Heterogeneities in Risk and Insurance in Uganda: An Emprical Exploration

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Abstract

This study provides new empirical evidence on the risks faced and the degree of insurance across heterogeneous households in the context of a developing economy, Uganda. Using country level panel data, I evaluate the capacity of households to smooth consumption depending on the types of shocks and the characteristics of the households. The main result is that as households get richer, insurance levels increase, setting evidence against insurance networks poverty traps. However, I do find a trade-off between income and insurance when households face the decision to migrate to cities.

1 Introduction

Households in the underdeveloped world suffer substantial risks that influence their life choices and wellbeing. In that context, Poverty is not only living under low income but also on a volatile and unpredictable one. Moreover, financial markets are imperfect or they do not exist, so households have low access to formal financial and insurance products. A result of this is that most empirical literature rejects the hypothesis of full insurance in developing countries.

Though rejecting full-insurance, literature has also found that even the poorest households are not hand-to-mouth. Across the developing world, people find sophisticated mechanisms to cope with risk[1]. In the absence of formal insurance, informal mechanisms allow people to smooth consumption substantially but not fully: (R. M. Townsend, 1994) in rural India, (Udry, 1994) in Northern Nigeria, (Kinnan et al., 2010) for Thailand, (Santaeulalia-Llopis and Zheng, 2016) for China. Moreover, some recent literature cannot reject full-insurance in the context of developing economies. (De Magalhaes and Santaeulalia-Llopis, 2015) cannot reject full-insurance for rural Malawi when consumption is measured as calories intake. (Chiappori et al., 2014) find it difficult to reject full-insurance when risk preferences are taken into account. Interestingly, they also find that less risk averse individuals would be worse off with a policy intervention that eliminates village level risk.Some recent empirical literature find small or no violation of full insurance in rural villages in Thailand: (Bonhomme et al., 2012) taking into account labor responses to shocks, (Kinnan and R. Townsend, 2012) and (Karaivanov and R. M. Townsend, 2014).

However, this capacity of households to smooth consumption is not complete and it has important setbacks. Informal risk-coping strategies are costly for the individuals and limited to the insurance network area [2].

Agents might face a trade-off of productivity vs low risk generating poverty traps. Opportunities might be there but they are just too risky. For example, farmers seem to sacrify profitability for lower risk, and this specially affects the

[1] See (Collins et al., 2009) for a detailed and brilliant explanation of how people cleverly, but with a lot of effort and struggle, manage to live with erratic low incomes.

[2] typically studies focus on village level networks.

poorest farmers(M. R. Rosenzweig and Binswanger, 1992). In a more general level, (Santaeulalia-Llopis and Zheng, 2016) find a trade-off between income and insurance in the period of economic expansion of China. This trade-off of profitability vs risk copying is also observed in daugther's marriage (M. R. Rosenzweig and Stark, 1989) and migration choices (Munshi and M. Rosenzweig, 2016), (Santaeulalia-Llopis and Zheng, 2016).

Risk copying strategies can also impose health risk. (Robinson and Yeh, 2011) find that commercial sex workers in Kenya adopt riskier sex behavior (and better compensated) as a response of unexpected health shocks on other household members. Dealing with uncertainty and reliance on family, neighbors and friends networks can create psychological and social costs. To avoid these costs individuals might prefer more expensive lenders, "moneylenders", than cheaper but emotionally attached alternatives (Collins et al., 2009).

Despite the evidence on the perversive impacts of risks on poor households, existing literature has not fully described what are these risks and how people with different characteristics experiment them. Here I analyze the type of shocks Ugandan households suffer and how they depend on the household characteristics. At the best of my knowledge, this is the first paper that uses the self-reported household data on shocks from the LSMS-ISA surveys as a way to measure risk at the country level. Interestingly, in these surveys households are asked about whether they suffer different types of shocks.

In the last decade rainfall index-based insurances have been growing attention as a powerful tool to mitigate risk and increase agricultural outcomes. Despite its appealing, most of these insurances have had low uptake. In Malawi (Giné and Yang, 2009) and India (Cole et al., 2013) found take-up was only 20/30%. One of the reasons for low uptake could be the presence of basis risk. Though farmers might be suffering from rain shocks, there can also be also other shocks that they are left uninsured (like pests or other crops diseases, price shocks, health shocks, etc). Therefore determining the level and impact of basis risk is key in order to better understand the possible scope of rainfall insurances.

Literature on insurance in developing countries is extensive. However, I believe

this study can bring some new information to the existing knowledge. One reason is that previous works have studied insurance at some specific villages or regions, while few studies have studied insurance using country level data. Therefore, this study tries to be a bridge between insurance at the village level to aggregate results.

A second reason is that existing literature has not studied whether particular shocks or households characteristics affect the capacity to smooth consumption. Firstly, I Study whether different shocks lead to different levels of consumption smoothing might be interesting for several reasons. If markets are complete, then agents can insure against idiosyncratic shocks but not on aggregate ones. Study heterogeneities in the types of shocks can bring some light on classifying them as aggregate or idiosyncratic. Moreover, it can also have policy implications. Maybe some insurance products, like rainfall insurances, might have a low take-up because households are already able to insure against the risks covered. Therefore, understanding which shocks households are less able to cope with is important for the design of risk mitigation and insurance policies.

Secondly, I study whether households with different characteristics on place of reside (urban vs rural), gender and income levels have different levels of consumption smoothing. Understanding how these heterogeneities affect the capacity of households can help to generalize existing results to other populations, test some potential trade-offs and have policy implications.

For example, (Munshi and M. Rosenzweig, 2016) and (Santaeulalia-Llopis and Zheng, 2016) find that rural areas tend to be better insured than urban ones. This might suggest that the results in the vast literature on insurance in rural villages cannot be extended to important parts of the society. Moreover, understanding these heterogeneities can provide information on how informal networks work. Particularly we can test whether trade-off with insurance and income arises and understand whether they are specific to some regions or types of population. Moreover, in the case of policy intervention, study heterogeneities can help policymakers to better target the needy and consequently design more effective policies. At the best of my knowledge, this is the first study that systematically test whether there exists heterogeneities across the capacity of insure among households characteristics and

the types of shocks suffered.

This thesis is organized as follows. Section 2 discusses the data and the measurement of key variables. Section 3 studies the risk Ugandan households experiment, how they diverge on household characteristics and translate to income and consumption variation. In Section 4 I perform insurance tests taking into account heterogeneities in the type of shocks and on the household characteristics using interaction effects. Section 5 concludes.

