature of groups, the group has higher index insurance uptake rate.

Though numerous studies have documented evidence regarding how informal risk sharing mechanisms crowds out the demand for formal insurance. A view that formal insurance would always crowd out informal insurance neglects the distinct feature of index insurance products. Index insurance, unlike traditional agricultural insurance, provides cover against aggregate risks, which is rarely covered by informal risk sharing. The substitute relationship between informal and traditional agricultural insurance might be weakened, or even reversed in the case of index insurance.

It is helpful to clarify what we mean by informal risk sharing at the beginning of

the discussion. In this article, we refer "informal risk sharing" to the following: inter-personal cash transfers; inter-personal in-kind transfers.

If this complimentary relationship holds universally, it can potentially: 1. alleviate the low take-up rate puzzle faced by index insurance pilot programs; 2. improve the sustainability of informal risk sharing in the case of aggregate shocks.

We specifically investigated the hypothesis that the availability of indemnity payment from index insurance will increase the involvement in informal risk sharing. We utilized the Index-Based Livelihood Insurance (IBLI hereafter) program piloted on pastoralists in Kenya and use the data provided by the International Livestock Research Institute (ILRI). The research group interviewed 924 households in October-November from 2009 to 2013. IBLI products were provided for sale to surveyed households from 2010 to 2013. Detailed information regarding the purchases and indemnity payouts of IBLI in each year is available. We used four indicators for informal risk sharing: whether or not the surveyed household has received cash transfer, has given cash transfer, has received in-kind transfer, and has given in-kind transfer with no expectation of repayment in the past year.

Because the treatment of receiving the insurance indemnity or not is not random, we used propensity score matching methods to control for the differences among households who have purchased IBLI (thus are eligible to receive the insurance indemnity) and households who have not purchased IBLI. By matching households who have purchased IBLI, we compared the informal risk sharing indicators between these two groups.

We found that, except for receiving cash, having received index insurance indemnity significantly increases the tendency to give cash, receive in-kind transfer and giving in-kind transfer as a gift from/to any other households. This work raised a potential complementary relationship between formal index insurance and informal insurance, and used empirical evidence from Kenya to support it. It is consistent with the idea of promoting index insurance at the meso level (Miranda and Gonzalez-Vega 2010). Instead of marketing index insurance towards individual farmers, groups of farmers who have diversified idiosyncratic risks among themselves by engaging in

informal risk sharing with each other might be better targets.

2. Related Literature

The similar idea of combining two different risk managing tools has been raised in the current literature.

2.1 Theoretical Literature

Doherty and Richter (2002) considered a decision maker (a primary insurer) who can purchase index hedge to manage catastrophic/aggregate risks and a gap insurance to cover the difference between index hedge payout and actual losses. Incorporating mean-variance framework into the utility function, and solving the utility maximization problem, the authors find that combining index hedge with gap insurance can extend the possibility set and thus lead to efficiency gain.

Miranda and Gonzalez-Vega (2010) show through dynamic modeling that index insurance purchased by banks to deal with aggregate risks leads to enhanced equity stability without suffering significantly in equity growth. The authors explain that banks already diversify idiosyncratic risks by pooling their clients' portfolios, thus the aggregate level index is closely correlated with banks profits. Group index insurance can be viewed as meso-level index insurance targeted at informal groups.

2.2 Empirical/Experimental Evidence

There are two previous studies (Mobarak and Rosenzweig 2012; Dercon, Hill, Clarke, Outes-Leon and Seyoum Ta_esse 2014) that have investigated specifically the potential complementary relationship between informal risk sharing and formal index insurance using empirical and experimental evidence, respectively.

Mobarak and Rosenzweig (2012) combine experiment data with Rural Economic and Development Survey (REDS) data in India, and show that the relationship depends on the geographical range of informal risk sharing arrangement. They show that village households diversify not only idiosyncratic risks but also some level of systematic risks through caste-level transfers, because a caste usually contains members from different villages. Village-level systematic risk will not totally tear up the informal groups as long as there are intact caste members from other villages.

They find the demand for index insurance is lower for households in caste who can diversify systematic risks, but higher for households in caste without access to diversify systematic risks.

(Dercon, Hill et al. 2014) randomized the training content to group leaders in a field experiment in Ethiopia. They found that when the group leader was trained about the risk sharing feature of a group, then the group members will demand more index insurance. Two mechanisms are provided to explain the increase in demand for index insurance: first, the group leaders whose training content emphasizes group risk sharing feature will select group members who are more likely to engage in informal risk sharing; second, the learning effect is transmitted from the group leader to group members. The comparisons are made at the group level. Group members formed by group leaders who were given the treatment training, were significantly more engaged in informal risk sharing and demanded significantly more index insurance. I differ from them in that I directly look at the effect on informal risk sharing of formal index insurance demand, rather than through the avenue of training effect.

