FOOD VERSUS NON-FOOD CONSUMPTION INSURANCE IN UGANDA

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Abstract

Households' income fluctuations in poor countries call for risk smoothing mechanisms, yet insurance is always found to be incomplete. We build a two-goods complete markets model, and confirm this result with the UNPS - a new representative Uganda panel data. As an attempt to uncover the friction to full insurance, we build a two-goods limited commitment model which we test and reject. The empirical evidence suggests that the degree of consumption insurance differs across consumption goods: Households insure food better than other nondurables. This finding has potential policy implications (e.g., consumption-item specific such as food coupons).

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1 Introduction

Households in developing countries are daily subject to income risks. If markets were complete, individual consumption would not respond to unanticipated changes in income (and other idiosyncratic changes such as health, death, family structure). However, a large empirical literature has rejected the full insurance hypothesis in a number of countries: Townsend (1994) in rural India, Udry (1994) in rural Nigeria, Kinnan (2014) in Thailand, Santaeulalia-Llopis and Zheng (2015) in China, Morten et al. (2015) in Blangadesh. The consensus is that households' transmission of income shocks to consumption is neither full nor completely buffered: Households in developing countries are actually found to do well in insuring their consumption.

The next question is then to understand why and on which dimensions insurance is incomplete. In this regard, the literature has resorted to endogenously incomplete markets models as a potential explanation to the lack of full insurance (Ljungqvist and Sargent (2004) provide a detailed overview of such models). These models entail a tension between insurance and incentives: A social planner has to provide incentives for households to stay in the contract, at the cost of providing them with lower insurance. The workhorse model in this literature is limited commitment, which points at the possibility for households to leave the contract as an impediment to the first best outcome (Kocherlakota (1996), Ligon, Thomas, and Worrall (2002)). Another widely tested theory states that moral hazard problems, arising because villagers' actions are not observable by the planner, lead to incomplete insurance (Rogerson (1985), Phelan (1998)). Lastly, the hidden income model is based on villagers' ability to hide their income instead of truthfully revealing it and making transfers to the others participants of the risk sharing group (Kinnan (2014)).

The novel contribution of the paper is to consider some of these risk-sharing mechanisms[1] by looking separately at two specific consumption items, food and other non-durables. The reason why studying the implications of differential insurance behaviour for different consumption categories is relevant is because they share diverse properties. The first difference relates to measurement issues. Food consumption is measured with much better precision, both as it suffers of smaller recall bias and as respondents to the surveys update their information on quantities and prices of food every day. The

[1]The spirit of the paper is neo-classical: We do not explore alternative explanations to incomplete insurance such as lack of trust in insurance arrangements, ambiguity aversion, or loss aversion (e.g., Cole et al. (2013), Bryan (2013)).

second difference has to do with households being less willing to give up their food consumption, and this mechanism is captured by economists through non-homothetic preferences.

Insurance matters at the macro-level because it is relevant for growth and migration decisions. On the time dimension, growth entails increasing risks that are accompanied with a loss of consumption insurance along the growth process. This is documented by Santaeulalia-Llopis and Zheng (2015), who apply the Blundell, Pistaferri, and Preston (2008) estimation method on a panel of household consumption and income in rural and urban China from 1989 to 2009. On the spatial dimension, rural areas tend to be better insured than urban areas (Munshi and M. Rosenzweig (2016)).

Taking a macroeconomic perspective to the consumption insurance analysis, our aim is to assess whether households insure their consumption baskets differently in rural versus urban Uganda, with the ultimate goal of finding out what the barrier to full insurance is. If markets are incomplete, knowing the source of friction matters for policy: Social insurance polices can mitigate the welfare loss from growth. On top of that, getting to know the degree of differential insurance behaviour by households would help designing consumption-item specific policies (e.g., food versus non-food coupons).

To start with, we build a complete markets model in which the utility function of agents is defined over two consumption goods. The model predicts that, for each consumption category, individual consumption growth co-move one to one with aggregate consumption growth, and we test this implication with Uganda data. We make use of a new and unique representative dataset under the LSMS-ISA umbrella, the UNPS (Uganda National Panel Survey). This is a multi-topic panel household survey characterized by three waves, with data from 2009 to 2012. An important contribution of the paper is to link the waves over time to create a panel, which - to the best of our knowledge - we are the first to use in the literature . The complete markets model is rejected, and the evidence suggests that the degree of insurance differs across consumption goods. In particular, households insure food better than other non-durables, and this feature is more salient for rural areas than for urban areas.

As a second step, we introduce two consumption goods, food and non-food, in an otherwise standard limited commitment model by extending Kocherlakota (1996). Households are paid in food terms, and they can decide whether to participate in the contract or not. In autarky, they can possibly suffer low output realizations and therefore consume little amount of both goods. The social planner makes sure, by setting up a participation constraint, that everybody prefers the contract to autarky. We show that, when insurance is constrained by limited commitment, an adjusted ratio of partial marginal utilities is a sufficient statistic to forecast an efficient allocation of consumption items. This model is also rejected with Uganda data.

The rest of the paper is organized as follows. Section 2 develops two models of risk-sharing: A two-goods complete markets economy and a two-goods limited commitment economy. Section 3 presents the data used to test the models. Section 4 shows the empirical results, and section 5 concludes.

2 Models of Risk Sharing

In this section, we develop two risk sharing models: Complete markets and limited commitment. Our contribution is to introduce two consumption goods, food and other non-durables, in the aforementioned economies. Appendix A contains the proofs of the main results.

2.1 Setting

In each period there is a realization of a stochastic event $s_t \in S$. Let s^t be the publicly observable history of events up to time t: $s^t = [s_0, s_1, \ldots, s_t]$, and let $\pi_t(s^t)$ be the unconditional probability of observing a particular history of events s^t. Let N be the number of agents in the economy, each of whom we denote by $i = 1, \ldots, N$. Each individual i owns at a given time t a stochastic endowment (say, labor income) $y_{i,t}(s^t)$, which can be used to buy a (history-dependent) basket of consumption plan $c_i = \{c_{i,t,a}(s^t), c_{i,t,m}(s^t)\}_{t=0}^{\infty}$ where we distinguish between food consumption (c_a) and non-food consumption (c_m). The utility function of agent i is:

$$U(c_i) = \sum_{t}^{\infty} \beta^t \sum_{s(t)} \pi_t(s^t)[u(c_{i,t,a}(s^t), c_{i,t,m}(s^t))]$$

or, equivalently, $U(c_i) = E_0 \sum_{t}^{\infty} \beta^t [u(c_{i,t,a}, c_{i,t,m})]$[2]. We assume an explicit functional form for the per-period utility function:

[2]The assumption of a common discount factor across individuals is common in this literature.

$$u(c_{i,t,a}(s^t), c_{i,t,m}(s^t)) = e^{b_{i,t}(s^t)} \left[\ln(c_{i,t,a}(s^t) - \overline{c}_{t,a}) + \frac{\kappa(c_{i,t,m}(s^t))^{1-\sigma}}{1-\sigma} \right]$$

In this specification, the parameter b represents household structure which may change over time: Individuals may leave or enter the household over time. Food consumption is modelled in a non-homothetic fashion to stress the little willingness of households to give up food consumption, with $\overline{c}_{t,a}$ being the food subsistence level at time t. Non-food consumption enters in a more flexible CRRA specification, with σ being the coefficient of relative risk aversion and κ being the relative weight the household gives to non-food over food. In this context, a feasible allocation satisfies the aggregate resource constraint:

$$\sum_{i=1}^{N} [p_{t,a}(s^t) c_{i,t,a}(s^t) + c_{i,t,m}(s^t)] \leq \sum_{i=1}^{N} y_{i,t}(s^t) \qquad \forall t, s^t.$$

which states that the sum of consumption items across individuals cannot exceed the sum of individual income. With such constraint, we are precluding the planner from borrowing or saving in any given period. We make non-food consumption the numeraire, with $p_{t,a}$ being the aggregate-level relative price of food[3].

