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Consumption and Expenditure in Sub-Saharan Africa: The Role of Self-Farming over the Lifecycle*

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Abstract

Using novel micro data we explore the lifecycle profiles of consumption and expenditure in Sub-Saharan Africa. Adult-equivalent expenditure shows a hump over the lifecycle that is twice larger in urban areas than in rural areas. In contrast to expenditure, consumption (measured in caloric intake) remains relatively stable across ages in both rural and urban areas, including in old age. Interestingly, consumption in old age is sustained by the increasing role of self-farmed food over the lifecycle, as opposed to traditional savings mechanisms. The specialization in self-farmed staple food leads to a nutritional loss.

Keywords: Consumption, Expenditure, Sub-Saharan Africa, Lifecycle, Self-Farming, Nutritional Loss
JEL Classification: E21, O11, R20

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1 Introduction

In economies where large populations live on less than one dollar per day, how much can households smooth consumption and expenditure over the lifecycle? The distinction between consumption (measured in nutrient intake) and expenditure is important (Aguiar and Hurst, 2005). This can be particularly relevant for Sub-Saharan Africa (SSA) where food is the largest item of total household expenditure. While a lot of attention has been drawn to the testing of alternative risk-sharing hypothesis in poor countries (Townsend, 1994, Attanasio and Ríos-Rull, 2000, Kinnan, 2014), less is known about the behavior of consumption over the lifecycle in these countries with few exceptions based on household expenditure (Deaton, 1992, 1997). We draw on a new data set, the Integrated Surveys on Agriculture under the Living Standards Measurement Study (LSMS-ISA), which allows us to separate consumption and expenditure for a set of SSA countries.[1] We focus on Malawi, Uganda, and Nigeria.[2] To the best of our knowledge, ours is the first investigation on lifecycle consumption and expenditure in SSA. Four main results emerge.

First, household expenditure has a hump shape over the lifecycle in SSA in both urban and rural areas, but the hump is much less pronounced in rural areas.[3] This difference between urban and rural areas also holds once we control for household structure. Precisely, the size of the adult-equivalent expenditure hump for urban areas is roughly double that for rural areas. The size of the hump is computed by comparing the range between the peak and the bottom expenditure levels over the lifecycle.[4] This implies that rural households have a lifecycle expenditure path that is twice flatter or smoother than urban households. The presence of a hump shape in lifecycle expenditure in SSA is consistent with previous evidence from rich and middle-income countries (Deaton and Paxson, 1994, Blundell et al., 1994, Attanasio et al., 1999, Storesletten et al., 2004). Interestingly, the size of the hump in household expenditure in the urban areas of SSA is comparable to the U.S., suggesting that the rural-urban composition of the population together with the flatter lifecycle expenditure in rural areas can help explain cross-country differences in lifecycle expenditure profiles.

Second, we find that food expenditure is twice smoother over the lifecycle than nonfood expenditure. Investigating food by source of origin, we find that the smoothing of food is driven

[1] For a detailed analysis on the LSMS-ISA improvements on previous LSMS data sets see Carletto et al. (2010) and Beegle et al. (2012).

[2] Within SSA Malawi is one of the poorest countries with an average income per capita of 850, Uganda is closer to the middle of the income distribution with an income per capita of 1,230, and Nigeria is somewhat richer with an income per capita of 2,160. These values are in purchasing power parity for 2010 as provided by the World Bank. Using US current dollars (USD), rural households in Malawi and Uganda have income per capita levels of less than 250USD (De Magalhães and Santaeulàlia-Llopis, 2015).

[3] In Malawi and Uganda roughly 80% of households are rural. In Nigeria 68% of households are rural.

[4] All construction details are in Section 4.

by substituting into self-farmed staple food (e.g., maize in Malawi)—which increases over the life cycle—and away from purchased food—which substantially decreases in old age. Food gifts play a minor role in lifecycle smoothing as they are flat throughout. These findings are important as they suggest a potential mechanism through which Schultz (1953)'s "food problem" affects the economy (Timmer, 2002, Gollin et al., 2007). Households with elderly heads focus on self-farming in order to meet subsistence needs instead of looking for more productive alternative occupations for their household members, including their cohabiting adult children. For example, in Malawi we find that 56% of elderly households (head aged 55 or more) have at least one cohabiting adult child. This is consistent with results for China where 32% of elderly households cohabit with an adult child (Oliveira, 2015). Importantly, we show that while the hours that household heads and spouses work on self-farming decline in old age, the hours their cohabiting adult children work on self-farming increase as the household head ages. That is, the increasing role of self-farming, sustained by cohabiting adult children, maintains consumption in old age.[5]

Third, the lifecycle profile of food consumption (measured in caloric intake) is considerably smoother than the lifecycle profile of food expenditure. Household consumption practically shows no hump over the lifecycle in SSA despite there being a hump in food expenditure. This result is closely related to the findings in Aguiar and Hurst (2005) for the U.S. and Hicks (2015) for Mexico. These authors show that food consumption remains stable with age as retired households substitute away from eating out and spend more time shopping and preparing food at home. In contrast with these authors we show that in SSA caloric intake remains stable in old age because older households substitute away from purchased food and into farming their own food.

Fourth, we show that the specialization in self-farmed staple foods—despite being able to provide a stable caloric intake—comes at a nutritional cost. Take the case of maize in Malawi as an example. Maize is the most important contributor to total household caloric intake, 65% in rural areas and 45% in urban areas. However, maize consumption, which rises over the lifecycle, provides calories and iron, but not much more. This implies a substantial nutritional loss in old age in micro nutrients such as vitamin A, B12, C and D and macro nutrients such as sugar and fat for both Malawi and Uganda.[6] This is particularly relevant for policy as SSA is aging (Payne et al., 2013) and an older and less healthy population can represent an important burden for economic growth (Weil, 2014).

Our results suggest that households in the poorest economies do a good job in smoothing

[5]More generally, the role of children as old-age support has been studied in Boldrin and Jones (2002) and Banerjee et al. (2014), and the role of consumption in the interaction between children and parents has been studied in, among others, Hayashi et al. (1996), Bethencourt and Ríos-Rull (2009) and Akin and Leukhina (2015).

[6]In Nigeria, nutrient intake is as stable in old age as caloric intake, suggesting the nutritional loss in old age might depend on the stage of economic development.

lifecycle consumption but use a mechanism that has not previously been studied in the literature: an increase in self-farmed food consumption in old age sustained by cohabitation with adult children. We are able to empirically discard two traditional alternative explanations of how consumption smoothing is achieved in old age in SSA. First, lifecycle consumption smoothing is not achieved through buffer savings or borrowing as we show that purchased food declines in old age. In this sense our paper speaks to a literature that has identified a savings constraints among the poorest and studies how they attempt to smooth consumption in spite of this (Dupas and Robinson, 2013a,b, Karlan et al., 2014, Brune et al., 2015). In the same direction, De Magalhães and Santaeulàlia-Llopis (2015) show that saving and borrowing levels are negligible in SSA.[7] Second, despite the quantitatively important role of informal arrangements in managing consumption insurance against unanticipated changes in income in poor countries (Attanasio and Ríos-Rull, 2000), we find that food gifts do not contribute to smoothing consumption against aging, i.e., an anticipated change in income, in SSA. The study of lifecycle smoothing against anticipated changes in income has been previously studied in the context of more developed countries (Browning and Collado, 2001, Berg, 2013).

The rest of the paper proceeds as follows. Section 2 discusses the household survey data and the detailed construction of expenditure and consumption of nondurables, food, and nonfood. In Section 3, we specify an empirical method to be used to compute the lifecycle profiles of consumption and expenditure based on a simple lifecycle consumption model. Our main empirical results follow in Section 4. We conclude in Section 5.

2 Data and Measurement Issues

We work with the Integrated Surveys of Agriculture (ISA) recently collected under the umbrella of the Living Standard Measurement Surveys (LSMS) of the World Bank. The ISAs are seen as a clear improvement on previous LSMS rounds (Carletto et al., 2010) and they are unique in the level of detail on nondurable and durable consumption (Beegle et al., 2012).[8] We focus the discussion on Malawi because it has the most detailed ISA questionnaire and the largest sample size with two cross-sectional waves of approximately 12,000 households each, 2004-05 and 2010-11, and an additional panel wave between 2010 and 2013 of roughly 3,500 households.[9] The surveys in Uganda and Nigeria have a smaller sample, respectively 3,000 and 5,000 households

[7] In contrast, in richer countries such as South Africa, state pensions are available (Case and Deaton, 1998).

[8] A large part of the ISA improvements draw on Grosh and Glewwe (2000) that include specific issues on consumption measurement (Grosh and Deaton, 2000).

[9] The Malawi ISA is also labeled as the Integrated Household Survey (IHS) 2 and 3. Both IHS2 and IHS3 were a considerable improvement on the previous IHS1 wave in 1997-1998. So much so that we believe it is best to restrain our attention to the latter two waves, as the IHS1 data may not be directly comparable.

per wave. There are three waves for Uganda (2005-06, 2009-10, 2010-11, 2011-2012) and two for Nigeria (2010-11 and 2012-2013). Parallel results for Uganda and Nigeria in the appendix.