3. Conceptual Framework

Consider two agents enter a risk sharing arrangement without enforcement. Let i denote the individual, with i=1 or 2. Both agents agree on an exogenous risk sharing rate σ, which means when one's income is lower than the other agent's income, the agent will get a transfer of $\sigma * |y_1 - y_2|$, where y_i is agent i's income. Because formal enforcement of this arrangement is absent, one can deviate from his obligation by keeping all his income and not making the transfer that he is supposed to do. Assume whenever one fails to honor his obligation, both agents will be in autarky in all remaining periods and re-entering this risk sharing arrangement is not allowed. A social stigma ϖ is imposed on the agent who fails to honor his obligation.

The agent decides whether or not make such transfer by comparing his current disutility of transferring and the future utility gain from staying in this risk sharing arrangement rather than be in autarky. If the current disutility of transferring is greater

than the future utility gain, the agent will choose renege; if smaller, the agent will not choose renege. That is, if $u(y_1)-u(\frac{y_1+y_2}{2})>A-(B-\varpi)$, then the agent will choose to renege. A denotes the utilities of staying in this risk sharing arrangement in all the following periods discounted into current period. It can be solved by dynamic programming. B denotes the utilities of staying in autarkly in every following period discounted into current period. $B=E\sum_{t}^{\infty}\delta^t u(y_t)$.

Now suppose agent 1 obtains an indemnity payout γ. Then the inequality becomes $u(y_1+\gamma)-u(\frac{y_1+y_2}{2}+\gamma)>A-(B-\varpi)$. Due to the concavity of utility function, the left hand side becomes smaller, so the inequality is harder to hold, so the agent is less likely to renege. Now suppose it is agent 1 who is the one with less income, then it is up to agent 2 to decide whether or not to make the transfer, similarly, agent 2 will transfer if and only if $u(y_2)-u(\frac{y_2+y_1}{2}+\gamma)<A-(B-\varpi)$. It is easy to see that this inequality is easier to hold when $\gamma>0$ compared to when $\gamma=0$.

Using this simple decision rule, we showed that when receiving an indemnity payout, the agent is more willing to make a transfer to other people, when he has favorable outcomes; and is more likely to receive a transfer from others, when he has unfavorable outcomes. Our conceptual result relies on the assumption that agent 2 have not received indemnity payout.

Based on the discussion, we establish the following hypothesis:

People who receive an indemnity payout from index insurance will engage more in informal risk sharing.

3.1 Data

We utilize the IBLI (Index-Based Livelihood Insurance) program piloted with pastoralists in Kenya and use the data provided by the ILRI (International Livestock

Research Institute).[1] Up until now, five waves of data are available; the research team interviewed 924 households in 16 sublocations in the Marsabit District in Kenya in October-November from 2009 to 2013. In round 1 survey (October-November 2009), basic household characteristic information was recorded. From 2010 and 2013, the research team in collaboration with local banks including UAP Insurance and Equity Bank sold IBLI in January-February and/or August-September, right before the one of the two yearly rainy seasons each year.

Each year, March-May is the long rain (LR) reason, June-September is the long dry (LD) season, October-November is the short rain (SR) season, and December-February is the short dry (SD) season. The IBLI contract covers one year. For IBLI sold during the August-September period, the coverage lasts from the October in current year to September in the following year (covering the SRSD-LRLD periods). For IBLI sold at Jan-Feb period, the coverage lasts from March in current year to December in current year (covering the LRLD-SRSD periods). After the short/ long rain season, if the recorded rainfall level falls short of the critical level, an indemnity is paid in March/October.

In round 2 survey (during October-November 2010), not only the basic information, but also the real purchase in the 1st IBLI sales period were also recorded. After that is 2nd IBLI sales periods and 3rd IBLI sales period followed by survey round 3. Then is the 4th IBLI sales period followed by survey round 4. Then are 5th and 6th IBLI sales periods followed by survey round 5. The first indemnity payout happens in October-November 2011.

Respondents indicate their informal risk sharing behavior by answering the following four questions:

Has your household received any CASH from any other households as a gift with no expectation of repayment (including from family members who are working or living away from home) in the past 12 months?

[1] The data is publicly available at *http://data.ilri.org/portal/dataset/ibli-marsabit-r1*.

Has your household given any CASH from any other households as a gift with no expectation of repayment (including from family members who are working or living away from home) in the past 12 months?

Has your household received any (non-livestock) IN-KIND TRANFER (e.g. food, labor, tools) from any other households with no expectation of return (including from family members who are working or living away from home) in the past 12 months?

Has your household given any (non-livestock) IN-KIND TRANFER (e.g. food, labor, tools) from any other households with no expectation of return (including from family members who are working or living away from home) in the past 12 months?

Respondents choose yes or no to the above questions. We thus use four dummy indicators to denote the informal risk sharing participation.

This informal risk sharing data has the advantage that, the indemnity payout is made in Oct-Nov in 2011, the survey responses were collected in Oct-Nov in 2012. The informal risk sharing indicators asked about their inter-personal transfer in the past 12 months preceding the time of the survey. This satisfies Holland (1986)'s argument that in order to induce casual reference of A causes B, A has to precede B in time.

Respondents state their IBLI purchases by answering the following questions:

Did any member of your household purchase the livestock insurance?