2.2 Complete Markets

The set of first-best allocations can be achieved by solving a Pareto problem for a fictitious risk-neutral social planner. The planner attaches nonnegative Pareto weights ω_i on each consumer and chooses allocations of consumption to maximize:

$$W = \sum_{i=1}^{N} \omega_i U(c_i)$$

subject to the aggregate resource constraint. Hence, the program of the social planner is:

[3]In principle, the relative price of food consumption $p_{t,a}$ might be individual-specific; as data at individual-level are not available, however, we directly solve the models with the aggregate-level relative price.

$$\max_{\{c_{i,t,a}(s^t)\}_{i=1}^N,\{c_{i,t,m}(s^t)\}_{i=1}^N} \quad \sum_{i=1}^{N}\omega_i\sum_{t}^{\infty}\beta^t\sum_{s(t)}\pi_t(s^t)e^{b_{i,t}(s^t)}\left[log(c_{i,t,a}(s^t)-\bar{c}_{t,a})+\frac{\kappa(c_{i,t,m}(s^t))^{1-\sigma}}{1-\sigma}\right]$$

$$\text{subject to} \quad \sum_{i=1}^{N}[p_{t,a}(s^t)c_{i,t,a}(s^t)+c_{i,t,m}(s^t)]\leq\sum_{i=1}^{N}y_{i,t}(s^t) \qquad \forall t$$

Proposition 1: Individual food consumption growth is perfectly correlated with aggregate food consumption growth. Individual non-food consumption growth is perfectly correlated with aggregate non-food consumption growth. The relationship between the growth of individual consumption categories depends only on the growth of the aggregate-level relative price of food:

$$\Delta_t \ln(c_{i,t,a}(s^t)-\bar{c}_{t,a}) = \Delta_t\overline{\ln(c_{i,t,a}(s^t)-\bar{c}_{t,a})}+\Delta_t[b_{i,t}(s^t)-\overline{b_{i,t}(s^t)}] \tag{1}$$

$$\Delta_t \ln(c_{i,t,m}(s^t)) = \Delta_t\overline{\ln(c_{i,t,m}(s^t))}+\frac{1}{\sigma}\Delta_t\left[b_{i,t}(s^t)-\overline{b_{i,t}(s^t)}\right] \tag{2}$$

$$\Delta_t \ln(c_{i,t,m}(s^t)) = \frac{1}{\sigma}\Delta_t\ln(c_{i,t,a}(s^t)-\bar{c}_{t,a})+\frac{1}{\sigma}\Delta_t\ln p_{t,a}(s^t) \tag{3}$$

Proof. In Appendix A.1. ■

The two-goods complete markets model preserves the main result of the one-good counterpart: An efficient allocation of consumption does not depend on individual income. However, since this implication has been rejected by large part of the empirical literature, it is necessary to move the focus on endogenous incomplete markets models to uncover the specific friction to full insurance.

2.3 Limited Commitment

The lack of commitment of households to stay in an efficient contract may explain the failure of full insurance. The limited commitment model assumes symmetric information but a limited ability of the planner to enforce contracts. Households may find autarky more attractive than the contract, and leave it at the cost of not entering it anymore. We extend the standard limited commitment model developed by Kocherlakota

(1996) to include two consumption goods, food and other non-durables. Our model is for rural households: They work and get paid in food terms (i.e., in-kind). In this environment, a social planner designs a contract trying to pool all households together. For this purpose, she requires households to give up their income realizations in order to receive each period food and non-food transfers, together with a promised utility.

In autarky, the households can frictionlessly access the consumption markets in every period but they are subject to the risk of getting low income outcomes:

$$V_{aut} = \mathbb{E}\sum_{t}^{\infty}\beta^t u(c^*_{t,a}, c^*_{t,m})$$

$$\text{subject to} \quad [p_{t,a}c^*_{t,a} + c^*_{t,m}] = p_{t,a}y_{t,a} \quad \forall t.$$

where $c^*_{t,a}$ and $c^*_{t,m}$ represent the consumption basket at time t that maximizes the autarky value function. Here, households decide every period whether to remain in the contract or to forever enter autarky. At the beginning of the period, households receive a promised utility from the planner which must be at least as much as what they get at the end of the period in terms of food, non-food, and future promised utility[4]:

$$\sum_{s=1}^{S}\Pi_s[u(c_{i,s,t,a}, c_{i,s,t,m}) + \beta u_{i,s,t+1}] \geqslant u_{i,t} \quad \forall i.$$

On top of that, the planner has to respect the following participation constraint if she wants to pool every household in the contract:

$$u(c_{i,s,t,a}, c_{i,s,t,m}) + \beta u_{i,s,t+1} \geqslant V_{aut} \quad \forall i, s.$$

where s is the state of nature. Hence, the contract problem faced by the social planner can be characterized as follows:

[4]For this reason, such constraint has been called in the literature the "promise-keeping constraint".

$$
\begin{aligned}
V(\mathbf{u}_t) = \max_{\mathbf{c}_{s,t,a},\mathbf{c}_{s,t,m},\mathbf{u}_{s,t+1}} \quad & \sum_{s=1}^{S} \Pi_s u(c_{N,s,t,a}, c_{N,s,t,m}) + \beta \mathbb{E}[V(\mathbf{u}_{t+1})] \\
\text{subject to} \quad & \sum_{s=1}^{S} \Pi_s [u(c_{i,s,t,a}, c_{i,s,t,m}) + \beta u_{i,s,t+1}] \geqslant u_{i,t}, \ \ \forall i < N; \\
& u(c_{i,s,t,a}, c_{i,s,t,m}) + \beta u_{i,s,t+1} \geqslant V_{aut}, \ \ , \forall i, s; \\
& \sum_{i=1}^{N} [p_{s,t,a} c_{i,s,t,a} + c_{i,s,t,m}] \leq \sum_{i=1}^{N} p_{s,t,a} y_{i,s,t,a}, \quad \forall s; \\
& u_{i,s,t+1} \in [V_{aut}, V_{max}], \\
& c_{i,s,t,a} \in [c_{a,min}, c_{a,max}], \\
& c_{i,s,t,m} \in [c_{m,min}, c_{m,max}].
\end{aligned}
$$

where V represents the Pareto frontier, Π_s is the ex-ante probability of a particular state s happening, and the upper and lower bounds on consumption items and Pareto frontier guarantee a convex constraint set.