The ISAs are particularly detailed in capturing food consumption. Food consumed is recorded by origin including purchases, agricultural (home) production and received gifts. This is essential for the SSA countries that we study because the value of self-farmed food consumption represents close to 50% of the total value of household food consumption, and the total value of food consumption is roughly 60% of total expenditure (De Magalhães and Santaeulàlia-Llopis, 2015).

Seasonality and home production are two important aspects of consumption in SSA that deserve further discussion. First, seasonality is particularly relevant for food consumption, which is reported with a 7-day recall (other consumption items are usually reported with longer recalls). Given the short recall period, food consumption may exhibit monthly patterns (Paxson, 1993). Since the Malawi surveys in 2004/05 and 2010/11 are rolled out across the year from March to March, we can control for seasonality with monthly dummies.[10] Second, the food items that are self-farmed or in-kind gifts must be given a monetary value. Our measure of food expenditure is the sum of food purchases, the monetary value of self-farmed food and received food gifts. The monetary value of in-kind consumption is assigned using season- and region-specific prices.[11]

Direct measures of consumption, i.e., the intake of calories and other micro and/or macro nutrients, help circumvent problems of measurement relating to prices. In this direction, the ISAs allow us to isolate the effects of prices and distinguish between consumption and expenditure because the quantity of food consumed is also carefully recorded. These quantities are reported in units that must be converted to kilograms.[12] The survey for Malawi allows for 135 separate food items to be reported and includes any items consumed outside the home. With such level of detail the food basket of Malawian household can be accurately recovered.[13] We use the Food Composition Tables from the United States Department of Agriculture (USDA) National Nutrient

[10] The Nigeria surveys take place in two different points in time: pre and post harvest. At each visit a 7-day recall food consumption questionnaire is applied. This double visit allows us to account for seasonality in Nigeria. The annualized food expenditure/consumption is the average of the pre and post harvest answers. In Uganda the surveys are not rolled out throughout the year, but across all waves there are data for all months and we are able to deseasonalize the data in a similar manner to Malawi.

[11] Spatial differences in prices might introduce additional biases in the comparison of expenditure across households, although this is more of a concern for larger countries (Deaton and Dupriez, 2011, Gaddis, 2015).

[12] De Magalhães and Santaeulàlia-Llopis (2015) discuss in detail the price method we use to generate conversion rates. This conversion is also performed for Nigeria. The Uganda data is already available in kilograms.

[13] The Uganda survey lists 60 different food items and Nigeria 89. Unlike Malawi and Uganda, the Nigeria survey does not provide a list of food items consumed outside the home, only their overall monetary value. This difference in the level of detail in food consumption is another reason for our focus on Malawi. Note that the objective of the paper is not to estimate the precise level of caloric intake, but to estimate the lifecycle behavior in consumption. For this purpose the number of items present in the Uganda and Nigeria are more than sufficient as they include all staple foods and more.

Database to compute the nutritional intake of each and all of the food items consumed. In our analysis we include calories and other macro-nutrients (fat and sugar), minerals (iron and zinc), and vitamins (A, B12, C and D); see our discussion in Section 4.2.[14]

Nondurable expenditure other than food (62% of average household consumption in Malawi) are classified under alcohol and tobacco (negligible), clothing (3%), health (i.e., prevention, treatment, hospitalization, and traditional healers — 2%), education (2%), utilities (15%), housing (i.e, mostly self-reported rental value of dwelling or rent — 2%), transportation (1%) and other nondurables[15] (13%). This level of detail is similar in the Nigeria and Uganda surveys.

3 Theory and Empirical Strategy

We present a lifecycle model à la Attanasio et al. (1999) to guide our empirical analysis in Section 3.1. Importantly, we distinguish between food and nonfood consumption. We discuss household structure in Section 3.2 and our empirical strategy in Section 3.3.

3.1 A Life-Cycle Model of Two Consumption Goods: Food and Nonfood

A household lives for a finite number of periods until age J. Each household maximizes lifetime utility by choosing age profiles of household food consumption, $c_{a,j}$, and household nonfood consumption, $c_{m,j}$, as follows:

$$\max_{\{c_{a,j},c_{m,j}\}_{j=0}^{J}} \sum_{j=0}^{J} \beta^j \left[u(c_{a,j})\exp(\theta_a' z_j) + \kappa v(c_{m,j})\exp(\theta_m' z_j)\right],$$

subject to a budget constraint $p_a c_{a,j} + c_{m,j} + a_{j+1} = y_j + (1+r)a_j$, where p_a is the relative price of food in terms of nonfood consumption good, y_j is labor income, and a_j is a risk-free asset with a constant return r. We assume additive separability of the utility function across consumption goods as is standard in the structural transformation literature (Gollin et al., 2002, 2007). In our preferences we have a time discount factor β and a set of household characteristics that may affect each consumption good differently. We denote the household characteristics as vector z_j, namely household structure. The fact that household structure might have different effects across consumption goods, through the vectors θ_a and θ_m, allows for each household member to

[14] The use of nutrient intake for consumption comparisons across households is not straight-forward as the need for different types of nutrients might differ across persons, regions, and time (Behrman and Deolalikar, 1990, Alderman et al., 2008, Pitt et al., 2012). See Eli and Li (2015) for a pioneering treatment of some these concerns.

[15] For example: fuel, newspaper and paper products, milling fees, hygiene and cleaning products, cooking and cleaning utensils, repair costs, cell phones, carpets and rugs, mats and linen, mosquito nets, rubber, plastics, construction and repair materials, mortgage payments, marriage and funeral costs and bridewealth costs.

potentially have a different share per consumption good (Aguiar and Hurst, 2014). For example, children might require a higher share of food consumption than of other consumption goods.

We assume a constant relative risk aversion (CRRA) utility function separately for food and for nonfood consumption with, respectively, coefficients η_a and η_m. Isolating $c_{m,j}$ from the budget constraint and plugging into the utility function we can compute the first order conditions of a_{j+1} and $c_{a,j}$. The first order conditions imply, after taking logs, that

$$\ln c_{i,j+1} - \ln c_{i,j} = \text{cons.} + \frac{1}{\eta_i}\, \theta_i' \left(z_{j+1} - z_j\right) \tag{1}$$

for $i = \{a, m\}$ and the constant is $\frac{1}{\eta} \ln \beta(1 + r)$.[16] In this simple formulation, the lifecycle behavior of food and nonfood consumption is driven by changes in household structure z_j. We empirically test this hypothesis separately for rural and urban areas.

3.2 Household Structure Over the Lifecycle

We document the behavior of household structure by household heads' age groups separately for rural and urban areas for Malawi.[17] The average age of household heads is larger in rural areas, 43, than in urban areas 39. Heads aged between 15-44 account for 60% of the heads population in rural areas and for 73% in urban areas (panel A1 and B1, Table 1). This rural-urban gap is largely driven by the heads aged between 25 and 34 that account for 29% of the heads population in rural areas and 40% in urban areas. The complement is that the number of heads who are older than 55 is almost twice larger in rural areas (24%) than in urban areas (13%), a feature that is also present for heads above 65.

Household heads in both rural and urban areas are predominantly married with 70% of heads having a cohabiting spouse in rural areas and 71% in urban areas. In rural areas, 70% of heads aged 15-24 have a cohabiting spouse, a figure that increases to roughly 80% for heads aged 25-44

[16] This follows from the separability of u and v. First, note that the intertemporal Euler equation, or first order condition of a_{j+1} is,

$$v_{c_{m,j}} \exp(\theta_m z_j) = \beta(1 + r) v_{c_{m,j+1}} \exp(\theta_m z_{j+1}). \tag{2}$$

Second, we plug the first order condition for $c_{a,j}$, i.e., $u_{c_{a,j}} \exp(\theta_a z_j) = p_a \kappa v_{c_{m,j}} \exp(\theta_m z_j)$, into (2) to find,

$$u_{c_{a,j}} \exp(\theta_a z_j) = \beta(1 + r) u_{c_{a,j+1}} \exp(\theta_a z_{j+1}). \tag{3}$$

This way, assuming a CRRA shape for u and v and taking logs, we can write (2) and (3) as (1).

[17] ISAs' household roster provides demographic information about each and all members of the household. In particular, the relationship between each member and the household head is identified. Relatives who are members of the household include children (i.e., son/daughter-in-law, niece/nephew, grandchildren), wife/husband, father/mother, father/mother-in-law, brother/sister, brother/sister-in-law, and grandfather/grandmother. Non-relatives who are members of the household include servants and lodgers living in the household.

and slowly decreases thereafter to reach 50% for heads aged more than 65 (panel A2, Table 1). Urban areas follow a similar pattern starting with a lower figure of 50% of heads aged 15-24 having a cohabiting spouse, reaching 80% for heads aged 35-44, and decreasing thereafter (panel B2, Table 1).[18] In terms of children (household members below 15), household heads in the age group 15-24 have on average 1.1 children in rural areas and this number increases to 3.1 children for heads in the age group 35-44, and decreases gradually to 1.2 for heads aged above 65. For heads in old age, household members below 15 represent, mostly, grandchildren. A similar hump is present in urban areas starting with 0.7 children for heads aged 15-24, increasing to 2.5 for heads aged 35-44, and declining thereafter to 1.3 for heads above 65. The hump in children is more prominent in rural areas, representing the lower amount of children per household in urban areas than in urban areas, respectively 2.2 and 1.8. Finally, the number of adult offspring, which includes mostly head's children (and nephews/nieces, or grandchildren) above 15, also shows a hump over the lifecycle. In rural areas, the size of adult offspring rises from 0.1 for the youngest heads to peak at 1.2 for heads aged 45-54, and remains high at 0.8 for heads above 65. In urban areas, the peak occurs at 1.9 for heads aged 55-64 and remains high at 1.4 for heads above 65. As we will see below, a substitution away from purchased food towards home produced foods is a key mechanism to smooth consumption in old age. The relatively high number of adult children living with elderly parents (and helping with home production) may be an important channel through which elderly heads maintain their level of household consumption. The presence of adults who are not head's children is negligible in rural and urban areas.