Respondents were also asked about whether or not they have received insurance indemnity in the previous year.

Other control variables include: the gender of the household head, the age of the household head, the family size of the household, the total loss in terms of livestock unit experienced during last round, the squared term of total loss in terms of livestock unit experienced during last round; dummy indicator for the household head being

able to write simple letters with several sentences in English; total household income in last round, and total savings during last round.

3.2 Summary Statistics

Table 1 presents summary statistics splitted by whether or not received an insurance indemnity in 2011,2012 and 2013. After deleting observations with missing variables, There are 671, 671and 707 observations in each wave. Some characteristics are not significantly different between the group of people that have received indemnity payout and the grouop of people that have not, such as the units of livestock losses in previous year, whether or not the household head can write in English, household savings and the household head's risk aversion. While all four informal risk sharing indicators, excpet the giving cash indicator, are significantly different between two groups in 2011 and 2012. A representative household who has received the indemnity is more often to receive cash and gave/received in-kind transfer from/to other households. The households who have received indemnity payout in Oct-Nov 2011 have higher household income, larger family size. The households who have received indemnity payout in Jan-Mar 2012 have higher household income. The households who have received indemnity payout in Jan-Mar 2013 are with a significantly older household head.

3.3 Stylized Facts

Table 2 summarizes Kenyan pastrolists' sources of income. Out of the sample, 64-68% people have income source from the sale of livestock. 14%-25% people have income source from the sale of livestock products. It can be shown livestock and its related products are important in their livelihood. We then list the type of major risks Kenyan pastoralists face in Table 3. Starvation/drought and rain together account the biggest reason for livestock loss events (39.35%).

4. Empirical analysis

4.1 Baseline Model

We start with the basic econometric model as follows, assuming that receiving indemnity is exogenous, uncorrelated with error terms.

$$y_{it} = c_{it} + \beta z_{it} + \gamma indemnity_{it} + \varepsilon_{it}$$

y_{it} is informal risk sharing participation indicator. Four indicators are used: whether or not have received cash, given cash, received in-kind transfer, and given in-kind transfer in the last twelve months without the expectation of repayment. z_{it} are control variables listed in table 1. Indemnity is an indicator for whether or not having received indemnity from IBLI. β is the coefficient of control variables; λ is the coefficient of main interest, representing the effect of receiving IBLI on informal risk sharing participation. ε is the error term.

The Probit regression result is presented in Table 4-6. The standard errors are clustered at sublocation level. Column 1-column 4 shows the result for informal risk sharing with differing indicators, respectively. Except for giving cash, having received index insurance indemnity significantly increases the tendency to receive cash, receive in-kind transfer and giving in-kind transfer from any other households in 2011 and 2012. This is consistent with our hypothesis that informal risk sharing is a complementary good to index insurance. Though only giving in-kind transfer is significantly positive in 2013. Higher total income also significantly contributes to engaging in informal risk sharing (in the form of giving cash and in-kind transfer in all waves), but does not affect informal risk sharing that characterizes receiving cash or in-kind transfer (except for 2012). This is consistent with expectation in that more wealth embodies the household a role of "benefactor" instead of the "beneficiary" in informal financial interactions. More wealth will reduce the probability to receive cash or in-kind transfer from any other household. Indemnity from index insurance, however, seems to be of effect through another mechanism other than adding wealth: receiving indemnity will enhance both receiving and giving cash and in-kind transfers (though not significantly so for giving cash).

Having a male household head will reduce the probability to engage in informal

risk sharing, but not significantly. The age of household head will increase the tendency to integrate into informal risk sharing networks (in terms of give cash and receive in-kind transfer). Total livestock loss will significant reduce the probability to receive and give in-kind transfer for 2011 and 2012, with the probability reducing at a lower rate as loss increases. This result indicates when people experience a livestock loss, they reduce informal risk sharing activities. This might due to the fact that most of livestock losses are due to covariant shocks such as drought, disease, rain and starvation, as shown in Table 3. Even though they actually need more help from others through informal transfer, but they as less likely to receive help as such losses might be covariant. Being able to write simple letters with sentences in English (an indicator for education) has positive effect in informal risk sharing participation, but not generally significantly (except for the negative coefficient for receiving in-kind transfer for 2011-2013 and receiving cash for 2013). Family size has a mixed effect: larger household engage more in giving cash and in-kind transfer; but less in receiving cash and in-kind transfer.

4.2 Identification

Because the treatment of receiving the insurance indemnity or not is not random, we use the propensity score matching method to control for difference among households who purchased index insurance (thus have the potential to receive an insurance indemnity) and households who did not purchase index insurance.

The result for PMS is reported in Table 7. Four matching methods are used: radius matching, kernel matching and stratification matching. The covariates used for calculating the propensity scores are the same household characteristic variables used in the probit regression. Covariates balance check after propensity score matching indicated that the baseline covariates were comparable between the two groups. T statistics with bootstrapped standard errors are reported.