2 Data

This study utilizes the 4 available waves of the Ugandan National Panel Survey [3]. The UNPS is a national representative panel survey carried out by the Ugandan National Statistics and is part of the World Bank LSMS-ISA project. The Living Standars Measurement Survey, LSMS, are representative household surveys with particular focus on living standards and inequality. The Integrated Survey on Agriculture, ISA, are surveys designed to capture all crops and livestock outputs and inputs. Other 7 Sub-Saharan African countries are part of the LSMS-ISA project. Given that LSMS-ISA survey are fairly homogenized, this study and data procedure could be explored to the rest of countries part of the LSMS-ISA project [4].

The UNPS is one of the longest panels of the LSMS-ISA project. The first wave started in 2009/10 and has been followed by 3 more waves in 2010/11, 2011/12, 2013/14. In each wave around 3000 households were interviewed. Interviews were proceeded along 2 years. Therefore within each wave households were interviewed at different months and years. One of the consequence of this is that I correct all monetary variables for price levels per each household depending on the year and the month they were interviewed. To simplify analysis, all monetary variables are in 2013 US$. Most of the study presented is using a balanced panel. the total number of households that has been interviewed in the 4 waves is 1490. Most of this drop

[3] Uganda - National Panel Survey 2013-2014, the World Bank.

[4] Though the LSMS-ISA datasets are rich and freely avaialable, their usage in the research has been low. As far as I know, this is the first study in creating a panel out of the 4 waves of Uganda. I must thank my master thesis advisor for presenting me the LSMS-ISA data.

comes from the last wave were 1286 households were newly interviewed.

2.1 Measuring Key Variables: Shocks, Consumption and Income

The integrity and consistency of the results deeply depend on the proper measurement of the key variables in the study. For this reason, I describe in detail how shocks, consumption and income household measures have been constructed.

The LSMS-ISA surveys across countries ask about the particular shocks households have suffered. The specific shocks might slightly vary across countries but they are substantially homogenized allowing for across countries comparisons [5]. Households are asked about shocks on climate variables; shocks on health and death within the household; shocks on wages, unemployment and business failure; shocks on input and output agricultural prices; crops and livestock pests and disease and other shocks like robbery, fire in the property, etc. In concrete, households are asked whether or not they suffer each shock during the last 12 months. In figures 7.2 in the appendix, I report the frequencies of the shocks per each wave.

The UNPS have a very detailed questionnaire on household consumption (section 15). This part is divided in 3 sections: food consumption (last 7 days), non-food/non-durable consumption (last month) and durable consumption (last year). For each consumption item, individuals are asked how much (in quantities and monetary values) were acquired across 3 means: purchases, own production and gifts or in-kind payments. My measure of household consumption is the sum over items and means of reported expenditure on food and non-durable goods[6]. In tables (5 to 8) in the appendix I present summary statistics of consumption variables per each wave.

Measuring household income tends to have important difficulties. Households might

[5] In a previous study I compare reported shocks across LSMS-ISA countries. The 2 main takeovers are that there exist important heterogeneities across countries and that climate shocks tend to be the most reported ones.

[6] Since the focus of this paper is to study variation on temporary consumption, expenditure on durable goods are not included in consumption, they are considered as investment expenditure. Given that durable goods account for small part of total consumption, results do not vary significantly using durable goods.

not remember all the income they are obtaining or might have incentives to misreport it. This difficulties are much pronounced in developing countries were household income tends to come from informal sources, different agents, and much erratic across time. Therefore, information about households income in developing countries tends to be missing or with important setbacks (Deaton, 2005). The main strength and target of the LSMS-ISA datasets is to have a very detailed measure of income across poor countries, specially in agricultural one, which is lacking in most previous datasets. Income information is provided from both the household questionnaire and the agricultural one.

In the household questionnaire individuals are asked about income coming from labor services (section 8) and income coming from business operations (section 9) [7]. In section 8 individuals within household are asked about the wages obtained [8] and for how many months and weeks they were working. An important setback is that individuals are not asked about for how many days and hours they were working. Therefore, for individuals that reported wages in hours and days I use the average working hours in Uganda that are of 50 hours per week and 6 days per week[9].

One of the strengths of the LSMS-ISA data is the detailed measure of agricultural income. It is worth to note that the interviewers measure the plot size of each household and the GPS coordinates can be obtained upon request. The agricultural questionnaire is very detailed. Being located in the equator, Uganda is a favorable country for agriculture with rich soil, abundant rains and mild temperatures. Most of the country, except the north, enjoys 2 crop seasons per year. Given this, households are asked for crop's outputs and inputs for the 2 different seasons. Therefore, the agricultural questionnaire can be divided in 3 sections: first crop season, second crop season and livestock. It is important to emphasize the level of detail of the these sections. From both the agricultural and the livestock part very different output means and inputs usage are asked. In terms of inputs, households are asked

[7] The questionnaire also ask for income coming from other sources (rents from properties, taxes and subsidies and remittances, section 11). Since questions in this part changed across waves I do not include them. However, these income sources represent a very small fraction of total income for Ugandan households.

[8] Individuals are asked how much they were paid (cash and estimated in-kind) for the job in the last 7 days and what period the payment covered: hours, days, weeks and months.

[9] See Africapay

about fertilizers and seeds usage, labor payed, land or animal rents (both received and payed) and other expenditures. Therefore we have a very detailed and probably precise estimate of households agricultural and livestock net income.

From the crops part we can recover the output sold, own consumed, stored, given as gifts, used to feed livestock and used to make processed food. Similarly, in the livestock part we also have information on output sold and own consumed. In order to measure the monetary value of the outputs not sold, I input for each product the median prices per season and year given the ratio of value and quantities sold [10]. Importantly, quantities are given in different measures (kilograms, baskets, bags, etc). I use the median conversion values per quantity unit and I set all quantities in kilograms. In the case of livestock, to measure the monetary own consumption value, I input self-consumption of livestock products reported in the consumption part of the household questionnaire, since some of the products, as own consumption of meat produced, are not asked in the agricultural one and selling prices for some items as eggs or milk were too high. In tables (9 to 12) in the appendix I present summary statistics of income variables per each wave. It is worth to notice that mean income tends to be lower than mean consumption, which is a common aspect in most datasets. Labor income is the one with higher mean, while income from business tends to have the lowest mean. Agriculture and livestock are the most common source of income for Ugandan households.

To be able to check for heterogeneities and run robustness checks I make use of different sociodemographic characteristics. In tables (7.3.4 to 20 I present summary statistics for age, urban, gender, health and education variables for each wave. Given that occupational choices might be relevant for risk-managing, using the share of income from agriculture, labor and business, I categorize individuals as farmers, workers or entrepreneurs. See tables (13 to 16) for summary statistics of these variables.