Overall, household size shows a clear lifecycle hump in both rural and urban areas. In rural areas the household of the youngest heads, aged 15-24, have 3.0 members, a number that peaks at 5.7 for heads aged 35-44, and declines to 4.5 for heads aged 55-64 and to 3.4 for ages 65 and above. In urban areas, heads aged 15-24 have a household size of 2.7, peaking for heads aged 45-54 at 5.6, and declining to 4.8 for heads above 65.

3.3 Empirical Strategy

We investigate mean lifecycle profiles of expenditure in two different ways. First, we estimate the lifecycle profiles with the following regression that controls for time effects:

$$\ln C_{it}^k = \beta_0^k + \mathbf{1}_a \beta_a^k a_{it} + \mathbf{1}_t \beta_t^k t + \epsilon_{it}^k, \tag{4}$$

where C_{it}^k is the household expenditure of household i during period t on expenditure category k (e.g., food and nonfood), a_{it} is a full set of age dummies (for ages 26-65) referring to the age of

[18] This is a reminiscent of lower age at first marriage in rural areas, Palamuleni (2011).

the household head, and period t are wave dummies for each household survey (e.g., Malawi ISA 2004/05, 2010/11, and 2013).[19] We run the regression for urban and rural households separately.

Second, we additionally control for household structure,

$$\ln C_{it}^k = \beta_0^k + \mathbf{1}_a \beta_a^k a_{it} + \mathbf{1}_t \beta_t^k t + \theta_{it}^k X_{it} + \epsilon_{it}^k, \tag{5}$$

with an additional vector of household structure characteristics, X_{it}, that includes dummy variables for marital status, household size, and the number of male and female children in age categories 1-2, 3-5, 6-13, and 14-18. This implies that we take the equivalence scales (and household structure) as exogenous, as in Aguiar and Hurst (2014) although we allow for the gender of the child and a thinner set of age categories of children defined as individuals under 15.[20] To examine the lifecycle effect of household structure on different types of consumption, we compare the estimated coefficients of age dummies, β_a, from these two models in the Section 4.

4 Empirical Results

We document the lifecycle behavior of expenditure and consumption in poor Africa. In the main text we present and discuss in detail the results for Malawi. The results for Nigeria and Uganda go in the same direction and are presented in the appendix. First we focus on expenditure. We emphasize the differential behavior of food and nonfood expenditure and the role of household structure (Section 4.1). Then we investigate the lifecycle behavior of consumption, focusing on food, maize kilograms, and nutrient intake (Section 4.2).

4.1 Life-Cycle Expenditure

We show the age profile of household-level nondurable expenditure (in logs) in Figure 1 using our specification (4). The age profiles are normalized to 0 (in logs) at age 25 and we plot a cubic polynomial on age as well as the estimated age dummies. Before dissecting the lifecycle behavior of household expenditure in poor countries, we contextualize it with respect to the U.S.

[19] To compute lifecycle profiles, we need to disentangle time and cohort effects from age effects. Yet, since age, time, and cohort effects are not independent from each other, only two of the three can be operative. More discussions can be found in Heathcote et al. (2005). Since economies such as Malawi are likely to be far from steady state, time effects play a key role and must be controlled for. For example, Malawi faced a famine the year before the 2004-5 survey and by 2010-11 the economy had not only recovered fully but a program of widespread fertilizer subsidy had been implemented. Controlling for time means that part of our results are driven by differences across cohorts – but since we are interested in the behavior of these economies during transition, these differences across cohorts are of interest. Alternatively, if we control for cohorts the profiles would be driven by the high growth between 2004 and 2010, and explaining growth is not the objective of this paper.

[20] In Aguiar and Hurst (2014) children are household members up to the age of 21.

(Panel (a), Figure 1). Nationwide, household expenditure in Malawi increase by 0.25 log points between the age of 25 and its peak in early 40s, while household expenditure in the US increases by roughly twice as much, 0.42 log points, between the ages of 25 and its peak, somewhat later than Malawi, in the late 40s. That is, there is a clear lifecycle hump in nondurable expenditure in both countries but it is twice as prominent in the U.S. as in Malawi.

The Rural-Urban Divide. A potential explanation behind the nationwide differentials across countries is the rural-urban composition of the population. In Malawi, roughly 85% of the population lives in rural areas, while this figure is less than 1% in the U.S. We explore the lifecycle behavior of household expenditure separately for rural and urban Malawi (Panel (b), Figure 1). In rural areas, the peak in nondurable expenditure is reached at 0.23 log points in the early 40s with respect to age 25. The nondurable expenditure in urban areas peaks at 0.46 log points in the late 40s with respect to age 25. Beyond the peak, nondurable expenditure reaches back the initial level at age 60 in rural areas with log deviation of -0.11 at age 65, while it remains always above the initial level in urban areas with a log deviation of 0.20 at age 65. This implies that the total range of household expenditure from its peak to its minimum is 0.34 in rural areas and 0.46 in urban areas, suggesting more lifecycle consumption smoothing in rural areas by 0.46/0.34-1=0.35. In summary, nondurable expenditure shows a lifecycle hump that is 0.35 larger in urban areas than in rural areas. The hump is also more prolonged for urban than for rural households. Overall, the rural-urban divide largely accounts for the nationwide behavior of nondurable expenditure over the lifecycle: nationwide expenditure follows the behavior of rural areas. Interestingly, lifecycle expenditure in urban Malawi closely follows its U.S. counterpart (Panel (b), Figure 1).

The Role of Household Structure. The excess sensitivity of consumption to anticipated income changes throughout the lifecycle can be partially explained by household structure.[21] When we control for household structure with our specification (5) separately for rural and urban areas, we find the adult-equivalent profiles in Figure 2. Adult-equivalent expenditure shows a hump that peaks lower and at an earlier age over the lifecycle than its household-level counterpart. In rural areas, adult-equivalent expenditure increases by 0.06 log points from age 25 to its peak age, while this figure is 0.23 at the household-level. That is, household structure accounts for more than 2/3 of the lifecycle hump in expenditure. In urban areas, adult-equivalent expenditure increases by 0.30 log points from age 25 to its peak age, while this figure is 0.46 for households. This implies that household structure accounts for roughly 1/3 of the lifecycle hump in expenditure. It is also interesting to note that adult-equivalent expenditure peaks roughly 8

[21] See Blundell et al. (1994) and Attanasio et al. (1999).

years earlier than its household-level counterpart in both rural (early 30s) and urban areas (late 30s), and declines by twice as much in urban areas than in rural areas. Precisely, adult-equivalent nondurable expenditure drops back to the age-25 expenditure levels by age 45 in rural areas and by age 57 in urban households. By age 65 the log deviation from age 25 is -0.17 in rural areas and -.09 in urban areas. This implies that total range of adult-equivalent nondurable expenditure from its peak to its minimum at age 65 is 0.23 in rural areas and 0.39 in urban areas, suggesting about twice more consumption smoothing in rural areas than in urban areas.

Food and Nonfood Expenditure To examine the source of the hump in adult-equivalent nondurable expenditure, we decompose the lifecycle profiles into food and nonfood. Food expenditure (panel (a), Figure 3) is smoother than nonfood expenditure (panel (b), Figure 3). In rural areas, food expenditure and nonfood expenditure peak in the early 30s at a similar level with respect to age 25, a deviation of 0.06 log points, but the decline after the peak is starker for nonfood expenditure reaching a deviation of -0.31 log points at age 65 that is larger than for food expenditure, -0.13 log points. In urban areas, nonfood expenditure peaks at a larger level than food expenditure, respectively, by a deviation of 0.33 and 0.23 log points in the late 30s with respect to age 25. As it was the case in rural areas, the decline after the peak is starker for nonfood expenditure reaching a deviation of -0.17 log points at age 65 that is roughly three times larger than for food expenditure, -0.06 log points, in urban areas. The total range of food expenditure is 0.19 in rural areas and 0.29 in urban areas, while the range in nonfood expenditure is 0.36 in rural areas and 0.49 in urban areas suggesting more lifecycle smoothing in food than in nonfood expenditure. Food expenditure largely drives the behavior of nondurable expenditure, which is consistent with food expenditure representing respectively roughly 70% and 60% of nondurable expenditure in rural and urban Malawi.[22] These shares are stable through the lifecycle (panel (c), Figure 3).