Proposition 2: The vector of adjusted lagged partial marginal utilities ratio for every member of the insurance group is a sufficient statistic for history when forecasting corresponding households' consumption:

$$
pr((c_{i,t+1,a})_{i=1}^{N} | \Gamma_{t,a}, x_t) = pr((c_{i,t+1,a})_{i=1}^{N} | \Gamma_{t,a}), \quad \forall x_t; \tag{4}
$$

$$
pr((c_{i,t+1,m})_{i=1}^{N} | \Gamma_{t,m}, x_t) = pr((c_{i,t+1,m})_{i=1}^{N} | \Gamma_{t,m}), \quad \forall x_t. \tag{5}
$$

where $\Gamma_{t,a}$ and $\Gamma_{t,m}$ are $(N-1)$ vectors whose ith components are the ratio between sum of marginal utilities of individual N and partial marginal utility of individual i (adjusted by the relative price in case of non-food marginal utility):

$$
\Gamma_{i,t,a} = \left[\frac{u_1(c_{N,t,a}(s^t), c_{N,t,m}(s^t)) + p_{ta} u_2(c_{N,t,a}(s^t), c_{N,t,m}(s^t))}{u_1(c_{i,t,a}(s^t), c_{i,t,m}(s^t))} \right], \quad \forall i < N;
$$

$$
\Gamma_{i,t,m} = \left[\frac{u_1(c_{N,t,a}(s^t), c_{N,t,m}(s^t)) + p_{t,a} u_2(c_{N,t,a}(s^t), c_{N,t,m}(s^t))}{p_{t,a} u_2(c_{i,t,a}(s^t), c_{i,t,m}(s^t))} \right], \quad \forall i < N.
$$

Proof. In Appendix A.2. ■

The sufficiency of $\Gamma_{t,a}$ and $\Gamma_{t,m}$ means that once these quantities are controlled for, then any other information at time t has no explanatory power in forecasting future consumption. This result is the two-goods counterpart of the result by Kocherlakota (1996), who found that the vector of lagged marginal utility ratios for every member of the insurance group is a sufficient statistic when forecasting any household's consumption. We will test the implications of this result in section 4.

3 Data

Uganda has experienced strong economic growth over the past two decades, and in order to further promote economic expansion the Government of Uganda has designed development plans with a special focus on poor households (e.g., the National Development Strategy). To effectively monitor outcomes of these plans, the Uganda Bureau of Statistics (UBOS) is implementing the Uganda National Panel Survey (UNPS) program, with financial and technical support from the Government of Netherlands, and the World Bank Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) project.

The UNPS is the longest of the panels under the umbrella of the LSMS-ISA. It is a unique, multi-topic panel household survey carried out annually that commenced in 2009/10, and it has been followed by two more waves (2010/11 - 2011/2012). The UNPS has been set out to track and re-interview 3123 nationally representative households that were distributed over 322 enumeration areas (EAs), selected out of the 783 EAs that had been visited for the first time by the Uganda National Household Survey (UNHS) in 2005/06. Table 3 in Appendix B presents a summary of the status of the UNPS sample since the baseline in 2005/06 to 2011/12, and figure 2 in Appendix C shows a map with the distribution of UNPS households originally sampled.

The first contribution of the paper is to create a panel out of the three UNPS waves: Each wave is worked out separately, then homogenized to the others and then linked over time. To the best of our knowledge, this is the first paper that uses the time dimension of this data.

Finally, the Bank of Uganda offers freely the decomposed consumer price index at monthly frequency, which is used in this paper to map the aggregate-level relative price of food to the data.

3.1 Measures of relevant variables

A big section in the household questionnaire is devoted to household consumption expenditures. They come in purchases, home produced, and received in-kind/gifts. The subsections deal with food (7 days recall), non-durable goods (30 days recall and 1 year recall) and durable goods (1 year recall). While the set-up of the survey is standard for the last two categories, the food subsection is worthy of special mention. The survey is rolled out throughout the year, and this is crucial in order to capture seasonality naturally rising from the weekly recall of food consumption expenditures. Hence, season effects can be net out: For this purpose, we follow a similar deseasonalization procedure as in De Magalhaes and Santaeulalia-Llopis (2015).

Regarding income, several sections in the household questionnaire are devoted to household income (labor income, business income, capital income etc.) and, with the addition of the ISA component to previous LSMS surveys, a whole questionnaire is targeted to agricultural production only. The effort to gather precise information on agricultural production has been huge: The survey offers individual-level information such as number of plots cropped, type of crops used, GPS-type measure of plot size etc. The yearly survey is conducted in two visits in order to better capture agricultural outcomes associated with the two cropping seasons of the country. The UNPS therefore interviews each household twice each year, in visits six months apart. Our baseline measure of income is the sum of net agricultural production, business income, capital income, and labor income.

3.2 Adjustment of consumption and income

The UNPS dataset allows us to compute the budget constraints of the respondents, however some caveats needs to be taken into account. To start with, households report consumption and production in units that are very often different even for the same item, and this inconsistency holds true over time[5]. While in the production side households also report a self conversion rate to Kg, this is not the case in the consumption side. Hence, it is necessary to transform all reported units into a single unit - Kg where possible - to correctly estimate the monetary value of consumption. To do so, we follow

[5] Say, bananas are sometimes reported in Kg and sometimes reported in bunches.

a similar conversion method as in De Magalhaes and Santaeulalia-Llopis (2015). For each "macro-unit"[6], we create unitary prices paid by the households for each item they buy, and then for each item (if the price information is big enough - meaning more than 7 price observations are available) we create a median price by regions, rural and urban areas, and seasons. After these steps, we compute conversion rates for each observation and subsequent median conversion rates for each item-unit pair.[7]

Another issue that is necessary to deal with in the UNPS dataset is to value unsold agricultural production. Some authors use the price at gate for this purpose, however De Magalhaes and Santaeulalia-Llopis (2015) show that in Malawi such procedure leads to underestimation of the value of unsold production. This is mainly because some households store their production for later use, and consume it when the consumption price of those products is higher. As a consequence, their production have an additional value and this must be properly taken into account as a big fraction of Ugandan households store their production.

4 Empirical Results

In this section, we test the two models presented in section 2. We make use of the panel constructed from pooling wave 1, wave 2, and wave 3 together. Consumption and income variables are annualized, deflated to March 2011 and transformed in adult equivalence scales following the definition of Krueger and Perri (2006). Moreover, consumption variables are deseasonalized.

Appendix B shows robustness checks for results in this section: We consider an alternative definition for the food subsistence level and different specifications of household income.

4.1 Complete Markets

An implication of proposition 1 is that income growth does not affect individual food and non-food consumption growth (i.e., income growth does not enter equation (1)

[6]We define as macro-units Kg, Number of units, Heap, Bunch, Cluster, Bundle, Packet, Akendo, and Piece. Apart from Kg itself, these are units that cannot be transformed into Kg.