In order to capture the time trend that affects informal risk sharing behavior regardless of whether or not one has received indemnity payout. Using difference-in-difference method, we differenced out the time trend that affect all

households. The result shows we found significant difference between treatment and control group in terms of receiving cash and in-kind tranfer.

5. Robustness check

5.1 Restrict to the sample who actually bought index insurance

Propensity score matching method relies on the assumption that the selection into treatment group is only based on observables. When the exogeneity assumption is violated, the estimation results will be biased. For instance, attitude towards risks and perceptions of the effectiveness of risk tools might affect the decision to purchase index insurance (thus eligible for receiving indemnity) as well as affect the participation in informal risk sharing. Past experience on dealing with income shocks will affect both index insurance purchase and informal risk sharing, but no information available for us to control past experience on risk management. The set of respondents who purchase index insurance might be inherently different from the set of respondents who do not purchase index insurance in terms of unobservable characteristics that also affect their willingness to financially interact with others through informal channels.

So we restrict the sample to those who have purchased index insurance. Because the indemnity payout is determined by the predicted livestock mortality rated based on Normalized Difference Vegetation Index (NDVI), which can be viewed as exogenous. So in this restricted sample, the indemnity payout is exogenous if the NDVI index is exogenous, which is very reasonable.

Because the sample size is limited when we only look at those who have purchased index insurance in each wave, we pooled these three waves of data together. The pooled logit regression result is shown in Table 8, with standard error clustered at sub-location level. The coefficients of sublocation fix dummies are omitted for convenience.

The result is largely unchanged. Among those who have purchased index insurance, receiving an indemnity significantly increases the probability to engage in informal risk sharing, in terms of receiving cash and receiving/giving in-kind transfer.

5.2 The Effect of Purchasing Index Insurance on Informal Risk Sharing

We looked at the effect of just purchasing index insurance on informal risk sharing, regardless of whether or not having received indemnity payout. The results for year 2011, 2012 and 2013 are reported in Table 9-11, respectively.

As shown in Table 9-11, the effect of purchasing index insurance on informal risk sharing is just occasionally significantly positive, compared to the effect of receiving indemnity payout.

5.3 Effects on Other Risk Coping Strategies

We looked at the effect of receiving an indemnity payout on other risk coping strategies on the sample of respondents who have purchased index insurance. The result is shown in Table 12. Except for receiving government aid, receiving an indemnity payout does not have significant effect of receiving transfers from other sources, including food aid, school feeding, supplementary feeding, employment feeding, NGO aid. We view this difference in the effect of receiving indemnity on informal risk sharing and on other risk coping strategies as evidence that informal risk sharing and formal index insurance are complementary, whereas no such complementary relationship can be found among other risk coping strategies and formal index insurance.

6 Conclusion

We present empirical evidence showing that informal risk sharing is boosted among those who have received an indemnity payout from Index Based Livelihood Insurance. The complimentary evidence is in the sense that for those who purchased index insurance and also received an indemnity payout, they will engage more in informal risk sharing. But there is no effect on informal risk sharing for those people who just purchased index insurance.

This work relies on the assumption that receiving indemnity payout is exogenous, which is more likely to hold for index insurance whose indemnity payout is determined by an objective index such as the vegetation index measure by satellite than conventional insurance product. Examining the distribution of vegetation index

over multiple periods is interesting. Future work can look into the distribution of index and examine the sorting issue: why some people settle in areas with systematically lower levels of vegetation index, whereas other people settle down in areas with systematically different vegetation index levels.

REFERENCE

Binswanger-Mkhize, H. P. (2012) "Is There Too Much Hype about Index-based Agricultural Insurance?" The Journal of Development Studies **48**(2): 187-200.

Carter, M. R. (2011). "Innovations for managing basis risk under index insurance for small farm agriculture." Ferdi Policy Brief **41**.

Clarke, Daniel J. (2011)."A Theory of Rational Demand for Index Insurance". Department of Economics, University of Oxford.

Dercon, S., R. V. Hill, et al. (2014). "Offering rainfall insurance to informal insurance groups: Evidence from a field experiment in Ethiopia." Journal of Development Economics **106**: 132-143.

Gine, X., R. Townsend, et al. (2008). "Patterns of Rainfall Insurance Participation in Rural India." The World Bank Economic Review **22**(3): 539-566.

Guirkinger, C. "Group insurance for cotton producers in Mali." FERDI Policy Brief B **38**.

Holland, P. W. (1986). "Statistics and causal inference." Journal of the American statistical Association **81**(396): 945-960.

Miranda, M. J. and C. Gonzalez-Vega (2010). "Systemic risk, index insurance, and optimal management of agricultural loan portfolios in developing countries." American Journal of Agricultural Economics **93**(2): 399-406.

Patt, A., N. Peterson, et al. (2009). "Making index insurance attractive to farmers." Mitigation and Adaptation Strategies for Global Change **14**(8): 737-753.

Sarris, A., P. Karfakis, et al. (2006). "Producer demand and welfare benefits of rainfall insurance in Tanzania." Rome: FAO Commodities and Trade Policy Research Working Paper Series **18**.