The Role of Self-Farmed Food. Given the role of food in explaining the smoothing of total expenditure, we now investigate food expenditure in more detail. In particular, we break down expenditure by origin. We deconstruct adult-equivalent lifecycle behavior of food into purchases, the monetary value of self-farmed food and received food gifts.[23] First, the only category that goes up over the lifecycle is self-farmed food (left axis, panel (a), Figure 4). In rural areas the monetary value of self-farmed food is 0.10 log points higher at age 40 and 0.22 log points higher at age 65 compared to age 25. The increase in urban areas is more pronounced in old age and the monetary value of self-farmed food is 0.52 log points higher by age 65 than by age 25. The

[22] In the US, food represents less than 35% of nondurable expenditure (Aguiar and Hurst, 2014).

[23] Recall that we value self-farmed food consumed and food received as gifts consumed using prices constructed from food purchases (Section 2).

share of self-farmed food also increases during the lifecycle: from 38% to 48% in rural areas and from 4% to 17% in urban areas (right axis, panel (a), Figure 4). Second, food purchases show a hump that decreases substantially after peaking around ages 30-40 (left axis, panel (b), Figure 4). The hump in food purchases is larger than that of total nondurable expenditure. The decrease is particularly strong in rural areas where the level of purchased food is below that of age 25 by age 40, and by age 65 the level is lower than at age 25 by -0.51 log points. In urban areas the level of purchased food by age 65 is below that of age 25 by -0.31 log points. The share of purchased food also decreases during the lifecycle: from 52% to 40% in rural areas and from 92% to 78% in urban areas (right axis, panel (b), Figure 4). Third, the level of food expenditure from gifted consumption in rural areas is relatively flat throughout the lifecycle (panel (c)). In urban areas, we observe a hump shape peaking at age 45 and attaining the same level at 65 as that of age 25. In neither urban and rural areas does the share of received food gifts increase in old age which remains relatively stable at 10% in rural areas and 4% in urban areas. Therefore, it is self-farmed food that helps mitigate the hump from food purchases and hence smooth household food expenditure. These results rule out savings as well as social insurance through food gifts as mechanisms to smooth consumption in old age in SSA, as this is happening through self-farming.

To study how the rise of self-farmed food is sustained over the lifecycle, we explore the behavior of household hours employed in self-farming. We focus in rural areas, where 85% of the population lives and the majority of hours worked are employed in self-farming.[24] We find that self-farmed food grows at a similar rate than household's hours worked on self-farming, roughly by 0.22 log points over the lifecycle (panel (a), Figure 5). Interestingly, a decomposition of household hours worked on self-farming shows that household heads (and their spouses) increase these hours by almost only 0.1 log points from age 25 to 50, and decrease them thereafter. That is, the work of heads (and spouses) falls short in explaining the increase in household self-farmed food expenditure. However, the hours that cohabiting adult children employed in self-farming increase with the age of the household head after 32 to reach roughly 0.35 log points at age 65 (panel (b), Figure 5). That is, the increasing role of adult children in self-farming maintains household food expenditure in old age. This result is entirely driven by adult children because the self-farming hours of adult children show a similar lifecycle behavior as those of total children, which include the hours of young children.

To sum up, we find that rural households smooth adult-equivalent expenditure roughly twice

[24] We find that household heads work an average of 26 hours per week and spend 61% of their working hours self-farming, where 77% of the rural heads do self-farming. Spouses and cohabiting adult children spend an even higher percentage of their own working time in the household farm, respectively 87% and 82%. In urban areas, where 34% of households heads work on self-farming, heads work approximately 3 hours. Focusing on total hours per worker, we find a country average of 29 hours per week for household heads which is consistent with what Bick et al. (2016) find for Sub-Saharan countries.

more than urban households over the lifecycle. Deconstructing lifecycle expenditure, we show that households smooth food expenditure twice more than nonfood expenditure in both rural and urban areas. Our decomposition of food expenditure analysis suggests the main mechanism to smooth consumption in old age is the substitution away from purchased food and into self-farmed food.[25] Our results rule out traditional savings mechanisms to smooth consumption in old age in SSA. Instead, the behavior of hours worked in self-farming shows that it is the presence of adult children what sustains consumption in old age.

4.2 Lifecycle Consumption

To abstract from the effects of prices, we now turn to consumption. We start by exploring caloric intake and maize consumption, and then move to explore the nutritional quality of food. In the main text we focus on Malawi. Parallel results for Uganda and Nigeria are in the appendix.

Caloric Intake and Maize. We find that consumption, measured in terms of caloric intake, is more stable over the lifecycle than expenditure. In rural areas, caloric intake peaks in the early 30s with a deviation of 0.03 log points with respect to age 25, i.e., half the peak of food expenditure (panel (a), Figure 6). The decline after the peak is also less pronounced for caloric intake reaching a deviation of -0.04 log points at age 65 that is half that of food expenditure. In urban areas, caloric intake peaks in the late 30s with a deviation of 0.09 log points with respect to age 25, i.e., less than half the peak of food expenditure (panel (b), Figure 6). The decline of caloric intake after the peak is about the same as that of food expenditure, reaching a deviation of -0.06 log points at age 65. This implies that the total range of caloric intake over the lifecycle is 0.07 log points in rural areas and 0.15 log points in urban areas. Recall that for food expenditure these figures are respectively 0.19 for rural areas and 0.29 for urban areas. That is, households smooth caloric intake twice more than food expenditure in both rural and urban areas. Interestingly, the rural-urban divide persists with consumption. The ability to smooth consumption is twice as large for rural areas than for urban areas.

Maize is by far the most important staple food in Malawi and represents 61% of the total household caloric intake (65% in rural are and 46% in urban areas). Such a specialization in both production and consumption in Malawi provides us with a natural and direct way to compare consumption and expenditure. We find that household maize consumption (measured in kilograms) steadily grows throughout the lifecycle, both in rural and urban areas (respectively, panel (a) and (b), Figure 6). Indeed, Malawian households increase lifecycle maize consumption substituting

[25]This occurs in both rural and urban areas of Malawi and Uganda. In Nigeria, the substitution away from purchased food and into self-farmed food is also present but less pronounced. See our appendix

away from other forms of food (panel (c), Figure 6). This implies that the consumption of maize largely drives the smoothing of caloric intake over the lifecycle. We now turn to what happens to the quality of food consumption.[26]

Other Macro and Micro Nutrients. Households are able to smooth iron and zinc in both rural and urban areas, respectively panel (a) and (b) in Figure 7. This is consistent with a diet where maize is the staple food, since maize is abundant in both nutrients. In contrast, a look to vitamins shows a very different story. In rural areas, the consumption of vitamin A, B12, C and D show a similar but even larger hump and range over the lifecycle than food expenditure. In particular, there is a substantial nutrient loss in terms of all vitamins consumption at age 65 with log deviations of -0.10 for vitamin C, -0.13 for vitamin A, -0.18 for vitamin D and -0.19 for vitamin B12 compared with age 25 consumption (panel (c), Figure 7). This loss in vitamins consumption is between two and five times that of caloric intake that is barely -0.04 log points at age 65. For the 15% of the population that lives in urban areas, the nutritional loss in old age is particularly stark for vitamin B12 and vitamin D with log deviations of, respectively, -0.37 and -0.20 compared with age 25 consumption (panel (d), Figure 7). Interestingly, vitamin A and C grow and smooth better over the lifecycle in urban areas. Finally, macro nutrients such as fat and sugar intake also drop in both rural and urban areas below the levels at age 25 (panel (e) and (f), Figure 7). Overall, however, there is a clear reduction in the quality of food intake in old age consistent with a substitution of most food items towards the consumption of maize.

To sum up, households are capable of smoothing consumption through the lifecycle to a much larger extent than what measures of food expenditure suggest. This result echoes the results for the U.S. in Aguiar and Hurst (2005) and for Mexico in Hicks (2015) that find a stable caloric intake in old age, despite a decline of food expenditure in old age. In the case of Malawi, the consumption of self-farmed maize largely drives the smoothing of caloric intake over the lifecycle but at the expense of everything else. This has negative consequences for food quality in old age. Maize provides calories and iron, but not much more. This implies a substantial nutritional loss over the lifecycle in rural and, to a lesser extent, in urban Malawi. We find a similar drop in nutrition quality in Uganda, see appendix A, Figure A3. For Nigeria, however, nutrient intake in old age follows the same pattern as the stable caloric intake. Our findings for Malawi and Uganda also contrast with the evidence on the U.S., where food quality remains stable in old age (Aguiar and Hurst, 2005), suggesting that this result can depend on the aggregate stage of economic development.

[26] Nigeria and Uganda have considerably more diverse diets and agricultural diversification than Malawi. For brevity we do not provide a detailed analysis of the lifecycle behavior of the different staple foods for these two countries. We focus on caloric and nutrient intake, see our appendix.