[7]In some sections, consumption expenditures come as self-reported as well. For those cases, we compare expenditures we get from constructed conversion rates and self-reported expenditures, and the resulting distributions are very close.

and (2)). Hence, our model imposes the restriction $\beta_a = \beta_m = 0$ in the following regressions[8]:

$$\Delta_t \ln(c_{i,a} - \overline{c}_a) = \alpha_a + \gamma_a \Delta_t \overline{\ln(c_{i,a} - \overline{c}_a)} + \beta_a \Delta_t \ln(y_i) + \epsilon_{a,i} \tag{1'}$$

$$\Delta_t \ln(c_{i,m}) = \alpha_m + \gamma_m \Delta_t \overline{\ln(c_{i,m})} + \beta_m \Delta_t \ln(y_i) + \epsilon_{m,i} \tag{2'}$$

For each wave, the subsistence level $\overline{c}_a$ is defined as the minimum consumption across households minus 1% of it. Table 1 presents the results from estimating such specification both for rural and urban areas. The two-goods complete markets model is rejected, as income growth enters significantly - at 1% confidence level - both econometric specifications. We also provide evidence that food consumption is better insured than other non-durables, and this result holds in both geographical areas. In the rural sample, the elasticity of food consumption to income is 6.4% while that of non-food consumption is around 9.6%. In urban areas, the comparison is 9.8% to 14.5%. Finally, the evidence suggests that rural households insure consumption (both food and non-food) better than urban households.

4.2 Limited Commitment

Proposition 2 states that the quantities $\Gamma_{i,t,a}$ and $\Gamma_{i,t,m}$ are sufficient statistics in forecasting any households' consumption. Choosing the per-period utility function outlined in section 2.1 leads to:

$$\Gamma_{i,t,a} = \left[\frac{e^{b_N}\left((c_{N,t,a} - \overline{c}_{t,a})^{-1} + p_{t,a}\kappa c_{N,t,m}^{-\sigma}\right)}{e^{b_i}(c_{i,t,a} - \overline{c}_{t,a})^{-1}} \right], \qquad \forall i < N;$$

$$\Gamma_{i,t,m} = \left[\frac{e^{b_N}\left((c_{N,t,a} - \overline{c}_{t,a})^{-1} + p_{t,a}\kappa c_{N,t,m}^{-\sigma}\right)}{e^{b_i} p_{t,a}\kappa c_{i,t,m}^{-\sigma}} \right], \qquad \forall i < N.$$

where the benchmark household N is picked to match his consumption to the median household consumption. Hence, the two-goods limited commitment model im-

[8] More precisely, the test of complete risk sharing is a joint test for the co-movement of individual consumption with average consumption and individual income not affecting individual consumption. In terms of equation (1') and (2'), proposition 1 implies $\gamma_a = \gamma_m = 1$ together with $\beta_a = \beta_m = 0$. However, we follow the literature and focus mainly on the implication with rispect to income.

Table 1: Testing the two-goods complete markets model

	Rural Sample		Urban Sample	
	$\Delta\ln(c_{i,a}-\overline{c_a})$	$\Delta\ln(c_{i,m})$	$\Delta\ln(c_{i,a}-\overline{c_a})$	$\Delta\ln(c_{i,m})$
$\Delta\ln(y_i)$	0.064***	0.096***	0.098***	0.145***
	[0.041,0.087]	[0.069,0.123]	[0.053,0.142]	[0.095,0.195]
$\Delta\overline{\ln(c_{i,a}-\overline{c_a})}$	0.279		5.535	
	[-4.301,4.860]		[-4.015,15.085]	
$\Delta\overline{\ln(c_{i,m})}$		2.006		6.853***
		[-0.524,4.536]		[1.748,11.958]
Observations	3,084	3,084	666	666
R-squared	0.010	0.017	0.031	0.053

Notes: Variables are household-level residuals from education, age, gender, region, marital status, children dummies, and equivalence scales. 95% confidence intervals in brackets, with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All variables are in Ugandan Shilling and deflated to March 2010, and consumption variables are deseasonalized.

plies the restriction $\beta_a = \beta_m = 0$ in the following regressions:

$$(c_{i,t,a} - \overline{c_{t,a}}) = \alpha_a + \delta_a \Gamma_{i,t-1,a} + \beta_a y_{i,t-1} + \epsilon_{i,t,a}$$

$$c_{i,t,m} = \alpha_m + \delta_m \Gamma_{i,t-1,m} + \beta_m y_{i,t-1} + \epsilon_{i,t,m}$$

where we compute the subsistence level $\overline{c}_{t,a}$ as in the complete markets specification. Differently from the complete markets, however, testing limited commitment requires information on the utility function parameters σ and κ as they enter the sufficient statistics. One way to come up with an estimate for those is by resorting to the marginal rate of substitution condition:

$$\left[\frac{u_1(c_{i,t,a}, c_{i,t,m})}{u_2(c_{i,t,a}, c_{i,t,m})}\right] = p_{t,a}$$

which, given the per-period utility function specification and after taking logs, becomes:

$$\ln(c_{i,t,a} - \overline{c_{t,a}}) = \sigma \ln(c_{i,t,m}) - \ln(p_{t,a}) - \ln(\kappa)$$

We run OLS on this condition to get benchmark parameters[9], which we denote by κ^* and σ^*. Table 2 presents results from testing the above specification. The limited commitment model is rejected: Lagged income[10] enters significantly the main equations of the model. Similarly as the complete markets model results, food consumption is better insured than other non-durables within areas[11].

Table 2: Testing limited commitment at benchmark parameters

	Rural Sample		Urban Sample	
	$c_{i,t,a} - \overline{c}_{t,a}$	$c_{i,t,m}$	$c_{i,t,a} - \overline{c}_{t,a}$	$c_{i,t,m}$
$y_{i,t-1}$	0.051***	0.095***	0.051***	0.061***
	[0.040,0.063]	[0.087,0.103]	[0.030,0.072]	[0.025,0.097]
κ^*	0.00006	0.00006	0.0001	0.0001
σ^*	0.287	0.287	0.335	0.335
Observations	3,209	3,209	718	718
R-squared	0.135	0.357	0.145	0.248

Notes: Variables are in equivalence scales. 95% confidence intervals in brackets, with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All variables are deflated to March 2010 Ugandan Shilling, and consumption variables are deseasonalized.

Figure 1 checks sensitivity around the benchmark parameters for rural Uganda[12]. Panel 1a and 1c plot a 3-D representation of the betas coefficient (β_a and β_m, respectively) depending on a range of σ and κ, while panel 1b and 1d report the same plots but for the lower 95% confidence interval. The limited commitment model is rejected for any given combination of the utility parameter (σ, κ): The lower confidence interval never approaches or goes beyond the zero. Also, figure 1 shows that food is always better insured than other non-durables: For any (σ, κ) parameter couple, the elasticity of food consumption to income is always below 6% while the elasticity of other non-durables to income is always above that threshold. Finally, in order to provide a more intuitive comparison between the two elasticities, figure 3 in appendix C cuts the 3-D