Skees, J. R. and B. J. Barnett (2006). "Enhancing microfinance using index-based risk-transfer products." Agricultural Finance Review **66**(2): 235-250.

Table 1: Descriptive Analysis by Whether or Not Having Recieved Indemnity Payout

	Oct-Nov 2011			Jan-Mar 2012			Jan-Mar 2013		
	Received indemnity	Not Received indemnity	Ttest	Received indemnity	Not received indemnity	Ttest	Received indemnity	Not received indemnity	Ttest
Receive cash	0.65	0.5	*	0.78	0.5	**	0.5	0.33	
Give cash	0.56	0.45		0.61	0.45		0.2	0.21	
Receive in-kind transfer	0.63	0.46	**	0.72	0.46	**	0.5	0.28	
Give in-kind transfer	0.63	0.36	***	0.72	0.37	***	0.5	0.2	**
Household head is male	0.53	0.61		0.67	0.61		0.7	0.62	
Age of household head	49.07	48.86		53.11	48.97		67.5	49.83	***
Total loss in previous year	2.3	2.71		1.39	2.64		1.05	1.58	
Total income	143890.7	74186.35	***	158455.56	75502.12	**	98620	84632.84	
Family size	7.42	6.28	***	7	6.341		6.9	6.34	
Can write in English	0.6	0.55		0.67	0.55		0.8	0.6	
Saving	9290.70	10168.05		15916.67	9316.46		5430	7253.23	
Risk preference	2.35	2.51		2.11	2.57		2.9	2.59	
# Of observations	43	628		18	653		10	697	
	671			671			707		

*Notes: * p < 0.05, ** p < 0.01, *** p < 0.001*

Table 2: Source of Income by Category

	Round 1		Round 2		Round 3		Round 4	
	No.	%	No.	%	No.	%	No.	%
Sales of livestock	587	64	615	.67	641	69	631	68
Sales of livestock products	234	25	148	16	150	16	133	14
Sales of crop	24	3	37	4	21	2	46	5
Salaried employment	99	11	100	11	95	10	117	13
Casual labor	192	21	188	20	186	20	154	17
Business and petty trading	211	23	258	28	211	23	257	28
Other	13	1	10	1	21	2	9	1
Total	924		924		924		924	

Table 3: Livestock Loss Events

Reason	Frequency	Percentage
Starvation/drought	565	31.9
Disease	677	38.23
Predation	217	12.25
Raiding/rustling/conflict	26	1.47
Accident/poisoned	57	3.22
Just lost	62	3.5
Rain	132	7.45
Premature birth	16	0.9
Other	17	0.96
Old age	2	0.11
Total	1771	100

Table 4: Probit Analysis, 2011 Indemnity Payout

	(1) Receive cash in 2012	(2) Give cash in 2012	(3) Receive in-kind in 2012	(4) Give in-kind in 2012
Receive indemnity payout in 2011 Oct.	0.457***	0.163	0.487*	0.533**
	(2.92)	(0.86)	(1.78)	(2.48)
Household head male	0.101	0.0395	0.162	0.0784
	(0.77)	(0.42)	(1.15)	(0.58)
Household head age	3.24e-3	-5.41e-3**	5.42e-3**	1.12e-3
	(1.58)	(-2.25)	(2.33)	(0.35)
Total loss	-2.68e-2	2.02e-3	-7.76e-2***	-8.06e-2**
	(-0.76)	(0.05)	(-2.79)	(-2.40)
Total loss square	3.34e-4	-1.44e-4	1.11e-3**	1.32e-3**
	(0.42)	(-0.14)	(2.38)	(2.29)
Total income	-1.61e-7	1.23e-6*	-8.54e-7*	1.12e-6*
	(-0.42)	(1.75)	(-1.67)	(1.91)
Family size	-0.0566**	2.29e-2	-6.59e-3	4.78e-2
	(-2.24)	(0.77)	(-0.23)	(1.62)
Can write in English	6.60e-3	0.151	-0.111	0.229***
	(0.06)	(1.13)	(-1.30)	(3.59)
Savings	-6.38e-8	2.71e-6**	7.71e-7	-6.95e-7
	(-0.07)	(2.41)	(0.72)	(-0.49)
Risk aversion	0.0181	0.0510	0.0253	0.0532
	(0.71)	(1.53)	(0.81)	(1.41)
Constant	0.0828	-0.390	-0.335	-1.000**
	(0.24)	(-1.55)	(-0.79)	(-2.27)
N	671	671	671	671
Pseudo R2	0.02	0.03	0.04	0.06