5 Conclusion

Our study of the lifecycle consumption and expenditure in SSA yields four main results. First, rural households smooth adult-equivalent expenditure twice more than urban households over the lifecycle. Second, households smooth food expenditure twice more than nonfood expenditure over the lifecycle in both rural and urban of SSA. Interestingly, the smoothing of food expenditure is driven by the substitution away from purchased food and into self-farmed food, largely sustained by cohabiting adult children. This contrasts with traditional savings mechanisms which can be inaccessible to SSA populations. Third, households smooth food consumption twice more than food expenditure. Fourth, the shift toward self-farmed food in old age seems to help keeping caloric intake constant but has consequences for the quality of food consumed. For example, in the context of Malawi, households are capable of smoothing caloric intake and iron, which self-farmed maize provides, but not much more. This nutritional loss is evident in micro nutrients such as vitamin A, B12, C, and D and in macro nutrients such as sugar and fat. This drop in food quality in old age is particularly relevant for policy as an older and less healthy population can represent an important burden for economic growth (Weil, 2014).

The struggle to smooth caloric intake by turning into subsistence activity (e.g., self-farmed maize) speaks directly to the literature on the 'Food Problem' (Schultz, 1953, Timmer, 2002, Gollin et al., 2007). Our results raise the possibility that alternative mechanisms to smooth consumption in old age (e.g., a higher ability to save) may not only improve the quality of the food intake in old age, but free the labor force (adult children living with the elderly and the elderly themselves) to join more productive sectors and, hence, help kick-start economic growth. Finally, Feyrer et al. (2013) recently assess the effects of micronutrient deficiency on cognitive skills in the context of the United States. In this direction, we think that the loss of nutritional intake in old age that we document for poor Africa is potentially linked to the deterioration in cognitive health and skills of the elderly in Africa recently reported in Payne et al. (2013, 2016), a relation that we think deserves further exploration.

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Table 1: Household Structure (Malawi ISA 2010/11)

(A) Rural Residency

(A1) Population Shares (%) by Age Group

	15-24	25-34	35-44	45-54	55-64	65+
Population 2010	9	29	22	15	11	13

(A2) Household Structure by Age Group

	15-24	25-34	35-44	45-54	55-64	65+
Spouse	0.7	0.8	0.8	0.7	0.6	0.5
Children (< 15)	1.1	2.3	3.1	2.6	1.7	1.2
Adults (offspring) (≥ 15)	0.1	0.2	0.6	1.2	1.2	0.8
Adults (other) (≥ 15)	0.0	0.0	0.1	0.0	0.0	0.0
Household Size	3.0	4.3	5.7	5.6	4.5	3.4

(B) Urban Residency

(B1) Population Shares (%) by Age Group

	15-24	25-34	35-44	45-54	55-64	65+
Population 2010	8	40	25	13	7	6

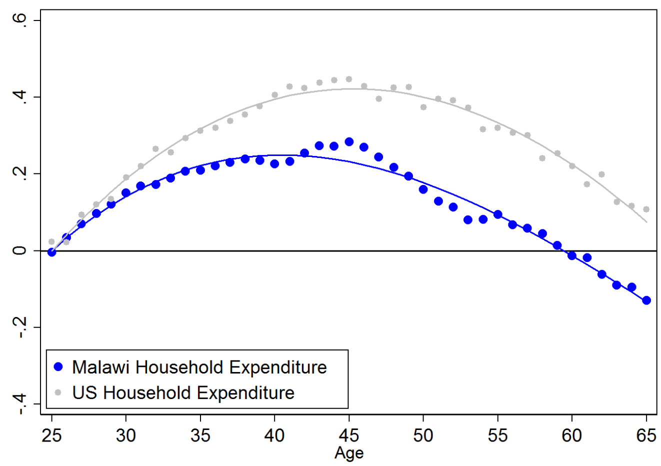
(B2) Household Structure by Age Group

	15-24	25-34	35-44	45-54	55-64	65+
Spouse	0.5	0.7	0.8	0.7	0.6	0.6
Children (< 15)	0.7	1.7	2.5	2.0	1.7	1.3
Adults (offspring) (≥ 15)	0.2	0.2	0.8	1.6	1.9	1.4
Adults (other) (≥ 15)	0.2	0.1	0.1	0.1	0.1	0.0
Household Size	2.7	3.8	5.1	5.6	5.3	4.8

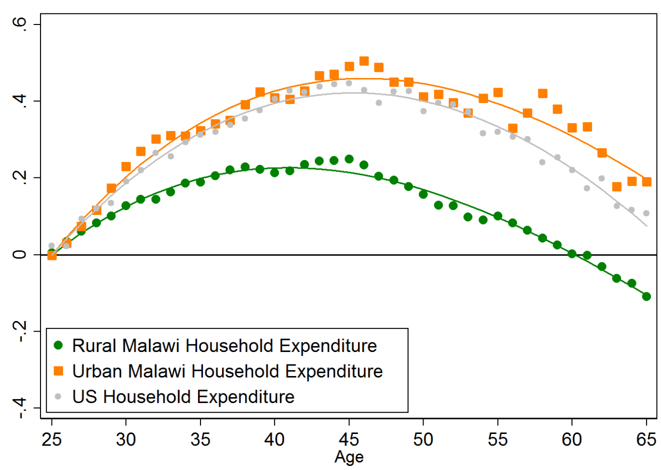
Notes: The data refer to the Malawi ISA 2010/11. We obtain similar insights for the alternative Malawi ISA surveys in 2004/05 and 2013. Children refer to household members age less than 15. Offspring adults refer to the household's head sons and daughters aged 15 or above. The relationship between each member of the household and the household head is collected in the household roster that includes relatives and non-relatives (e.g. servants and lodgers) living in the household at least 9 months in the last year.

Figure 1: Lifecycle Household Expenditure: Malawi, the U.S. and the Rural-Urban Divide

(a) Malawi versus the U.S.

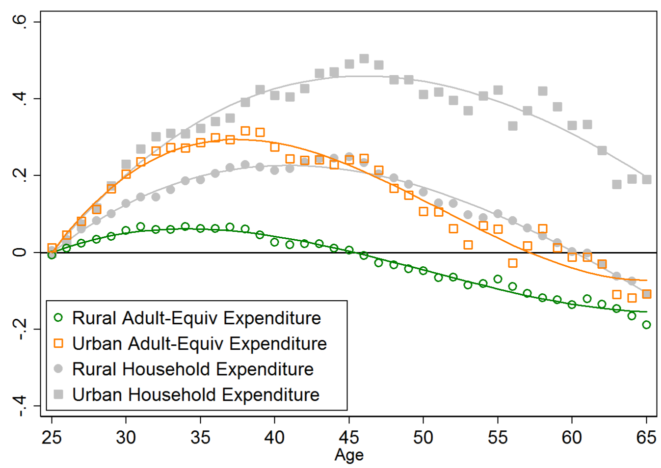


(b) The Rural-Urban Divide



Notes: Panel (a) shows household nondurable expenditure over the lifecycle in Malawi and in the US. Nondurable expenditure is defined in Section 2 and our empirical strategy in Section 3.3. The US profile is taken directly from Aguiar and Hurst (2014). Panel (b) additionally decomposes household nondurable expenditure over the lifecycle in the rural and urban areas of Malawi. See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials.

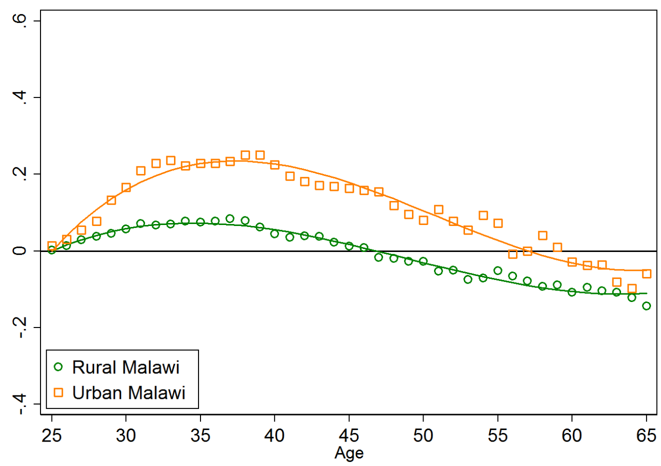
Figure 2: The Role of Household Structure



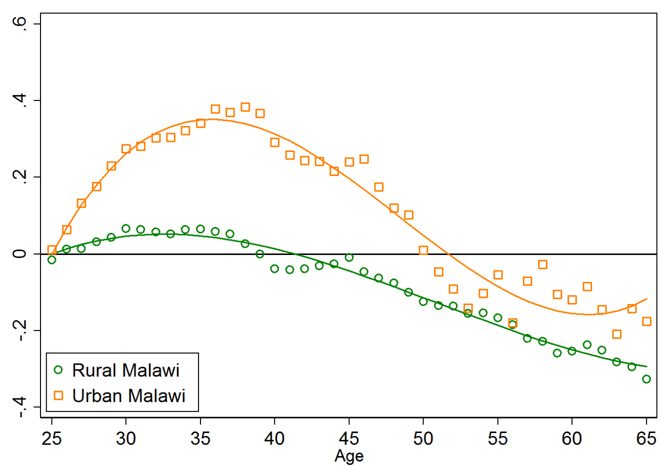
Notes: The adult-equivalent expenditure is defined in Section 3.3. To show the role of household structure we overlay adult-equivalent expenditure with the urban and rural household expenditure profiles from panel (b) of Figure 1 (gray lines). See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials.