Though previous studies using LSMS-ISA datasets (De Magalhaes and Santaeulalia-

[10] An alternative is to use the prices in the market, the prices that a consumer faces. Though market prices can be recovered from the consumption section, not all items are present there, and, in general, prices are too high for Uganda. The first idea was to use regional prices but since observatio might be low, regional prices did not have meaningful values.

Llopis, 2015) deseasonalize consumption and income variables, in my case I decided to not do so. Seasonality does not significantly affect income and, while it does for consumption, the R-squared is low. Therefore I considered that cost of deseasonalizing, in terms of no direct interpretation of the values, surpass the benefits. Importantly, I do not trim the variables of consumption since minimum and maximum values observed in tables (5 to 8) are not extreme values. In the case of income, minimum and maximum values for labor, business, agricultural and livestock values were indeed extreme. Therefore I trimmed both tails at the 0.1% for each income source.

It is important to note that such level of data detail have also setbacks. The main one is that it gives a lot of freedom for the researchers to construct their measures of household income. The researcher can discretionary use this freedom to find "nice" results. To avoid this measurement and researcher bias, I reported in detail the way I constructed such measurement and I report the main summary statistics for the different sources of income in the appendix. Finally, In order to have a more transparent research, I give free access of the code and the datasets elaborated in the following link.

3 Risk

This section specifies and quantifies the type of shocks Ugandan households suffer and how they diverge across households characteristics using self-reported household data. existing literature has not fully described what are the shocks that household suffer. Interestingly, LSMS-ISA datasets ask whether household experimented each specific shock. In the appendix 7.2 I present bar graphics on the proportion of households that reported each shock for the 4 waves of the data and I also present bar graphics aggregating shocks as climate, aggregate and idiosyncratic ones.

In the case of Uganda drought shocks clearly are the most reported ones. for the 4 waves, 40%, 27%, 20% and 25% of households reported drought shocks respectively. Given this dominance of drought, aggregate shocks count much more than idiosyncratic ones (55-70%).

In table (1) I present the proportions of shocks reported by different household characteristics. In the first row of table (1) I provide the means of the following constructed shocks: shocks (includes all types of shocks), aggregate, idiosyncratic, climate, agricultural prices, health, job and crop and livestock pests and diseases.[11]. In the next rows I explore how household with different characteristics report these shocks. For the characteristics, I use the place of reside (urban or rural), the region and the gender of the household head for the 2013/14 wave. I also use the main occupation of the household (farmer, worker, entrepreneur) in 2013/14. To elaborate the consumption quintiles, I use the household average consumption across waves. Finally, I report the mean of each shock per each wave.

The main takeover is that household heterogeneities do matter for how households experiment shocks. In concrete, I find the following relevant aspects:

- Rural households suffer much more shocks (50.34%) than urban ones (33%). This increase is mainly due to higher climate shocks. Agricultural prices, health and crop and livestock pests and diseases shocks are also higher.

- Poor households tend to suffer more shocks but the relationship is not monotonous. Below the median consumption households report more shocks (49.3%) than those above (44%). Poorer households report substantially more climate shocks while for the rest, including health, both poor and rich report similar levels. Rich people report more agricultural prices, job and crops and livestock pests and diseases shocks. Observing the shocks across quintiles we observe that the relationship is not monotonous. The quintile that report most shocks is the middle one (the 3th) followed by the first one. Households in the top quintile are the ones that report more health shocks. For climate shocks we do observe a more linear relationship, being the poorest quintile the one that reports most of these shocks.

- Female head households tend to report more shocks (48%) than male ones (45.7%). This difference comes mainly from health shocks were women report

[11] Check appendix 7.1 to know how shocks are classified

Table 1: Proportion of Shocks Households Reported to Experience during last 12 Months (Balanced panel: 2009-2014)

	Shock	Aggreg	Idios	Clima	Agr. P	Job	Health	Pest	Obs
Total	**46.69**	**34.65**	**18.28**	**34.18**	**2.28**	**0.69**	**11.33**	**2.62**	**7555**
by Reside									
Rural	50.34	38.89	18.79	38.40	2.60	0.45	11.67	2.97	4688
urban	33.01	18.78	16.39	18.39	1.12	1.20	10.07	1.36	1251
by Region									
Central	48.68	32.62	22.03	32.18	2.09	1.42	12.43	3.75	1625
Eastern	44.18	34.24	20.15	33.29	4.90	0.27	12.59	4.56	1469
Northern	54.69	45.05	16.21	44.86	1.34	0.26	10.34	0.45	1567
Western	36.93	24.54	13.40	24.29	0.59	0.42	9.38	1.51	1194
by Gender									
Male	45.77	34.19	17.73	33.68	2.46	0.62	10.78	2.91	3543
Female	48.06	35.34	19.11	34.92	2.04	0.58	12.14	2.21	2397
by C. Quin									
Quin1	50.38	40.27	17.19	40.02	1.43	0.34	11.63	1.35	1187
Quin2	47.27	35.58	17.58	35.24	1.93	0.34	11.35	1.85	1189
Quin3	51.01	38.49	18.82	37.82	2.77	0.34	11.51	2.94	1190
Quin4	43.86	31.65	17.34	31.06	2.95	0.67	9.34	3.62	1188
Quin5	40.93	27.26	20.51	26.75	2.36	1.35	12.83	3.38	1185
by C. 50%									
Poor	49.36	37.95	17.66	37.55	1.95	0.34	11.61	1.92	2972
Rich	44.02	31.34	18.91	30.81	2.63	0.88	11.05	3.34	2967
By Task									
Business	36.11	21.80	17.14	21.63	0.83	1.16	8.99	0.67	601
farmer	50.38	39.24	18.54	38.76	2.54	0.39	11.60	3.24	4131
worker	40.42	27.14	17.81	26.66	2.12	1.15	11.65	1.54	1039
By Wave									
2009-2010	63.67	51.31	26.93	50.77	3.49	0.94	16.05	4.84	1489
2010-2011	47.23	31.98	20.78	31.71	1.89	0.47	14.44	1.55	1482
2011-2012	35.77	25.22	13.39	24.48	2.23	0.68	7.17	2.23	1479
2013-2014	40.03	30.02	12.02	29.68	1.54	0.34	7.66	1.88	1489

20% proportionally more than the men ones. For the rest of shocks we do not observe big gender differences.

- In terms of the main occupation of the household, farmers are the ones that suffer more shocks followed by workers. Entrepreneurs are the ones that report less health shocks while also less climate ones.

- By region we also observes important differences being the Northern part the region were more shocks are reported. The Northern part of Uganda is the poorest and with the driest climate. Finally, shocks across waves change substantially. While in 2009/10 63.3% of households experienced some shock, in 2011/12 only 35.77% reported it.