*Notes: t statistics in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01.*

Table 5: Probit Analysis, 2012 Indemnity Payout

	(1) Receive cash in 2012	(2) Give cash in 2012	(3) Receive in-kind in 2012	(4) Give in-kind in 2012
Receive indemnity payout in 2012 march	0.80***	0.338	0.708**	0.816***
	(3.11)	(1.34)	(2.15)	(3.02)
Household head male	0.120	0.0464	0.177	0.105
	(0.91)	(0.47)	(1.27)	(0.76)
Household head age	3.03e-3	-5.48e-3**	5.24e-3**	1.03e-3
	(1.45)	(-2.28)	(2.27)	(0.32)
Total loss	-0.0268	2.04e-3	-0.0777***	-0.0806**
	(-0.76)	(0.05)	(-2.79)	(-2.39)
Total loss square	3.35e-4	-1.44e-4	1.11e-3**	1.32e-3**
	(0.42)	(-0.14)	(2.37)	(2.26)
Total income	-1.30e-7	1.26e-6*	-8.24e-7	1.28e-6**
	(-0.34)	(1.80)	(-1.52)	(2.07)
Family size	-0.0528**	0.0240	-2.43e-3	0.0523*
	(-2.16)	(0.80)	(-0.08)	(1.77)
Can write in English	5.16e-4	0.149	-0.115	0.225***
	(0.00)	(1.11)	(-1.38)	(3.48)
Savings	-1.33e-7	2.66e-6**	7.08e-7	- 8.71e-7
	(-0.15)	(2.40)	(0.62)	(-0.59)
Risk aversion	0.0193	0.0520	0.0262	0.0557
	(0.71)	(1.59)	(0.88)	(1.49)
Constant	0.0504	-0.405	-0.363	-1.060**
	(0.15)	(-1.61)	(-0.86)	(-2.41)
N	671	671	671	671
Pseudo r2	0.02	0.03	0.04	0.06

*Notes: T statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.*

Table 6: Probit Analysis, 2013 Indemnity Payout

	(1)	(2)	(3)	(4)
	Receive cash in 2013	Give cash in 2013	Receive in-kind in 2013	Give in-kind in 2013
Receive indemnity payout in 2013 March	0.402	0.0823	0.748	0.884***
	(1.24)	(0.13)	(1.55)	(2.58)
Household head male	-0.219*	0.0519	-0.296*	-0.203*
	(-1.70)	(0.43)	(-1.86)	(-1.81)
Household head age	6.78e-3*	-6.52e-3*	-5.03e-3**	-1.07e-3
	(1.74)	(-1.89)	(-2.04)	(-0.25)
Total loss	0.0651	0.0999***	0.047	0.0935**
	(1.46)	(3.1)	(1.24)	(2.25)
Total loss square	-3.01e-3	-5.40e-3***	-2.24e-3	-3.75e-3*
	(-1.11)	(-2.80)	(-1.04)	(-1.65)
Total income	-5.44e-7	2.03e-6***	-1.72e-7	9.12e-7**
	(-1.30)	(3.86)	(-0.35)	(2.23)
Family size	-0.03	0.017	-8.29e-3	0.0101
	(-1.58)	(1.33)	(-0.30)	(0.45)
Can write in English	-0.0154	0.0125	-0.0325	0.202**
	(-0.18)	(0.1)	(-0.32)	(1.99)
Savings	3.31e-6**	5.96e-7	-6.98e-7	2.54e-6*
	(2.36	(0.34)	(-0.29)	(1.93)
Risk aversion	-0.0281	0.0559*	-9.67e-3	0.0367
	(-0.91)	(1.87)	(-0.31)	(0.96)
Constant	-0.431	-1.112***	-0.111	-1.200***
	(-1.41)	(-6.90)	(-0.37)	(-4.50)
N	707	707	707	707
Pseudo R2	0.023	0.066	0.023	0.043

*Notes: T statistics in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01.*

Table 7: Propensity Score Matching Results

	Receive cash	Give cash	Receive in-kind transfer	Give in-kind transfer
Receive Indemnity in 2011 Oct	0.259***	0.101	0.165*	0.123*
Receive Indemnity in 2012 March	0.361***	0.00912	0.276*	0.322**
combined	0.243***	0.0967	0.206**	0.149*
	Δ Receive cash	Δ Give cash	Δ Receive in-kind transfer	Δ Give in-kind transfer
Receive Indemnity in 2011 Oct	0.361***	0.109	0.188*	0.0996
Receive Indemnity in 2012 March	0.414***	-0.0315	0.390***	0.279
combined	0.300***	0.0956	0.232*	0.164

*Notes: t statistics in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001.*