Figure 3: Lifecycle Food and Nonfood Expenditure

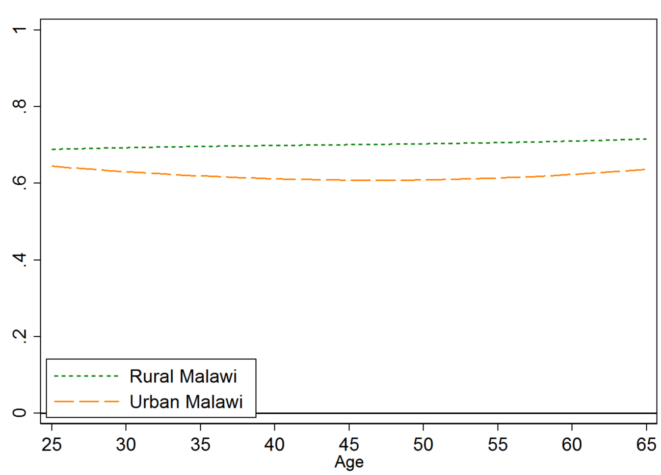
(a) Food expenditure



(b) Nonfood expenditure



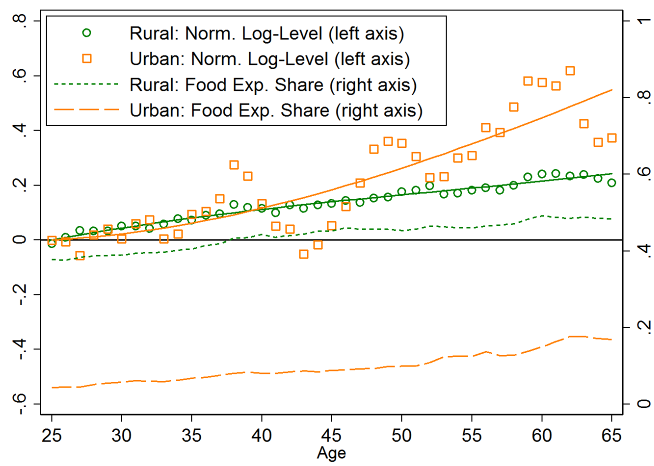
(c) Food Share of Total Expenditure



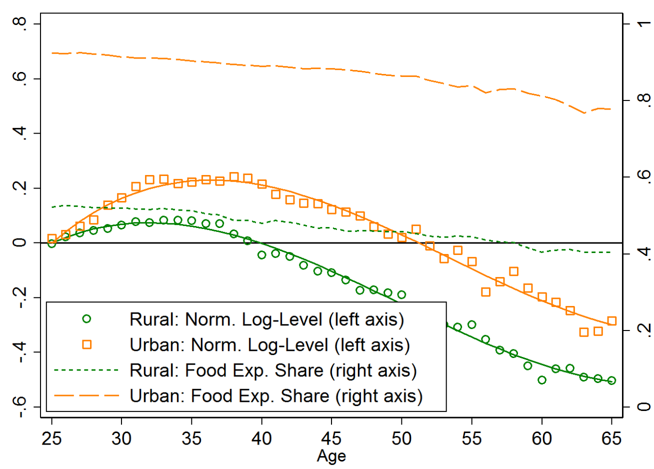
Notes: The expenditure profiles in rural and urban Malawi are decomposed into food and nonfood expenditure in respectively panel (a) and (b).We plot the food share of total nondurable expenditure in panel (c). See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials. All profiles are plotted in adult-equivalent terms.

Figure 4: Deconstructing Lifecycle Food Expenditure

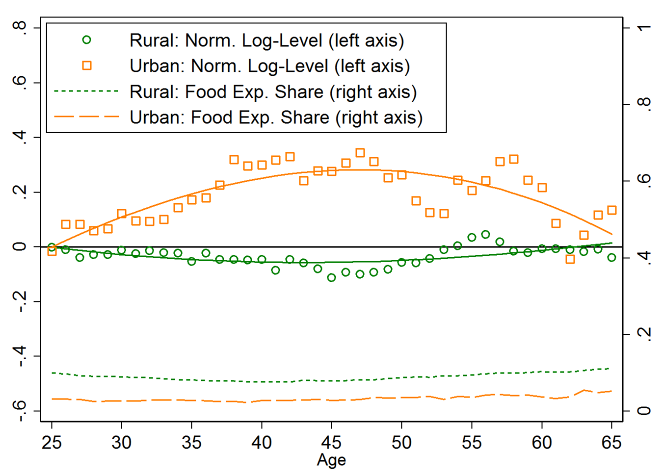
(a) Self-Farmed Food



(b) Food Purchases



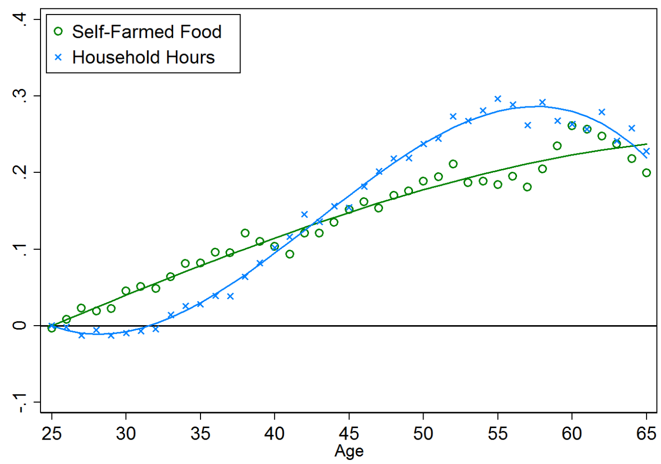
(c) Food Received as Gift



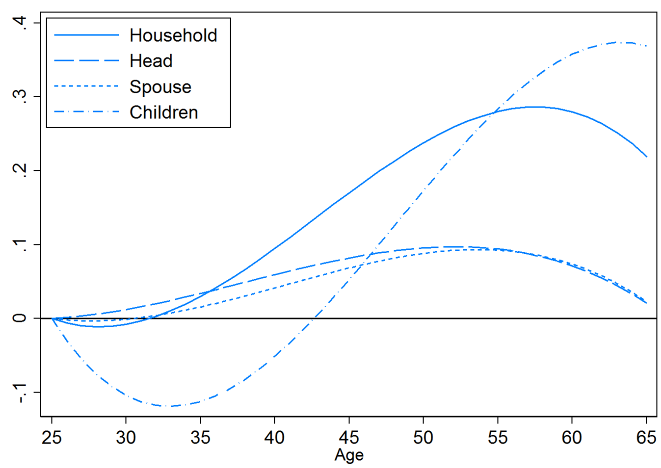
Notes: We break down food expenditure by its origin (left axis): self-farmed food in panel (a), food purchases in panel (b), and food received as gift in panel (c). In each panel we overlay the lifecycle profiles with the expenditure share out of total food expenditure (right axis). See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials. All profiles are plotted in adult-equivalent terms.

Figure 5: Self-Farming Hours over the Life Cycle

(a) Household Self-Farming Food and Hours



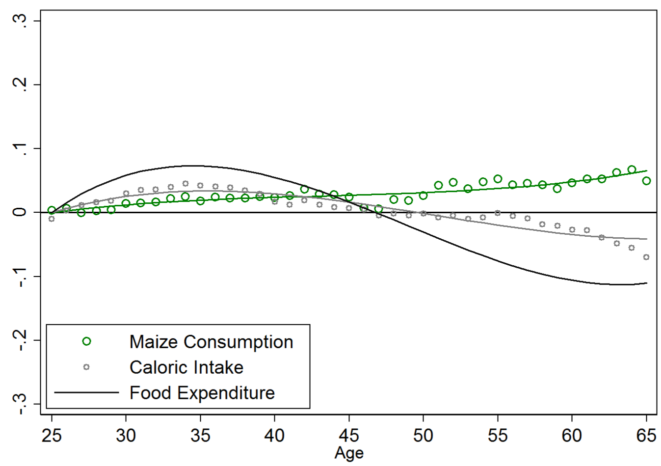
(b) Self-Farming Hours by Household Member



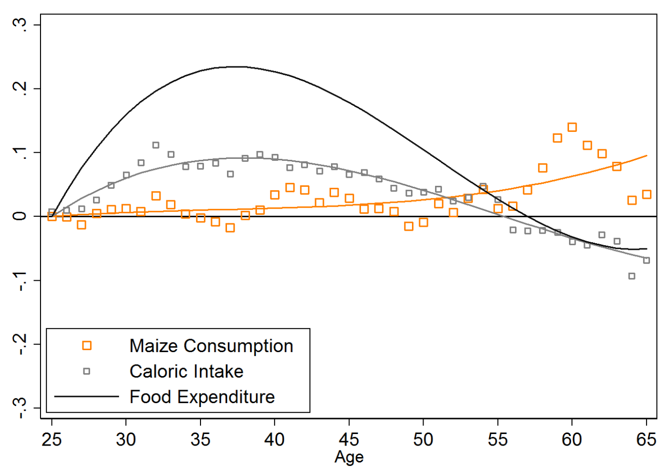
Notes: Panel (a) shows the adult-equivalent self-farmed food expenditure and adult-equivalent working hours employed in self-farming. Panel (b) breaks down the household hours employed in self-farming by household members: head, spouse, and children. In the case of children, hours are in per capita terms, i.e., we divide total children hours by total number of children. The age profiles are normalized to 0 (in logs) at age 25.