The main setback of the data is that we only observe whether a household experienced an specific shock or not, but we do not know the magnitudes. So, despite climate shocks are the most frequent ones, it could be that other less frequent shocks has a much bigger effect. To try to quantify the effect of each shock on households, I study how experience each shock changes the levels of consumption and income for the household. In order to study whether some risk-sharing applies to the households, I study how consumption coming from in-kind and gifts payments changes with respect to experiencing each type of shock. In concrete, in table 2 I present the coefficients of running the following regressions:

$$\Delta lna_{it} = +\beta_0 + \beta_1 \Delta shock_{it} + u_{it} \tag{1}$$

Where a_{it} represents total consumption, consumption only through gifts/in-kind and total income for each column. $\Delta shock_{it}$ represents the changes in reporting each type of shock described in 7.1. Note that testing $\beta_1 = 0$ for the different idiosyncratic shocks is a full-insurance test in the spirit of (Cochrane, 1991). However, in our case we find that households that report suffering a shock actually increase their proportional consumption while for most of shocks proportional income does not change. These results set difficulties at evaluating the magnitudes of the shocks and they might signal possible measurement error bias.

Table 2: How Shocks Lead to Consumption and Income Variation. Uganda Balanced Panel, 2009-2014.

	ΔlnC		ΔlnC(gift)		ΔlnY	
	Inter	Slope	Inter	Slope	Inter	Slope
$\Delta Shock$	0.0559***	0.0506***	-0.0853***	0.0352	-0.0415	0.0395
	(0.0089)	(0.0139)	(0.0312)	(0.0487)	(0.0258)	(0.0405)
$\Delta Aggregate$	0.0559***	0.0557***	-0.0906***	-0.0305	-0.0466*	-0.0257
	(0.0089)	(0.0148)	(0.0312)	(0.0498)	(0.0258)	(0.0429)
$\Delta Idiosyn$	0.0549***	0.0596***	-0.0805***	0.1171**	-0.0398	0.0967*
	(0.0088)	(0.0175)	(0.0311)	(0.0563)	(0.0257)	(0.0507)
$\Delta Climate$	0.0560***	0.0589***	-0.0917***	-0.0465	-0.0458*	-0.0158
	(0.0089)	(0.0148)	(0.0311)	(0.0498)	(0.0258)	(0.0429)
$\Delta Prices$	0.0521***	0.0282	-0.0868***	0.1323	-0.0454*	-0.1197
	(0.0088)	(0.0424)	(0.0309)	(0.1275)	(0.0256)	(0.1226)
$\Delta Health$	0.0540***	0.0772***	-0.0800***	0.2222***	-0.0382	0.2331***
	(0.0088)	(0.0210)	(0.0309)	(0.0663)	(0.0256)	(0.0609)
ΔJob	0.0523***	0.1988**	-0.0885***	-0.1383	-0.0458*	-0.5157**
	(0.0088)	(0.0854)	(0.0309)	(0.3358)	(0.0256)	(0.2485)
$\Delta Pests$	0.0528***	0.0911**	-0.0916***	-0.2000	-0.0483*	-0.3540***
	(0.0088)	(0.0422)	(0.0310)	(0.1296)	(0.0256)	(0.1207)

4 Insurance tests

In the benchmark of full-insurance tests, (Cochrane, 1991), (Mace, 1991), (R. M. Townsend, 1994),), if markets are complete, agents consumption should only depend on aggregate shocks but not on idiosyncratic ones. The previous section tried to identify aggregate and idiosyncratic shocks but results are not clear. Therefore, as in (R. M. Townsend, 1994) aggregate shocks are measured with changes in mean consumption. Here village level observations are not enough so households are aggregated at the regional level[12] [13].

Then, assuming that agents are homogeneous on preferences with CRRA utility function, under full-insurance, proportional changes in consumption should only vary with respect to proportional changes in aggregate consumption. This rises the following regression:

$$\Delta lnc_i = \beta_0 + \beta_1 \Delta \overline{lnc_r} + \beta_2 \Delta lny_i + e_{it} \tag{2}$$

And full-insurance implies $\beta_2 = 0$.

Though full insurance tests have been widely applied, this study tries to determine whether the capacity of households depend on the type of shocks and the household characteristics. Heterogeneities in consumption smoothing have been recently studied. (Schulhofer-Wohl, 2011) and (Mazzocco and Saini, 2012) showed that a test on (2) when risk preferences are heterogeneous might be biased against the null of full insurance. Both (Schulhofer-Wohl, 2011) (Mazzocco and Saini, 2012) propose alternative tests that allow heterogeneity. In an simplified approach, (Chiappori et al., 2014) also test for heterogeneities on risk preferences with a 2-steps OLS. They find that heterogeneities do matter.

Here I assume households have identical preferences, but I study whether heterogeneities on the type of shocks suffered and household characteristics can lead

[12] The survey has 4 main regions: North, West, East and South. Initially, the plan was to aggregate at the subregions level (8 regions) but this information is only available for the last 2 waves. A further step is to study how insurance levels change across the scale of the aggregate shocks.

[13] Though most studies focus on village level insurance schemes, (Fafchamps and Gubert, 2007), (M. R. Rosenzweig and Stark, 1989) find evidence that insurance networks can extend the village level.

to different levels of consumption smoothing. A possible setback of this approach is that household characteristics differences might underline heterogeneities in risk preferences, leading to biased estimates. However, (Chiappori et al., 2014) do not find correlation between risk preferences and related demographics.

To test for heterogeneities on consumption smoothing on the type of shocks, I run OLS with interaction terms of the differentials of reported shocks [14]. Concretely I test whether ($\gamma = 0$), absence of heterogeneities, in the following regression:

$$\Delta c_{it} = \beta_0 \Delta \overline{lnc_{rt}} + \beta_1 \Delta lny_{it} + \Delta Shock_{it}\theta + (\Delta lny_{it} \times \Delta shock_{it})\gamma + \epsilon_{it} \tag{3}$$

Table 3: Insurance tests under Heterogeneous Shocks

	Δlnc				
	Intercept	$\Delta \bar{lnc}$	ΔlnY	Slope	Interaction
$\Delta shock$	0.0246**	0.3598***	0.0325***	0.0463***	0.0021
	(0.0105)	(0.0691)	(0.0060)	(0.0141)	(0.0087)
$\Delta Aggregate$	0.0244**	0.3683***	0.0326***	0.0557***	0.0021
	(0.0105)	(0.0688)	(0.0060)	(0.0149)	(0.0096)
$\Delta Idiosyn$	0.0225**	0.3777***	0.0312***	0.0571***	-0.0035
	(0.0104)	(0.0687)	(0.0060)	(0.0177)	(0.0102)
$\Delta Climate$	0.0245**	0.3676***	0.0326***	0.0576***	0.0031
	(0.0105)	(0.0688)	(0.0060)	(0.0149)	(0.0096)
$\Delta Prices$	0.0193*	0.3844***	0.0318***	0.0464***	-0.0126
	(0.0104)	(0.0688)	(0.0060)	(0.0427)	(0.0323)
$\Delta Health$	0.0219**	0.3712***	0.0310***	0.0612***	-0.0054
	(0.0104)	(0.0689)	(0.0060)	(0.0212)	(0.0123)
ΔJob	0.0196**	0.3854***	0.0321***	0.2479***	0.0139
	(0.0104)	(0.0687)	(0.0060)	(0.0878)	(0.0454)
$\Delta Pests$	0.0196*	0.3975***	0.0319***	0.1177***	0.0274
	(0.0104)	(0.0689)	(0.0060)	(0.0420)	(0.0296)