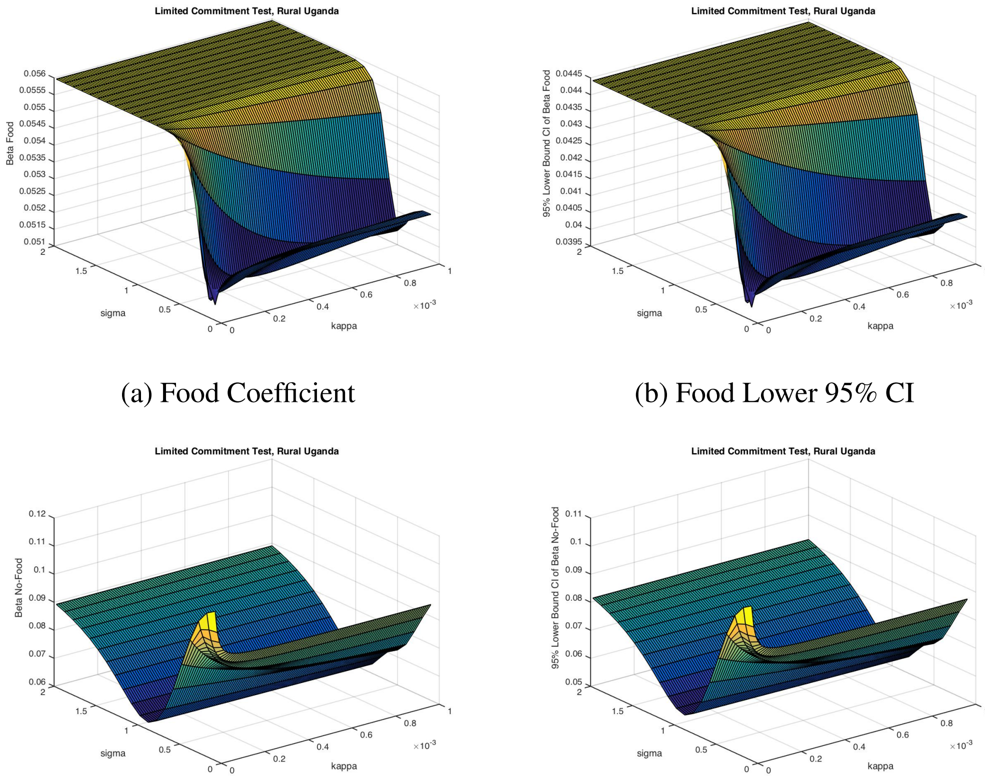
[9]Another sensible way to pin those parameters down is by minimizing β_a and β_m and then check whether the resulting parameter couple (σ, κ) is in an admissible range.

[10]The model predicts, by construction, correlation between income and consumption at time t. This is because the social planner looks at time t income realizations of the households to define time t allocations of consumption.

[11]The limited commitment model developed in section 2 is about rural households, and so the urban results hold with a grain of salt.

[12]Results for urban Uganda are very similar, and we make them available upon request.

Figure 1: Testing Limited Commitment: Food vs Non-Food Insurance in Rural Uganda



(a) Food Coefficient

(b) Food Lower 95% CI

(c) Non-Food Coefficient

(d) Non-Food Lower 95% CI

representation of figure 1 at κ^*, confirming more directly the above results.

5 Conclusion

This paper argues that distinguishing specific consumption categories when studying models of risk-sharing may be relevant, as food consumption has different properties with respect to other non-durables. With this consideration in mind, we build a two-goods complete markets model and a two-goods limited commitment model in which the utility of the households is defined over food and non-food consumption.

Results from a representative panel of Uganda from 2009 to 2012 are consistent with none of the economies: The models are rejected in both rural and urban Uganda. However, and consistently across models, we find that households insure differentially their consumption categories: Food consumption is always better insured than other non-durables. This result has policy implication: Uncovering the differential degree of consumption insurance across items may lead to the design of consumption-item specific policies (e.g., food versus other non-durables coupons).

Kinnan (2014), focusing on one good only, also rejects limited commitment in Thailand. She finds, however, that thai villages data supports the hidden income economy: Individuals seem to be given incentives to truthfully report their income. Lim and Townsend (1998) consider a moral hazard model with capital assets and livestock, and find that moral hazard fits Indian data better than full insurance or permanent income benchmarks. These findings in the literature motivate us to move the analysis to limited information economies.

References

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Blundell, R., L. Pistaferri, and I. Preston (2008). "Consumption inequality and partial insurance". *The American Economic Review*, pp. 1887–1921.

Bryan, G. (2013). "Ambiguity Aversion Decreases Demand for Partial Insurance: Evidence from African Farmers".

Cochrane, J. H. (1991). "A simple test of consumption insurance". *Journal of political economy*, pp. 957–976.

Cole, S. et al. (2013). "Barriers to household risk management: Evidence from India". *American Economic Journal: Applied Economics* 5.1, pp. 104–135.

De Magalhaes, L. and R. Santaeulalia-Llopis (2015). "The consumption, income, and wealth of the poorest: cross-sectional facts of rural and urban Sub-Saharan Africa for macroeconomists". *Income, and Wealth of the Poorest: Cross-Sectional Facts of Rural and Urban Sub-Saharan Africa for Macroeconomists (April 15, 2015).*

Hall, R. E. (1979). "Stochastic implications of the life cycle-permanent income hypothesis: theory and evidence". *NBER working paper* R0015.

Kaplan, G. and G. L. Violante (2014). "A model of the consumption response to fiscal stimulus payments". *Econometrica* 82.4, pp. 1199–1239.

Kinnan, C. (2014). "Distinguishing barriers to insurance in Thai villages".

Kocherlakota, N. R. (1996). "Implications of efficient risk sharing without commitment". *The Review of Economic Studies* 63.4, pp. 595–609.

Krueger, D. and F. Perri (2006). "Does income inequality lead to consumption inequality? Evidence and theory". *The Review of Economic Studies* 73.1, pp. 163–193.

Ligon, E., J. P. Thomas, and T. Worrall (2002). "Informal insurance arrangements with limited commitment: Theory and evidence from village economies". *The Review of Economic Studies* 69.1, pp. 209–244.

Lim, Y. and R. M. Townsend (1998). "General equilibrium models of financial systems: Theory and measurement in village economies". *Review of Economic dynamics* 1.1, pp. 59–118.

Ljungqvist, L. and T. J. Sargent (2004). *Recursive macroeconomic theory*. MIT press.

Mace, B. J. (1991). "Full insurance in the presence of aggregate uncertainty". *Journal of Political Economy*, pp. 928–956.

Morten, M. (2013). “Temporary migration and endogenous risk sharing in village india”. *Unpublished Manuscript*.

Morten, M. et al. (2015). *Migration and Consumption Insurance in Bangladesh*. Tech. rep. Society for Economic Dynamics.

Munshi, K. and M. Rosenzweig (2016). “Networks and misallocation: Insurance, migration, and the rural-urban wage gap”. *The American Economic Review* 106.1, pp. 46–98.

Nelson, J. A. (1994). “On testing for full insurance using consumer expenditure survey data”. *Journal of Political Economy* 102.2, pp. 384–394.

Phelan, C. (1998). “On the long run implications of repeated moral hazard”. *Journal of Economic Theory* 79.2, pp. 174–191.

Rogerson, W. P. (1985). “Repeated moral hazard”. *Econometrica: Journal of the Econometric Society*, pp. 69–76.

Rosenzweig, M. R. and K. I. Wolpin (1993). “Credit market constraints, consumption smoothing, and the accumulation of durable production assets in low-income countries: Investments in bullocks in India”. *Journal of political economy*, pp. 223–244.

Santaeulalia-Llopis, R. and Y. Zheng (2015). “The Price of Growth: Consumption Insurance in China 1989-2009”. *Available at SSRN 2511587*.

Schulhofer-Wohl, S. (2011). “Heterogeneity and tests of risk sharing”. *Journal of Political Economy* 119.5, pp. 925–958.

Suri, T. (2011). *Estimating the extent of local risk sharing between households*. Tech. rep. Working Paper.