Table 8: Restrict to the Sample Who Have Purchased Index Insurance

	(1) Receive cash	(2) Give cash	(3) Receive in-kind	(4) Give in-kind
Receive indemnity payout	1.029**	-0.150	0.984*	1.070*
	(2.43)	(-0.24)	(1.86)	(1.73)
Year 2011	1.323**	1.274*	-0.288	0.681
	(2.55)	(1.66)	(-0.35)	(1.42)
Year 2012	1.470**	1.451**	-0.214	0.630
	(2.52)	(2.05)	(-0.28)	(1.33)
Household head male	0.930**	0.200	0.454	0.784
	(2.48)	(0.31)	(0.98)	(1.15)
Household head age	0.0399***	-0.00426	0.0280*	0.00327
	(2.67)	(-0.17)	(1.90)	(0.29)
Total loss	0.190**	0.118	0.134	0.110
	(2.09)	(0.62)	(0.54)	(1.56)
Total loss square	0.00191*	-0.00469	-0.0101	0.000622
	(1.68)	(-0.27)	(-0.60)	(0.76)
Total income	9.88e-6	8.00e-6	-1.27e-5**	-6.86e-6
	(1.46)	(1.52)	(-2.04)	(-1.26)
Family size	-0.260***	-0.125	0.0427	-0.0945
	(-2.60)	(-1.17)	(0.38)	(-1.23)
Can write in english	0.215	0.453	0.599	0.328
	(0.74)	(0.77)	(1.64)	(0.96)
Savings	-1.65e-5**	-7.87e-6	4.28e-6	2.33e-5*
	(-2.17)	(-1.42)	(0.95)	(1.75)
Risk aversion	-0.229**	-0.0266	-0.167*	-0.300***
	(-2.48)	(-0.27)	(-1.70)	(-2.71)
Constant	-0.503	0.422	-0.328	15.31***
	(-0.54)	(0.33)	(-0.23)	(10.63)
N	273	267	279	279
Pseudo R^2	0.200	0.161	0.240	0.280

Notes: t statistics in parentheses. * *p < 0.10,* ** *p < 0.05,* *** *p < 0.01*

Table 9: The Effect of Buying Index Insurance on Informal Risk Sharing

	(1) Receive cash in 2011	(2) Give cash in 2011	(3) Receive in-kind in 2011	(4) Give in-kind in 2011
Buy index insurance	-0.130	0.330	-0.185	0.219
in 2011 January	(-0.57)	(1.09)	(-0.50)	(0.61)
Buy index insurance	0.301**	-0.0101	0.610***	0.0610
in 2011 August	(1.96)	(-0.03)	(3.54)	(0.18)
Household head	0.302	0.0263	0.458	0.441*
male	(1.58)	(0.13)	(1.61)	(1.75)
Household head age	0.00749*	-0.0135**	-0.00215	-0.00867*
	(1.68)	(-2.23)	(-0.46)	(-1.83)
Total loss	0.0356**	0.0213*	0.0370*	0.00183
	(1.96)	(1.72)	(1.80)	(0.08)
Total loss square	-6.39e-4*	-1.96e-4	-4.98e-4	8.71e-6
	(-1.80)	(-0.99)	(-1.48)	(0.03)
Total income	-1.05e-6	1.15e-6***	-3.97e-6**	1.59e-6***
	(-1.30)	(3.60)	(-2.10)	(3.67)
Family size	-0.0958**	0.0231	-0.00184	-0.0184
	(-2.22)	(0.56)	(-0.04)	(-0.40)
Can write in english	-0.0332	0.0411	0.208	0.316
	(-0.24)	(0.26)	(1.15)	(1.16)
Savings	9.82e-7	2.49e-6	-4.61e-6	-3.80e-8
	(0.78)	(0.55)	(-1.49)	(-0.03)
Risk aversion	-1.54e-3	0.194***	0.0101	0.162**
	(-0.05)	(3.16)	(0.20)	(2.51)
Constant	-0.989	-1.816***	-1.601*	-2.263***
	(-1.36)	(-3.95)	(-1.88)	(-3.30)
N	693	693	693	693
Pseudo R^2	0.026	0.052	0.050	0.039

Notes: t statistics in parentheses. * *p < 0.10,* ** *p < 0.05,* *** *p < 0.01.*

Table 10: The Effect of Buying Index Insurance on Informal Risk Sharing

	(1) Receive cash in 2012	(2) Give cash in 2012	(3) Receive in-kind in 2012	(4) Give in-kind in 2012
buy index insurance	0.0849	-0.250	-0.0383	-0.0581
in 2011 August	(0.27)	(-1.33)	(-0.15)	(-0.33)
buy index insurance	-0.0228	0.241	0.139	0.765***
in 2012 August	(-0.08)	(0.91)	(0.43)	(3.08)
household head	0.188	0.0894	0.305	0.202
male	(0.90)	(0.56)	(1.35)	(0.92)
household head age	5.49e-3	-9.17e-3**	8.89e-3**	1.31e-3
	(1.51)	(-2.37)	(2.12)	(0.24)
total loss	-0.0461	0.000479	-0.134***	-0.157***
	(-0.83)	(0.01)	(-2.73)	(-2.76)
total loss square	5.91e-4	-1.79e-4	1.90e-3**	2.51e-3***
	(0.49)	(-0.11)	(2.51)	(2.79)
total income	-4.10e-08	2.15e-6*	-1.12e-6	2.29e-6**
	(-0.07)	(1.73)	(-1.31)	(2.00)
family size	-0.0849**	0.0453	-2.49e-3	0.0922*
	(-2.01)	(0.92)	(-0.05)	(1.95)
can write in english	0.0104	0.250	-0.173	0.385***
	(0.06)	(1.18)	(-1.24)	(4.09)
savings	-2.93e-7	4.24e-6**	9.79e-7	-1.97e-6
	(-0.20)	(2.16)	(0.53)	(-0.69)
risk aversion	0.0259	0.0827	0.0410	0.0863
	(0.60)	(1.58)	(0.82)	(1.46)
constant	0.0779	-0.672	-0.627	-1.788**
	(0.14)	(-1.59)	(-0.88)	(-2.51)
N	671	671	671	671
pseudo R^2	0.015	0.034	0.039	0.060