Results can be find in table (3). While the different type of shocks affect differently the proportional changes of consumption (i.e. $\theta \neq 0$), I do not find that the different type of shocks affect the degree of consumption smoothing (i.e. $\gamma = 0$).

On the other hand, I test for heterogeneities on consumption smoothing depending on the following household characteristics: place of residence (urban vs rural),

[14] $\Delta shock = \{-1, 1, 0\}$

gender and purchasing power. The gender and the place of residence of the households are measured by the observations in 2013/14[15]. Purchasing power is measured by the consumption quintile that households belong taking into account household consumption mean across years. To test for household heterogeneities, I use a similar approach as described before and I test whether ($\gamma = 0$) in the following regression:

$$\Delta c_{it} = \beta_0 \Delta \bar{l}nc_{rt} + \beta_1 \Delta lny_{it} + X_i\theta + (\Delta lny_{it} \times X_i)\gamma + \varepsilon_{it}. \tag{4}$$

Where X_i represents the household characteristics variable(s). Results can be find in table 4. In this set of regressions we observe that heterogeneities do matter. In concrete, we observe that when household characteristics are included, the degree of consumption smoothing decreases (i.e. β_2 increases). We also observe that effects of residence and purchasing power are correlated. In column 4 in table (4) interaction of urban seems not particularly significant while in column 5 the effect of purchasing power it is also not clear. However, once purchasing power and place of residence are together in the regression, column 6 in table (4) the effects are no longer mixed and we have a clearer picture.

In concrete we observe that as households move along the consumption quintiles, insurance is significantly higher (i.e. interaction effect is negative). This presence evidence against a trade-off of insurance vs income growth. Taking into account the gender and the residence of the households, higher purchasing power increases insurance. On the other side, we observe that the interaction effect of urban in the long specification is significantly positive. Therefore, taking into account gender and purchasing power, living in a urban area decreases insurance levels. This is consistent with the quantitative model of (M. R. Rosenzweig and Stark, 1989) where individuals in rural India choose to migrate to the cities or not facing a trade-off of higher income vs loosing caste based rural insurance support. It is also consistent with (Santaeulalia-Llopis and Zheng, 2016) where migration to the cities increases income but reduces insurance levels during the period of economic expansion in China. Finally, gender does not significantly effect the capacity of household to smooth consumption.

[15]Migration from the cities and changes in the household head gender have not been particularly high, so imputing values of 2013/14 for the rest of years is not problematic.

Table 4: Household Heterogeneities in Consumption Smoothing

	Δlnc				
Intercept	0.0187*	0.0179	0.0185	0.0971***	0.1001***
	(0.0104)	(0.0120)	(0.0114)	(0.0204)	(0.0221)
c2				-0.0478*	-0.0518*
				(0.0279)	(0.0279)
c3				-0.1129***	-0.1179***
				(0.0278)	(0.0279)
c4				-0.1000***	-0.1118***
				(0.0280)	(0.0286)
c5				-0.1481***	-0.1695***
				(0.0284)	(0.0301)
female		0.0026			-0.0158
		(0.0188)			(0.0190)
urban			-0.0039		0.0368*
			(0.0211)		(0.0223)
$\Delta \bar{lnc}$	0.3898***	0.3893***	0.3973***	0.4172***	0.4306***
	(0.0686)	(0.0687)	(0.0688)	(0.0685)	(0.0686)
Δlny	0.0308***	0.0316***	0.0241***	0.0475***	0.0473***
	(0.0060)	(0.0075)	(0.0069)	(0.0095)	(0.0110)
$\Delta lny \times c2$				-0.0024	-0.0087
				(0.0149)	(0.0150)
$\Delta lny \times c3$				-0.0570***	-0.0668***
				(0.0159)	(0.0161)
$\Delta lny \times c4$				-0.0330*	-0.0531***
				(0.0171)	(0.0180)
$\Delta lny \times c5$				-0.0254	-0.0544***
				(0.0160)	(0.0179)
$\Delta lny \times female$		-0.0019			-0.0083
		(0.0108)			(0.0108)
$\Delta lny \times urban$			0.0223*		0.0459***
			(0.0118)		(0.0133)

5 Conclusion

Ugandan households suffer substantial risk. Around half of the households report to experience some shock during the last year. The main reported shocks are climatic and they are followed by health ones. We observe that households with different characteristics report different levels and types of shocks. This has model design and policy implications on which households and shocks should be targeted. We observe that poor people tend to report more shocks. We also observe that women tend to report more health shocks and that rural households substantially report more shocks than urban ones. The poorest households, those in the lowest quintile, specially suffer from climate shocks. These results suggest that poor people might be in need of more protection from climate events, so policies like index-based rain insurances seem an interesting policy to continue being studied.

Living with risk might not be as detrimental if households can insure against the shocks. I performed insurance test at the country level aggregating households by regions. Though households cannot fully insure, we observe a high degree of resilience. One of the targets of this study was to determine which type of shocks households are more or less able to insure against. However, with the current data, results are not conclusive. As a further step I would like to use other measures of shocks (like rainfall and health data) to continue testing differences in consumption smoothing across types of shocks.

A second target of this study was to evaluate how the capacity of households to smooth consumption depends on the households characteristics. Though insurance tests have been applied under heterogeneities in preferences, (Schulhofer-Wohl, 2011) (Mazzocco and Saini, 2012) (Chiappori et al., 2014), across urban vs rural households (Munshi and M. Rosenzweig, 2016) , and across different stages of economic development(Santaeulalia-Llopis and Zheng, 2016), I believe this is the first study to systematically test consumption smoothing heterogeneities across households place of reside (urban vs rural), income levels and gender.