Townsend, R. M. (1994). “Risk and insurance in village India”. *Econometrica: Journal of the Econometric Society*, pp. 539–591.

Udry, C. (1994). “Risk and insurance in a rural credit market: An empirical investigation in northern Nigeria”. *The Review of Economic Studies* 61.3, pp. 495–526.

Appendix A Proofs

This appendix contains the proofs of the two propositions stated in section 2.

A.1 Proof of Proposition 1

Let $\lambda_t(s^t)$ be the multiplier associated to the aggregate resource constraint. The Lagrangian associated to the complete markets program is:

$$\mathcal{L} = \sum_t^{\infty} \sum_{s(t)} \left\{ \sum_{i=1}^{N} \omega_i \beta^t \pi_t(s^t) e^{b_{i,t}(s^t)} \left[log(c_{i,t,a}(s^t) - \bar{c}_{t,a}) + \frac{\kappa(c_{i,t,m}(s^t))^{1-\sigma}}{1-\sigma} \right] \right.$$
$$\left. + \lambda_t(s^t) \sum_{i=1}^{N} \left[y_{i,t}(s^t) - p_{t,a}(s^t) c_{i,t,a}(s^t) - c_{i,t,m}(s^t) \right] \right\}$$

The first-order necessary conditions for maximizing $\mathcal{L}$ with respect to $c_{i,t,a}(s^t)$ and $c_{i,t,m}(s^t)$, respectively, are:

$$e^{b_{i,t}(s^t)} \omega_i \beta^t \pi_t(s^t)(c_{i,t,a}(s^t) - \bar{c}_{t,a})^{-1} = \lambda_t(s^t) p_{t,a}(s^t) \tag{6}$$

$$e^{b_{i,t}(s^t)} \omega_i \beta^t \pi_t(s^t) \kappa(c_{i,t,m}(s^t))^{-\sigma} = \lambda_t(s^t) \tag{7}$$

Work with equation (6). Take logs:

$$b_{i,t}(s^t) + \ln(\omega_i) + \ln(\beta^t) + \ln(\pi_t(s^t)) - \ln(c_{i,t,a}(s^t) - \bar{c}_{t,a}) = \ln(\lambda_t(s^t)) + \ln(p_{t,a}(s^t))$$

Now sum over i and divide by N to get:

$$N^{-1} \sum_{i=1}^{N} b_{i,t}(s^t) + N^{-1} \sum_{i=1}^{N} \ln(\omega_i) + \ln(\beta^t) + \ln(\pi_t(s^t)) - N^{-1} \sum_{i=1}^{N} \ln(c_{i,t,a}(s^t) - \bar{c}_{t,a}) =$$
$$\ln(\lambda_t(s^t)) + \ln(p_{t,a}(s^t))$$

Equate the right-hand side of the last two expressions to get:

$$\left[\ln(c_{i,t,a}(s^t) - \overline{c}_{t,a}) - N^{-1}\sum_{i=1}^{N}\ln(c_{i,t,a}(s^t) - \overline{c}_{t,a})\right] =$$
$$\left[\ln(\omega_i) - N^{-1}\sum_{i=1}^{N}\ln(\omega_i)\right] + \left[b_{i,t}(s^t) - N^{-1}\sum_{i=1}^{N}b_{i,t}(s^t)\right]$$

Subtract this equation from its previous period one to get:

$$\Delta_t \ln(c_{i,t,a}(s^t) - \overline{c}_{t,a}) = \Delta_t\overline{\ln(c_{i,t,a}(s^t) - \overline{c}_{t,a})} + \Delta_t[b_{i,t}(s^t) - \overline{b_{i,t}(s^t)}] \tag{8}$$

where Δ_t stands for the time difference operator and we have defined:

$$N^{-1}\sum_{i=1}^{N}\ln(c_{i,t,a}(s^t) - \overline{c}_{t,a}) = \overline{\ln(c_{i,t,a}(s^t) - \overline{c}_{t,a})}; \quad \overline{b_{i,t}(s^t)} = N^{-1}\sum_{i=1}^{N}b_{i,t}(s^t).$$

Equation (8) is the first equation characterizing the solution of the program. Similarly, work with equation (7). Take logs:

$$b_{i,t}(s^t) + \ln(\omega_i) + \ln(\beta^t) + \ln(\pi_t(s^t)) + \ln\kappa - \sigma\ln(c_{i,t,m}(s^t)) = \ln(\lambda_t(s^t))$$

Now sum over i and divide by N to get:

$$N^{-1}\sum_{i=1}^{N}b_{i,t}(s^t) + N^{-1}\sum_{i=1}^{N}\ln(\omega_i) + \ln(\beta^t) + \ln(\pi_t(s^t)) + \ln\kappa - \sigma N^{-1}\sum_{i=1}^{N}\ln(c_{i,t,m}(s^t)) = \ln(\lambda_t(s^t))$$

Equate the right-hand side of the last two expressions to get:

$$\sigma\left[\ln(c_{i,t,m}(s^t)) - N^{-1}\sum_{i=1}^{N}\ln(c_{i,t,m}(s^t))\right] =$$
$$\left[\ln(\omega_i) - N^{-1}\sum_{i=1}^{N}\ln(\omega_i)\right] + \left[b_{i,t}(s^t) - N^{-1}\sum_{i=1}^{N}b_{i,t}(s^t)\right]$$

Subtract this equation from previous period one equation to get:

$$\Delta\ln(c_{i,t,m}(s^t)) = \Delta\overline{\ln(c_{i,t,m}(s^t))} + \frac{1}{\sigma}\Delta[b_{i,t}(s^t) - \overline{b_{i,t}(s^t)}] \tag{9}$$

where, similarly as before, we have defined:

$$N^{-1}\sum_{i=1}^{N}\ln(c_{i,t,m}(s^t)) = \overline{\ln(c_{i,t,m}(s^t))}$$

Equation (9) is the second equation characterizing the solution of the program. Finally, take the ratio of the first order conditions - equation (6) and (7) - to get:

$$\frac{(c_{i,t,a}(s^t)-\bar{c}_{t,a})^{-1}}{\kappa(c_{i,t,m}(s^t))^{-\sigma}} = p_{t,a}(s^t)$$

Take logs:

$$-\ln(c_{i,t,a}(s^t)-\bar{c}_{t,a}) - \ln\kappa + \sigma\ln(c_{i,t,m}(s^t)) = \ln p_{t,a}(s^t)$$

and rearranging and taking time difference we finally get the third and last equation characterizing the solution to the program:

$$\Delta\ln(c_{i,t,m}(s^t)) = \frac{1}{\sigma}\Delta\ln(c_{i,t,a}(s^t)-\bar{c}_{t,a}) + \frac{1}{\sigma}\Delta\ln p_{t,a}(s^t) \tag{10}$$