Figure 6: Lifecycle Consumption and Expenditure

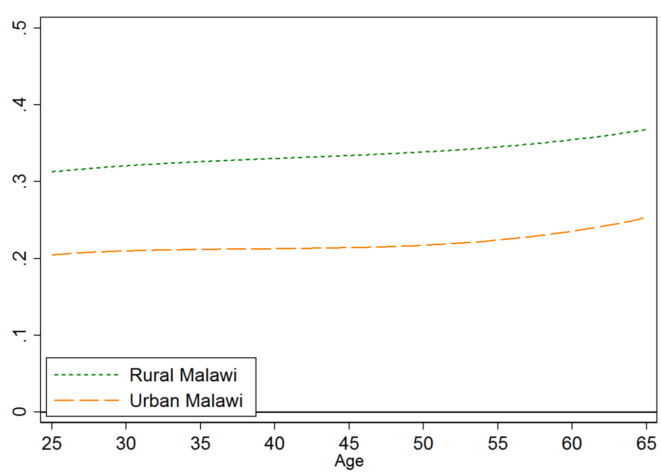
(a) Rural Malawi



(b) Urban Malawi

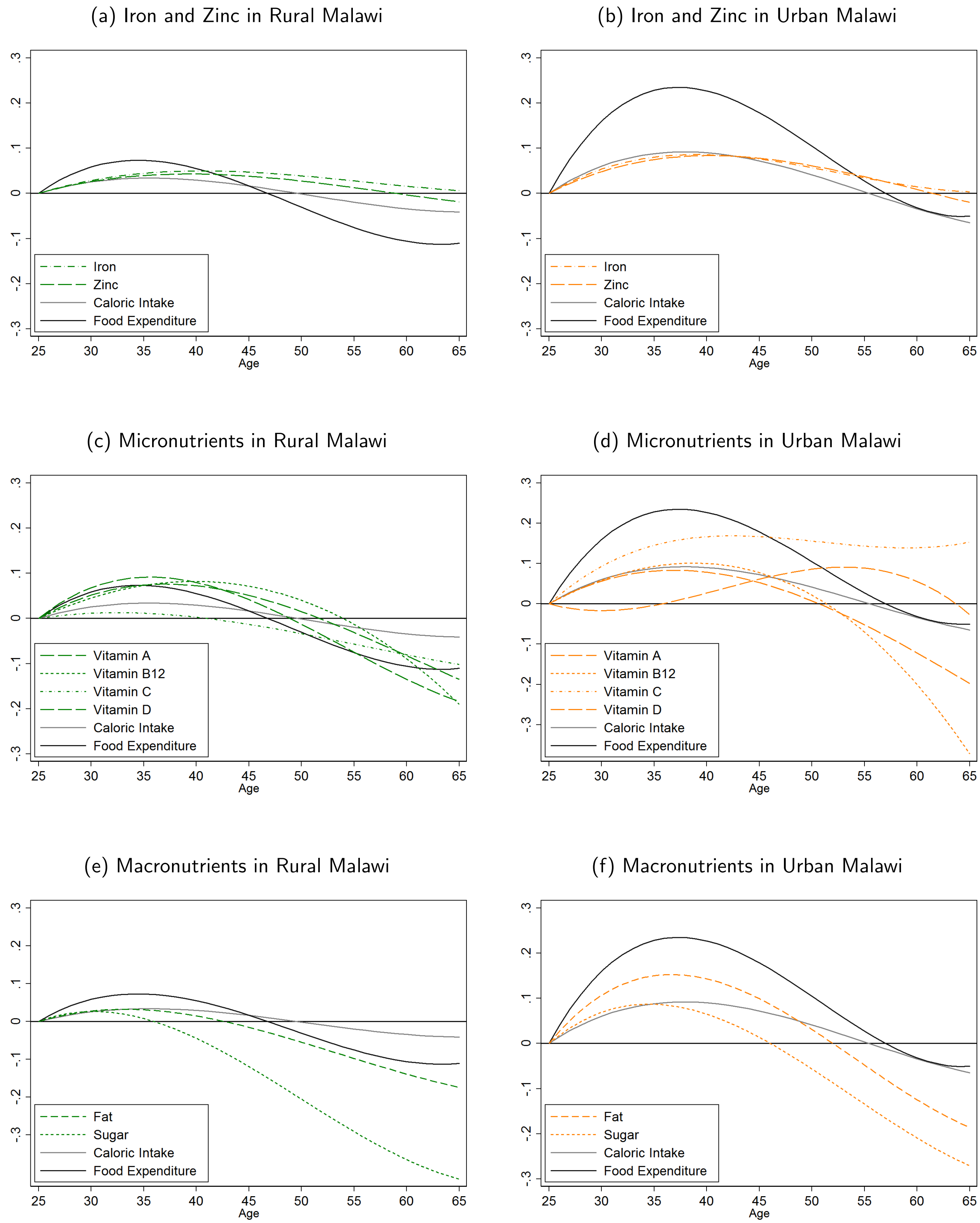


(c) Maize Share



Notes: Consumption profiles are measured in terms of caloric intake and the quantity (Kilograms) of maize consumed in rural and urban Malawi, respectively panel (a) and panel (b). In each panel, we overlay consumption with food expenditure profiles from panel (a) in Figure 3. In panel (c), we plot the expenditure share of maize out of total food expenditure. See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials. All profiles are plotted in adult-equivalent terms.

Figure 7: Quality of Lifecycle Consumption



Notes: We plot consumption profiles of nutrient intake by minerals (iron and zinc) in the top panels, micro nutrients (vitamins A, B12, C and D) in the center panels, and macro nutrients (fat and sugar) in the bottom panels. The left panels refer to rural areas, and the right panels refer to urban areas. In each panel, we overlay nutrient intake with calories and food expenditure profiles from Figure 6. See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials. All profiles are plotted in adult-equivalent terms.

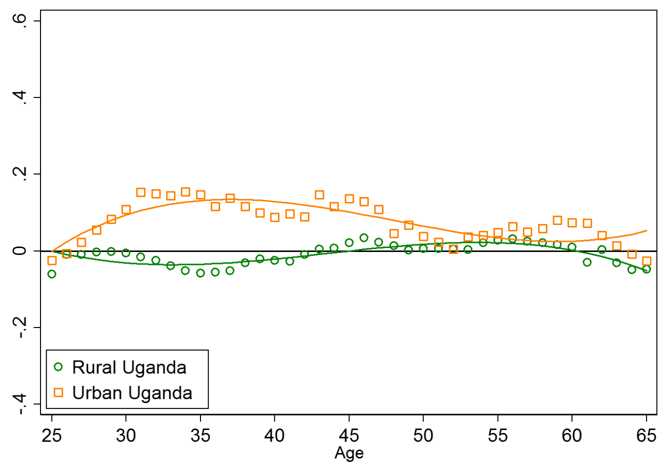
Appendix: “Lifecycle Consumption and Expenditure in Sub-Saharan Africa”

By Leandro De Magalhães, Dongya Koh and Raül Santaeulàlia-Llopis.

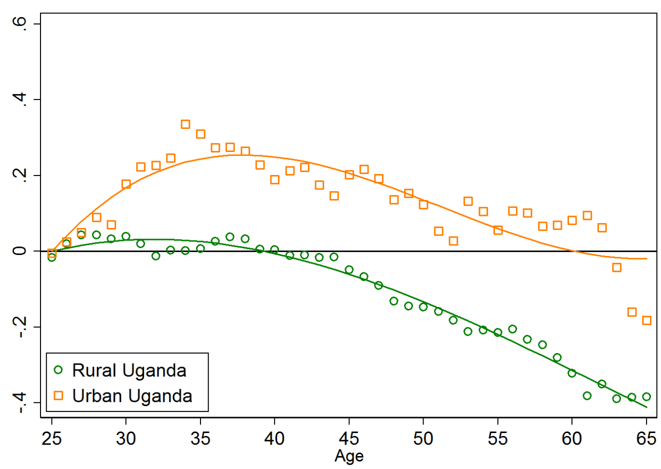
A Lifecycle Expenditure and Consumption in Uganda and Nigeria