Including household heterogeneities have substantial effects. Though we do not find evidence of different insurance capacity across the gender of the household, we

do observes differences for place of reside and purchasing power. Concretely, we observe that as households get richer their consumption smoothing significantly increases. On the other side, living in a urban area decreases the level of consumption smoothing. These results have important consequences. I do not find evidence of a general trade-off between income and consumption smoothing but the opposite: getting richer increases the insurance capacity of households. This is evidence against insurance networks poverty traps. However, and in line with (Munshi and M. Rosenzweig, 2016) and (Santaeulalia-Llopis and Zheng, 2016), I do find a trade-off between income and insurance when households must take the decision to migrate from rural to urban areas. Once income differences are taken into account, urban households are statistically significant worse off at smoothing consumption. It is important to mention that rural households report suffering much more shocks than urban ones. While we observe that rural households seem to have better insurance schemes, they also report to substantially suffer more shocks. Therefore, an contrary to existing literature, I cannot conclude whether living in a rural or urban area is better in terms of shocks resilience.

Heterogeneities on shocks and household characteristics seem to have important affects on the risks and the capacity to insure of the households. I believe further studies at the country level of heterogeneities in consumption smoothing should be an interesting aspect of research. Finally, I believe the possible trade-off of insurance vs income at migrating to the cities should be studied further.

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7 Appendix

7.1 Shocks classification

The socks are:

Shocks : Aggregate, Idiosyncratic and Other.

Aggregate : Drought, Irregular Rains, Erosion, Floods, Landslides, Unusually High Costs of Agricultural Inputs, Unusually Low Prices for Agricultural Output.

Idiosyncratic : Unusually High Level of Crop Pests & Disease, Unusually High Level of Livestock Disease, Death of Other Household Member(s), Reduction in the Earnings of Currently (Off-Farm) Employed Household Member(s), Loss of Employment of Previously Employed Household Member(s) (Not Due to Illness or Accident), Serious Illness or Accident of Income Earner(s), Serious Illness or Accident of Other Household Member(s), Death of Income Earner(s), Theft of Money/Valuables/Non-Agricultural Assets, Theft of Agricultural Assets/Output (Crop or Livestock), Conflict/Violence, Fire.

Climate : Drought, Irregular Rains, Erosion, Floods, Landslides.

Agr. Prices : Unusually High Costs of Agricultural Inputs, Unusually Low Prices for Agricultural Output.

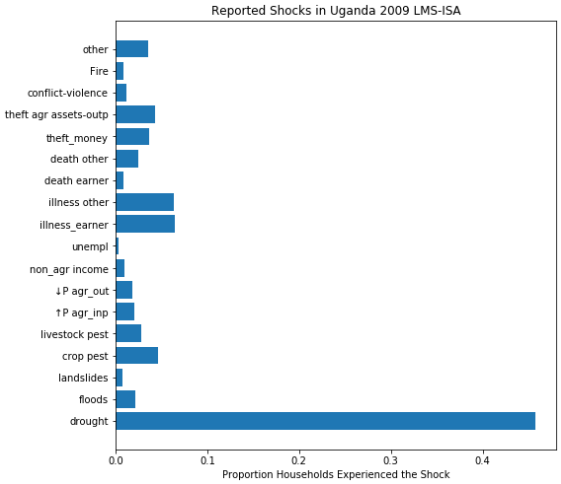
Job : Reduction in the Earnings of Currently (Off-Farm) Employed Household Member(s), Loss of Employment of Previously Employed Household Member(s) (Not Due to Illness or Accident).

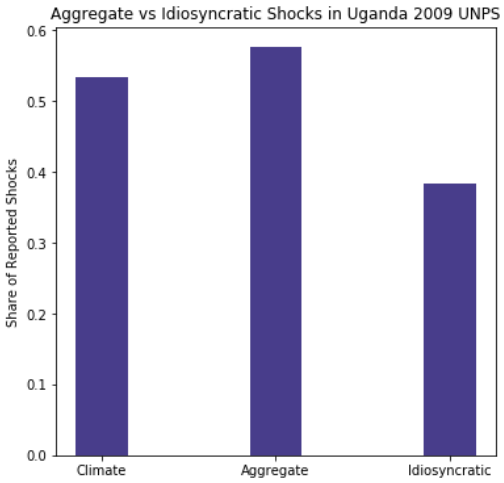
Health : Serious Illness or Accident of Income Earner(s), Serious Illness or Accident of Other Household Member(s), Death of Income Earner(s), Death of Other Household Member(s).

Crop-lvstk : Unusually High Level of Crop Pests & Disease, Unusually High Level of Livestock Disease.