A.2 Proof of Proposition 2

Let $\lambda_{i,t}$ be the multiplier on household i's promise-keeping constraint and $\mu_{i,s,t}$ be the multiplier on household i's participation constraint in state s[13]. Substituting the aggregate resource constraint into the objective function and forming the Lagrangian leads to:

$$\mathcal{L} = \sum_{s=1}^{S}\Pi_s u\Bigg(\sum_{i=1}^{N} y_{i,s,t,a} - \frac{c_{N,s,t,m}}{p_{s,t,a}} - \sum_{i\neq N}\left[\frac{p_{s,t,a}c_{i,s,t,a}+c_{i,s,t,m}}{p_{s,t,a}}\right], \sum_{i=1}^{N} p_{s,t,a}y_{i,s,t,a} - p_{s,t,a}c_{N,s,t,a}$$
$$- \sum_{i\neq N}\big[p_{s,t,a}c_{i,s,t,a}+c_{i,s,t,m}\big]\Bigg) + \beta\mathbb{E}\big[V(\mathbf{u}_{t+1})\big] + \lambda_{i,t}\left[\sum_{s=1}^{S}\Pi_s\big[u(c_{i,s,t,a},c_{i,s,t,m})+\beta u_{i,s,t+1}\big] - u_{i,t}\right]$$
$$+ \mu_{i,s,t}\big[u(c_{i,s,t,a},c_{i,s,t,m})+\beta u_{i,s,t+1} - V_{aut}\big]$$

The first-order necessary conditions for maximizing $\mathcal{L}$ with respect to $c_{i,t,a}(s^t)$,

[13] The contract program requires the promise-keeping constraint holding for any household, while the participation constraint additionally holding in any state.

$c_{i,t,m}(s^t)$ and $u_{i,t+1}$, respectively, are[14]:

$$-\Pi_t(s^t)[u_1(c_{N,t,a}(s^t), c_{N,t,m}(s^t)) + p_{t,a}u_2(c_{N,t,a}(s^t), c_{N,t,m}(s^t))] \\ +(\lambda_{i,t}\Pi_t(s^t) + \mu_{i,t}(s^t))u_1(c_{i,t,a}(s^t), c_{i,t,m}(s^t)) = 0$$

$$-\Pi_t(s^t)[u_1(c_{N,t,a}(s^t), c_{N,t,m}(s^t)) + p_{t,a}u_2(c_{N,t,a}(s^t), c_{N,t,m}(s^t))] \\ +u_2(c_{i,t,a}(s^t), c_{i,t,m}(s^t))[\lambda_{i,t}\Pi_t(s^t) + \mu_{i,t}(s^t)] = 0$$

$$\beta\Pi_t(s^t)\frac{\partial V(\mathbf{u}_{t+1}(s^t))}{\partial u_{i,t+1}(s^t)} + \beta\lambda_{i,t}\Pi_t(s^t) + \beta\mu_{i,t}(s^t) = 0$$

Rewrite the three conditions for them to have the same right-hand side:

$$\frac{u_1(c_{N,t,a}(s^t), c_{N,t,m}(s^t)) + p_{t,a}u_2(c_{N,t,a}(s^t), c_{N,t,m}(s^t))}{u_1(c_{i,t,a}(s^t), c_{i,t,m}(s^t))} = \frac{\lambda_{i,t}\Pi_t(s^t) + \mu_{i,t}(s^t)}{\Pi_t(s^t)} \quad (11)$$

$$\frac{u_1(c_{N,t,a}(s^t), c_{N,t,m}(s^t)) + p_{t,a}u_2(c_{N,t,a}(s^t), c_{N,t,m}(s^t))}{p_{t,a}u_2(c_{i,t,a}(s^t), c_{i,t,m}(s^t))} = \frac{\lambda_{i,t}\Pi_t(s^t) + \mu_{i,t}(s^t)}{\Pi_t(s^t)} \quad (12)$$

$$-\frac{\partial V(\mathbf{u}_{t+1}(s^t))}{\partial u_{i,t+1}(s^t)} = \frac{\lambda_{i,t}\Pi_t(s^t) + \mu_{i,t}(s^t)}{\Pi_t(s^t)} \quad (13)$$

Equate the right-hand side of equation (11) and (12) with the right-hand side of equation (13) to get the two equations characterizing the solution of the program:

$$\left[\frac{u_1(c_{N,t,a}(s^t), c_{N,t,m}(s^t)) + p_{ta}u_2(c_{N,t,a}(s^t), c_{N,t,m}(s^t))}{u_1(c_{i,t,a}(s^t), c_{i,t,m}(s^t))}\right] = -\frac{\partial V(\mathbf{u}_{t+1}(s^t))}{\partial u_{i,t+1}(s^t)}, \quad \forall i < N;$$

$$\left[\frac{u_1(c_{N,t,a}(s^t), c_{N,t,m}(s^t)) + p_{t,a}u_2(c_{N,t,a}(s^t), c_{N,t,m}(s^t))}{p_{t,a}u_2(c_{i,t,a}(s^t), c_{i,t,m}(s^t))}\right] = -\frac{\partial V(\mathbf{u}_{t+1}(s^t))}{\partial u_{i,t+1}(s^t)}, \quad \forall i < N.$$

or, substituting the utility function specification outlined in section 2.1:

[14]The are $(N-1)$ equations for each first-order condition: Each control maximizes $\mathcal{L}$ from $i = 1, \ldots, N-1$.

$$\Gamma_{i,t,a} = \left[\frac{e^{b_N}((c_{N,t,a} - \overline{c}_{t,a})^{-1} + p_{t,a}\kappa c_{N,t,m}^{-\sigma})}{e^{b_i}(c_{i,t,a} - \overline{c}_{t,a})^{-1}} \right] = -\frac{\partial V(\mathbf{u}_{t+1}(s^t))}{\partial u_{i,t+1}(s^t)}, \quad \forall i < N;$$

$$\Gamma_{i,t,m} = \left[\frac{e^{b_N}((c_{N,t,a} - \overline{c}_{t,a})^{-1} + p_{t,a}\kappa c_{N,t,m}^{-\sigma})}{e^{b_i} p_{t,a}\kappa c_{i,t,m}^{-\sigma}} \right] = -\frac{\partial V(\mathbf{u}_{t+1}(s^t))}{\partial u_{i,t+1}(s^t)}, \quad \forall i < N.$$

As the vectors of $\Gamma_{i,t,a}$ and $\Gamma_{i,t,m}$ specify one unique point on the Pareto frontier, they are sufficient quantities in forecasting any households' future consumption, food and non-food respectively.

Appendix B Additional Tables

Table 3: Summary of the number of households and population in the UNPS since 2005/06.

Wave	**Population Interviewed**	**Number of households sampled**	**Number of original households successfully interviewed**	**Original sample retention (%)**	**Number of split-off households**
Wave 0 (2005/2006)	16,759	3,123	3,123	100	0
Wave 1 (2009/2010)	17,511	3,123	2,607	83.5	367
Wave 2 (2010/2011)	18,810	3,123	2,564	82.1	305
Wave 3 (2011/2012)	16,139	3,123	2,356	75.4	479

B.1 Alternative food subsistence level specification

To start with, we consider an alternative specification for the food subsistence level: An average of the 10% bottom percentile of the distribution. Table 4 and table 5 show the results from testing the models back under this modification. The smaller number of households is due to the fact that the poorest ones (in food terms) are dropped from the sample. The evidence suggests again that food consumption is better insurance than other non-durables, and this feature is more salient for rural areas.