Notes: t statistics in parentheses. * *p < 0.10,* ** *p < 0.05,* *** *p < 0.01.*

Table 11: The Effect of Buying Index Insurance on Informal Risk Sharing

	(1) Receive cash in 2013	(2) Give cash in 2013	(3) Receive in-kind in 2013	(4) Give in-kind in 2013
buy index insurance	-0.237	0.494	0.601**	0.379
in 2013 January	(-0.58)	(1.61)	(2.02)	(0.89)
buy index insurance	0.806***	0.0795	-0.0644	0.531
in 2013 August	(3.05)	(0.18)	(-0.19)	(0.74)
household head	-0.359*	0.0875	-0.492*	-0.355*
male	(-1.73)	(0.42)	(-1.79)	(-1.79)
household head age	0.0116*	-0.0117*	-7.04e-3*	-5.90e-4
	(1.82)	(-1.87)	(-1.65)	(-0.08)
total loss	0.110	0.174***	0.0801	0.167**
	(1.49)	(3.08)	(1.31)	(2.48)
total loss square	-4.93e-3	-9.31e-3***	-3.81e-3	-6.71e-3*
	(-1.10)	(-2.69)	(-1.11)	(-1.84)
total income	-9.17e-7	3.44e-6***	-3.51e-7	1.48e-6*
	(-1.18)	(3.36)	(-0.38)	(1.91)
family size	-0.0496	0.0297	-0.0171	0.0166
	(-1.58)	(1.45)	(-0.36)	(0.44)
can write in english	-0.0189	0.0276	-0.0586	0.371**
	(-0.13)	(0.12)	(-0.33)	(2.01)
savings	5.08e-6**	1.05e-6	-1.45e-6	4.21e-6**
	(2.27)	(0.37)	(-0.26)	(1.99)
risk aversion	-0.0404	0.1000*	-0.0196	0.0629
	(-0.79)	(1.88)	(-0.36)	(0.95)
constant	-0.750	-1.888***	-0.210	-2.106***
	(-1.48)	(-6.96)	(-0.39)	(-4.25)
N	707	707	707	707
pseudo R^2	0.027	0.069	0.023	0.041

Notes: t statistics in parentheses. * *p < 0.10,* ** *p < 0.05,* *** *p < 0.01.*

Table 12: Restrict to the Sample Who Have Purchased Index Insurance: receiving indemnity on other assistance

	(1) Food aid	(2) School feeding	(3) Supplementary feeding	(4) Employ-ment	(5) Government aid	(6) NGO aid
Receive	0.777	1.059	-0.0933	0.478	1.326**	0.840
payout	(0.96)	(1.16)	(-0.10)	(0.57)	(2.34)	(1.49)
household	0.187	1.947**	-0.456	-0.935	-0.562	-0.886
head male	(0.27)	(2.21)	(-0.50)	(-1.08)	(-1.05)	(-1.48)
household	0.00686	-0.0160	-0.0330	-0.00442	0.0151	0.0183
head age	(0.28)	(-0.71)	(-1.06)	(-0.17)	(0.86)	(0.99)
total loss	-0.00576	-0.768**	0.397	0.0600	-0.301	-0.354**
	(-0.03)	(-2.07)	(1.61)	(0.09)	(-1.64)	(-1.97)
total loss	0.00183	0.0631*	-0.0200	-0.135	0.00374	0.0162
square	(0.17)	(1.95)	(-1.15)	(-0.82)	(0.23)	(1.41)
total	-3.49e-6*	6.54e-6	-8.80e-6	-3.73e-6	-4.02e-6*	-2.13e-6
income	(-1.67)	(1.35)	(-1.20)	(-0.91)	(-1.69)	(-0.81)
family	-0.155	0.894***	0.268	-0.00482	0.0545	0.0952
size	(-1.07)	(3.89)	(1.31)	(-0.03)	(0.50)	(0.79)
can write	-1.010	-0.787	1.041	-0.103	0.516	-0.260
in english	(-1.57)	(-1.23)	(1.30)	(-0.15)	(1.09)	(-0.52)
savings	-2.77e-6	3.89e-4	0	2.09e-5	1.60e-5	-1.62e-4
	(-0.44)	(1.11)	(.)	(1.49)	(1.54)	(-1.21)
risk	0.0119	0.192	0.109	0.198	0.179	-0.107
aversion	(0.06)	(0.94)	(0.47)	(0.95)	(1.26)	(-0.73)
constant	2.960*	-5.904**	-2.990	-0.594	-1.187	-0.383
	(1.69)	(-2.52)	(-1.30)	(-0.31)	(-0.90)	(-0.28)
N	103	103	88	103	103	103
pseudo R^2	0.099	0.375	0.148	0.155	0.174	0.162

Notes: t statistics in parentheses. * *p < 0.10,* ** *p < 0.05,* *** *p < 0.01*