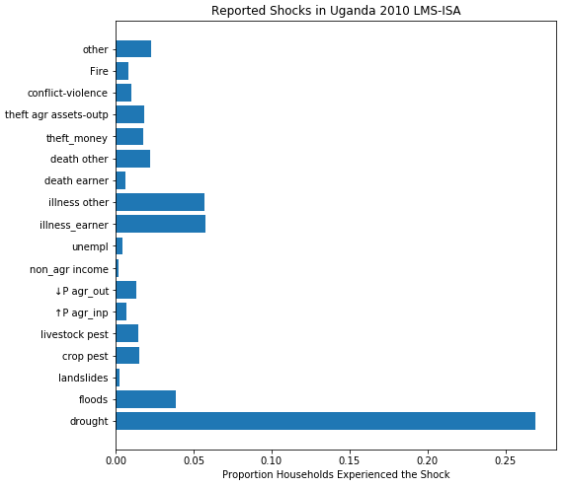
7.2 Figures

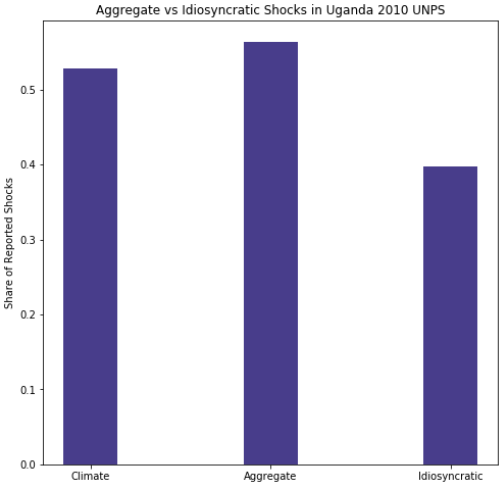
7.2.1 Shocks Uganda 2009-2010



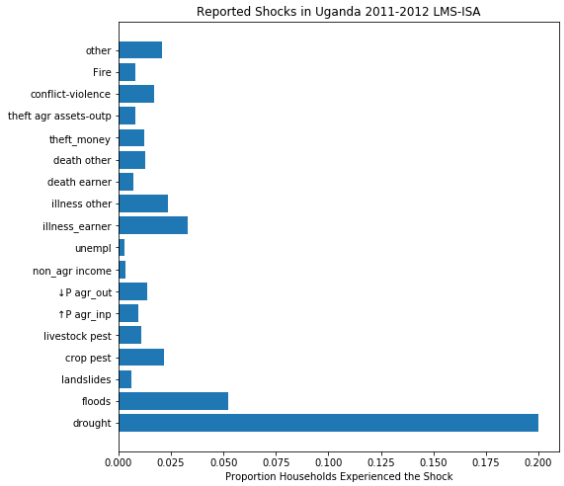


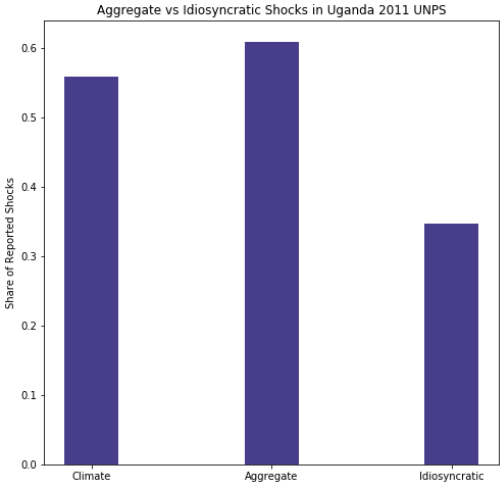
7.2.2 Shocks Uganda 2010-2011



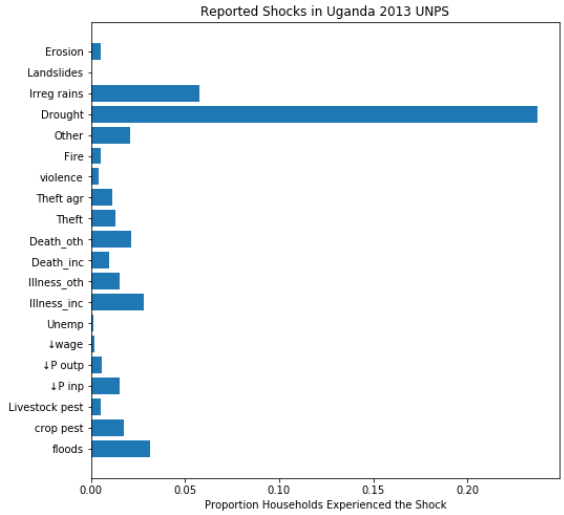


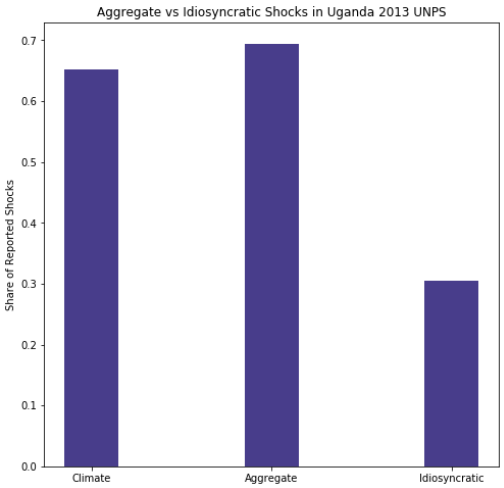
7.2.3 Shocks Uganda 2011-2012





7.2.4 Shocks Uganda 2013-2014





7.3 Complementary tables

7.3.1 Consumption summary tables

Table 5: Consumption Summary 2009/10

	Total	Total+dur	Gifts	Food	Non-Dur
Obs	2,940	2,940	2,940	2,929	2,752
Mean	1,874.02	1,889.57	170.70	1,079.76	852.84
Std	1,864.31	1,906.21	335.07	892.56	1,239.05
Min	0.00	0.00	0.00	14.47	6.74
25%	814.45	818.78	3.20	522.88	233.33
50%	1,347.55	1,355.34	85.97	848.75	471.22
75%	2,222.47	2,237.84	194.53	1,322.51	963.62
Max	28,802.51	28,802.51	8,229.10	12,981.91	25,719.35

Table 6: Consumption Summary 2010/11

	Total	Total+dur	Gifts	Food	Non-Dur
Obs	2,657	2,657	2,657	2,657	2,639
Mean	1,801.12	2,206.44	166.28	1,100.30	705.60
Std	1,937.61	3,818.34	688.96	1,146.58	1,155.15
Min	88.95	88.95	0.00	10.00	10.35
25%	766.79	839.16	0.00	502.28	177.61
50%	1,281.84	1,457.91	52.43	860.16	359.61
75%	2,109.72	2,448.05	182.68	1,381.38	756.04
Max	38,193.99	150,641.09	31,699.65	37,194.91	15,374.28

Table 7: Consumption Summary 2011/12

	Total	Total+dur	Gifts	Food	Non-Dur
Obs	2,810	2,810	2,810	2,784	2,798
Mean	1,871.45	2,264.89	134.40	1,148.95	736.27
Std	3,637.23	3,989.60	367.63	954.88	3,332.91
Min	0.00	33.33	0.00	30.95	9.34
25%	818.85	912.17	0.00	564.42	172.28
50%	1,309.42	1,490.54	35.06	908.00	353.93
75%	2,162.12	2,591.16	141.52	1,421.46	726.31
Max	168,644.62	169,110.41	13,567.74	14,354.57	166,537.33

Table 8: Consumption Summary 2013/14

	Total	Total+dur	Gifts	Food	Non-Dur
Obs	1,822	1,822	1,822	1,822	1,819
Mean	1,859.76	2,266.11	161.23	1,122.08	738.89
Std	1,689.65	2,185.49	314.75	839.26	1,103.48
Min	106.05	107.85	0.00	49.54	5.17
25%	915.84	1,023.36	26.07	617.68	236.94
50%	1,415.45	1,627.30	87.15	928.18	439.19
75%	2,222.97	2,681.95	197.25	1,411.09	824.17
Max	19,302.48	24,840.83	8,711.09	13,605.82	15,242.08

7.3.2 Income summary tables

Table 9: Income Summary 2009/10

	Total	Labor	Business	Agriculture	Livestock
Obs	2,812	1,288	1,414	2,778	2,752
Mean	1,749.50	1,444.07	111.71	935.56	109.99
Std	3,109.55	3,584.41	446.83	1,640.13	399.55
Min	-1,121.05	0.07	-2,024.39	-83.99	-117.98
25%	321.43	118.94	8.08	41.76	0.00
50%	770.55	427.55	26.63	383.81	0.00
75%	1,963.96	1,296.62	82.83	1,052.43	55.12
Max	57,929.68	57,531.09	5,930.45	18,061.12	6,052.40