Table 4: Testing the two-goods complete markets model

	Rural Sample		Urban Sample	
	$\Delta\ln(c_{i,a}-\overline{c_a})$	$\Delta\ln(c_{i,m})$	$\Delta\ln(c_{i,a}-\overline{c_a})$	$\Delta\ln(c_{i,m})$
$\Delta\ln(y_i)$	0.072***	0.091***	0.067**	0.126***
	[0.041,0.103]	[0.062,0.120]	[0.013,0.121]	[0.075,0.177]
$\Delta\overline{\ln(c_{i,a}-\overline{c_a})}$	1.153		2.138	
	[-1.165,3.471]		[-2.174,6.449]	
$\Delta\overline{\ln(c_{i,m})}$		-3.513		-13.375**
		[-9.766,2.740]		[-25.162,-1.588]
Observations	2,583	2,583	616	616
R-squared	0.008	0.015	0.012	0.042

Notes: Variables are household-level residuals from education, age, gender, region, marital status, children dummies, and equivalence scales. 95% confidence intervals in brackets, with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All variables are in Ugandan Shilling and deflated to March 2010, and consumption variables are deseasonalized.

Table 5: Testing limited commitment at benchmark parameters

	Rural Sample		Urban Sample	
	$c_{i,t,a}-\overline{c}_{t,a}$	$c_{i,t,m}$	$c_{i,t,a}-\overline{c}_{t,a}$	$c_{i,t,m}$
$y_{i,t-1}$	0.044***	0.094***	0.058***	0.096***
	[0.032,0.055]	[0.085,0.103]	[0.033,0.083]	[0.052,0.140]
Observations	2,682	2,682	671	671
R-squared	0.140	0.370	0.148	0.256

Notes: Variables are in equivalence scales. 95% confidence intervals in brackets, with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All variables are deflated to March 2010 Ugandan Shilling, and consumption variables are deseasonalized.

B.2 Alternative income specifications

The benchmark definition of household income is the sum of labor income, capital income, business income, and net agricultural production (that is, agricultural production net of production costs such as fertilizers, transportation, plots rent etc.). An alternative specification of income can be constructed by substituting the net agricultural production in the previous definition with the gross agricultural production (that is, gross of the aforementioned costs). Hence, the alternative specification of income considered in table 6 and table 7 is the sum of labor income, capital income, business income, and gross agricultural production. The evidence is consistent with previous results.

Finally, table 8 and table 9 show results of testing the two models when income is only gross agricultural production. Here we only consider rural households, who represent the biggest share of Uganda. Again, the main message of the paper is preserved (tough elasticities for this specification are much closer).

Table 6: Testing complete markets with alternative income specification

	Rural Sample		Urban Sample	
	$\Delta\ln(c_{i,a}-\overline{c_a})$	$\Delta\ln(c_{i,m})$	$\Delta\ln(c_{i,a}-\overline{c_a})$	$\Delta\ln(c_{i,m})$
$\Delta\ln(y_i)$	0.081***	0.118***	0.098***	0.145***
	[0.057,0.106]	[0.089,0.147]	[0.053,0.144]	[0.094,0.197]
$\Delta\overline{\ln(c_{i,a}-\overline{c_a})}$	0.170		5.763	
	[-4.402,4.742]		[-3.786,15.311]	
$\Delta\overline{\ln(c_{i,m})}$		2.081		6.689**
		[-0.443,4.605]		[1.582,11.796]
Observations	3,084	3,084	666	666
R-squared	0.013	0.021	0.030	0.050

Notes: Variables are household-level residuals from education, age, gender, region, marital status, children dummies, and equivalence scales. 95% confidence intervals in brackets, with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All variables are in Ugandan Shilling and deflated to March 2010, and consumption variables are deseasonalized.

Table 7: Testing limited commitment with alternative income specification

	Rural Sample		Urban Sample	
	$c_{i,t,a}-\overline{c}_{t,a}$	$c_{i,t,m}$	$c_{i,t,a}-\overline{c}_{t,a}$	$c_{i,t,m}$
$y_{i,t-1}$	0.052***	0.097***	0.049***	0.060***
	[0.041,0.063]	[0.089,0.104]	[0.029,0.070]	[0.024,0.096]
Observations	3,209	3,209	718	718
R-squared	0.138	0.372	0.144	0.248

Notes: Variables are in equivalence scales. 95% confidence intervals in brackets, with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All variables are deflated to March 2010 Ugandan Shilling, and consumption variables are deseasonalized.

Table 8: Testing complete markets in rural Uganda

	Income is gross agricultural production	
	$\Delta\ln(c_{i,a}-\overline{c_a})$	$\Delta\ln(c_{i,m})$
$\Delta\ln(y_i)$	0.039***	0.043***
	[0.023,0.054]	[0.025,0.061]
$\Delta\overline{\ln(c_{i,a}-\overline{c_a})}$	-3.634	
	[-8.445,1.178]	
$\Delta\overline{\ln(c_{i,m})}$		0.861
		[-1.773,3.496]
Observations	2,841	2,841
R-squared	0.009	0.008

Notes: Variables are household-level residuals from education, age, gender, region, marital status, children dummies, and equivalence scales. 95% confidence intervals in brackets, with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All variables are in Ugandan Shilling and deflated to March 2010, and consumption variables are deseasonalized.

Table 9: Testing limited commitment in rural Uganda

	Income is gross agricultural production	
	$c_{i,t,a}-\overline{c}_{t,a}$	$c_{i,t,m}$
$y_{i,t-1}$	0.080***	0.082***
	[0.058,0.101]	[0.066,0.097]
Observations	3,033	3,033
R-squared	0.111	0.248

Notes: Variables are in equivalence scales. 95% confidence intervals in brackets, with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All variables are deflated to March 2010 Ugandan Shilling, and consumption variables are deseasonalized.

Appendix C Additional Figures

Figure 2: UNPS Households distribution across the country.

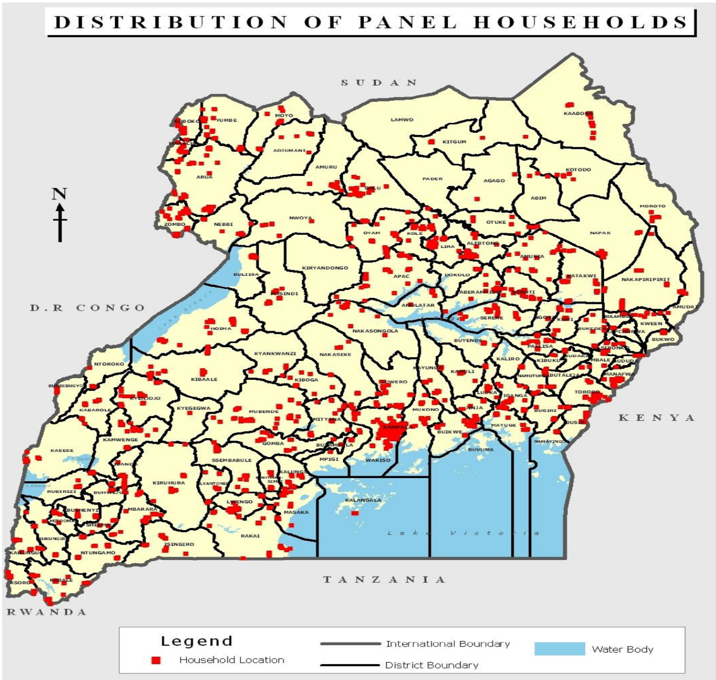

Figure 3: Testing limited commitment at the benchmark κ