Table 10: Income Summary 2010/11

	Total	Labor	Business	Agriculture	Livestock
Obs	2,582	1,103	1,227	2,529	2,503
Mean	1,149.11	1,409.10	121.38	382.58	118.37
Std	2,505.27	3,412.48	592.04	576.10	503.75
Min	-4,532.03	1.02	-4,532.03	-229.96	-103.10
25%	197.03	108.35	10.01	39.35	0.00
50%	496.40	454.65	29.31	193.27	0.00
75%	1,194.22	1,430.48	93.09	476.29	52.29
Max	66,017.83	66,017.83	11,916.22	6,398.39	13,551.48

Table 11: Income Summary 2011/12

	Total	Labor	Business	Agriculture	Livestock
Obs	2,727	964	1,203	2,673	2,646
Mean	1,616.70	1,282.40	134.74	1,019.84	107.48
Std	2,411.78	2,758.45	445.62	1,563.46	383.62
Min	-1,427.63	2.44	-1,427.63	-59.26	-39.44
25%	371.70	253.09	12.49	80.84	0.00
50%	919.50	661.21	36.50	481.71	0.00
75%	1,988.79	1,298.66	105.96	1,259.36	62.31
Max	43,436.59	43,337.01	7,726.66	16,267.06	7,600.62

Table 12: Income Summary 2013/14

	Total	Labor	Business	Agriculture	Livestock
Obs	1,822	616	802	1,391	860
Mean	885.39	1,424.00	186.27	345.36	123.49
Std	1,588.61	2,316.62	571.40	401.54	155.38
Min	-1,365.47	6.51	-1,365.47	-92.71	-53.74
25%	152.92	228.05	17.98	91.96	-1.26
50%	419.88	802.46	59.66	206.16	62.04
75%	1,024.36	1,553.20	151.89	432.13	194.77
Max	20,952.68	20,706.51	8,641.98	3,173.79	617.94

7.3.3 Labor summary tables

Table 13: Occupations Summary 2009/10

	Farmer	Worker	Entrepeneur	Agr. Share	Lab. Share	Bus. Share
Obs	2,922	2,922	2,922	2,708.00	1,288.00	1,413.00
Mean	0.68	0.28	0.10	0.66	0.55	0.23
Std	0.47	0.45	0.30	0.45	0.45	0.52
Min	0	0	0	-5.08	-1.55	-8.04
25%	0	0	0	0.27	0.17	0.01
50%	1	0	0	0.90	0.54	0.04
75%	1	1	0	1.00	0.94	0.21
Max	1	1	1	1.56	9.04	6.72

Table 14: Occupation Summary 2010/11

	Farmer	Worker	Entrepeneur	Agr. Share	Lab. Share	Bus. Share
Obs	2,668	2,668	2,668	2,474	1,103	1,227
Mean	0.66	0.30	0.11	0.69	0.61	0.16
Std	0.47	0.46	0.32	1.45	0.39	2.13
Min	0	0	0	-6.52	-0.64	-53.39
25%	0	0	0	0.24	0.29	0.02
50%	1	0	0	0.87	0.67	0.08
75%	1	1	0	1	0.96	0.31
Max	1	1	1	48.41	5.98	7.52

Table 15: Occupation Summary 2011/12

	Farmer	Worker	Entrepeneur	Agr. Share	Lab. Share	Bus. Share
Obs	2,808	2,808	2,808	2,618	964	1,203
Mean	0.73	0.24	0.10	0.61	0.60	0.46
Std	0.45	0.43	0.30	5.20	0.43	7.66
Min	0	0	0	-264.62	-1.31	-5.99
25%	0	0	0	0.45	0.27	0.02
50%	1	0	0	0.95	0.62	0.06
75%	1	0	0	1	0.98	0.27
Max	1	1	1	1.21	6.99	265.62

Table 16: Occupation Summary 2013/14

	Farmer	Worker	Entrepeneur	Agr. Share	Lab. Share	Bus. Share
Obs	1,822	1,822	1,822	1,452	616	802
Mean	0.64	0.29	0.14	0.72	0.72	0.33
Std	0.48	0.45	0.35	0.40	0.30	0.45
Min	0	0	0	-3.67	0.01	-2.00
25%	0	0	0	0.46	0.52	0.05
50%	1	0	0	0.92	0.82	0.15
75%	1	1	0	1	0.97	0.50
Max	1	1	1	3.00	1.60	4.67

7.3.4 Sociodemographic characteristics summary tables

Table 17: Sociodemographic Summary 2009/10

	Age	Days Sick	Urban	Women	Familysize	Bednet	Write&Read
Obs	2,758.00	1,431.00	2,975.00	2,975.00	2,902.00	2,671.00	2,751.00
Mean	45.86	12	0.26	0.26	5.69	0.52	0.33
Std	15.03	9.41	0.44	0.44	3.11	0.50	0.56
Min	14	0	0	0.00	1	0	0
25%	34	5	0	0.00	3	0	0
50%	43	7	0	0.00	5	1	0
75%	55	15	1	1.00	7	1	1
Max	100	37	1	1.00	23	1	1

Table 18: Sociodemographic Summary 2010/11

	Age	Days Sick	Urban	Women	Familysize	Bednet	Write&Read
Obs	2,597.00	1,128.00	2,668.00	2,668.00	2,625.00	2,501.00	2,597.00
Mean	46.16	12.01	0.22	0.68	5.70	0.61	0.32
Std	15.23	9.13	0.42	0.47	2.92	0.49	0.55
Min	14	0	0	0	1	0	0
25%	34	6	0	0	4	0	0
50%	44	7	0	1	6	1	0
75%	56	15	0	1	7	1	1
Max	99	30	1	1	22	1	1

Table 19: Sociodemographic Summary 2011/12

	Age	Days Sick	Urban	Women	Familysize	Bednet	Write&Read
Obs	2,810	1,062	2,810	2,810	2,810	2,696	2,810
Mean	46.22	11.88	0.20	0.31	5.80	0.59	0.34
Std	15.16	8.84	0.40	0.46	2.96	0.49	0.59
Min	14	0	0	0	1	0	0
25%	35	5	0	0	4	0	0
50%	44	7	0	0	6	1	0
75%	56	15	0	1	8	1	1
Max	100	30	1	1	22	1	1

Table 20: Sociodemographic Summary 2013/14

	Age	Days Sick	Urban	Women	Familysize	Bednet	Write&Read
Obs	1,822	648	1,822	1,822	1,822	1,756	1,822
Mean	48.47	11.44	0.25	0.33	5.94	0.67	0.27
Std	15.03	8.86	0.43	0.47	3.04	0.47	0.45
Min	18	0	0	0	1	0	0
25%	37	5	0	0	4	0	0
50%	46	7	0	0	6	1	0
75%	58	14	1	1	8	1	1
Max	102	30	1	1	24	1	1