Figure A1: Lifecycle Food and Nonfood Expenditure, Rural and Urban Uganda

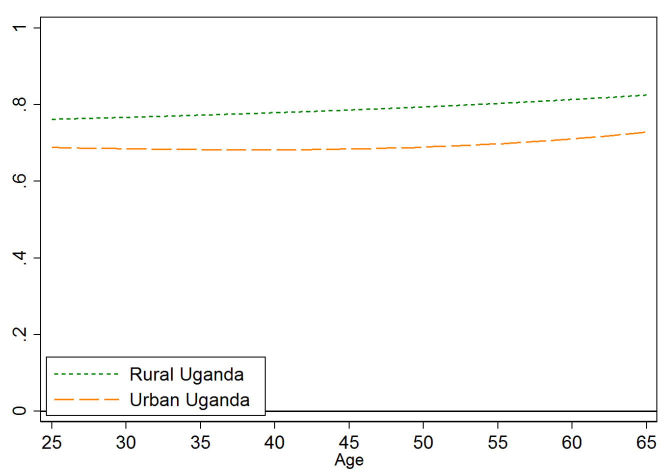
(a) Food Expenditure



(b) Nonfood Expenditure



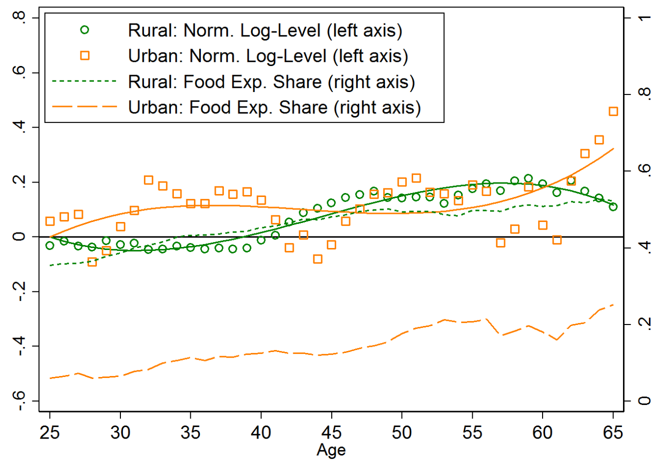
(c) Food Share of Total Expenditure



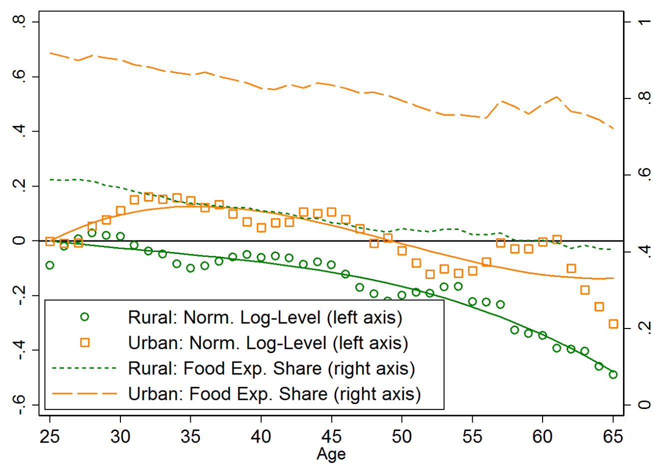
Notes: We use the four available waves of the Uganda LSMS-ISA data 2005/06, 2009/10, 2010/11, and 2011/12. The expenditure profiles in rural and urban Uganda are decomposed into food and nonfood expenditure in respectively panel (a) and (b). We plot the food share of total nondurable expenditure in panel (c). The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials following the specification with time controls described in Section 3.3. All plotted variables are deseasonalized, annualized, and in adult-equivalent terms.

Figure A2: Deconstructing Lifecycle Food Expenditure, Rural and Urban Uganda

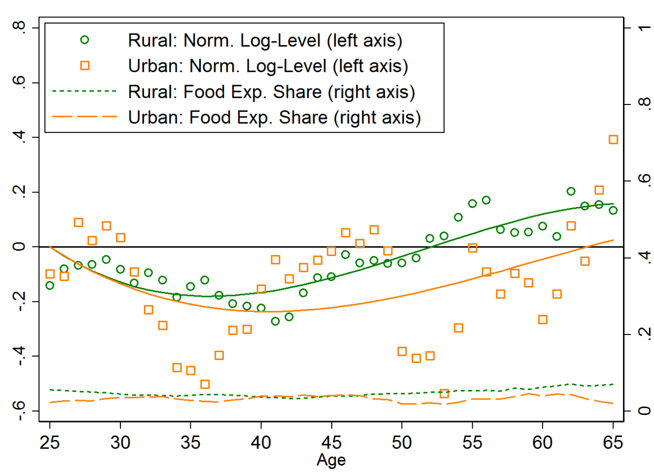
(a) Self-Farmed Food



(b) Food Purchases



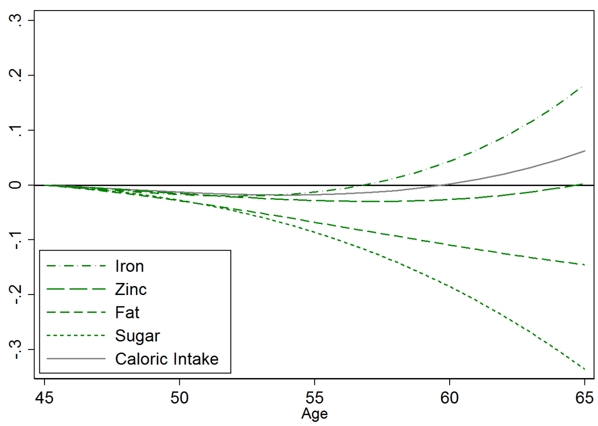
(c) Food Received as Gift



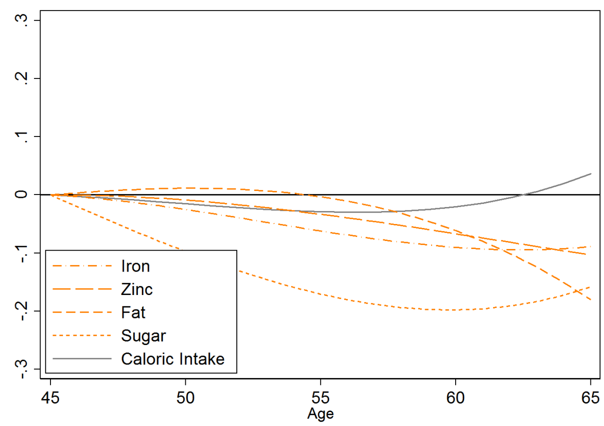
Notes: We use the four available waves of the Uganda LSMS-ISA data 2005/06, 2009/10, 2010/11, and 2011/12. We break down food expenditure by its origin (left axis): self-farmed food in panel (a), food purchases in panel (b), and food received as gift in panel (c). In each panel we overlay the lifecycle profiles with the expenditure share out of total food expenditure (right axis). See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25 The graphs show estimated age dummies (marked with dots) and associated cubic polynomials following the specification with time controls described in Section 3.3. All plotted variables are deseasonalized, annualized, and in adult-equivalent terms.

Figure A3: Lifecycle Consumption and Its Quality in Old Age, Rural and Urban Uganda

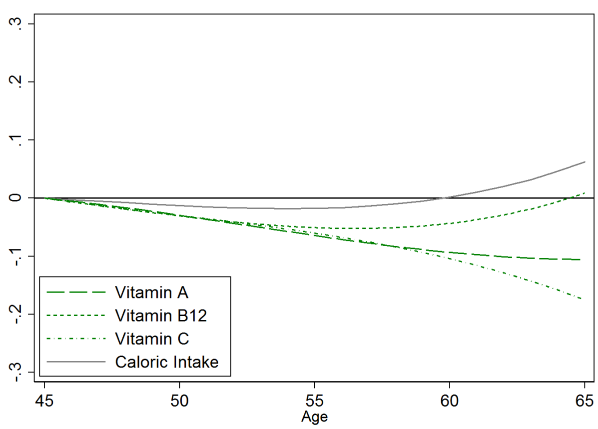
(a) Iron, Zinc, and Macronutrients in Rural Uganda



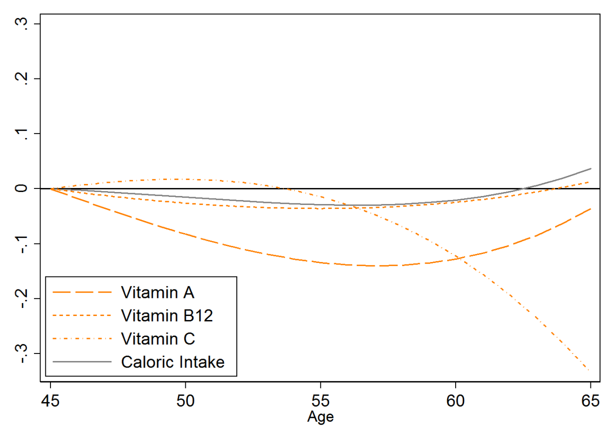
(b) Iron, Zinc, and Macronutrients in Urban Uganda



(c) Micronutrients in Rural Uganda



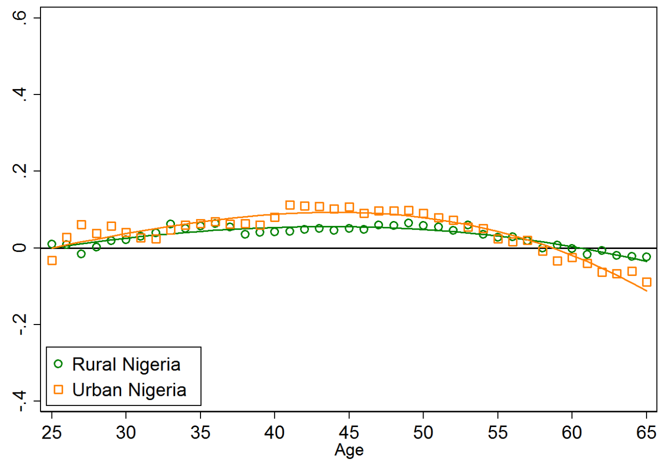
(d) Micronutrients in Urban Uganda



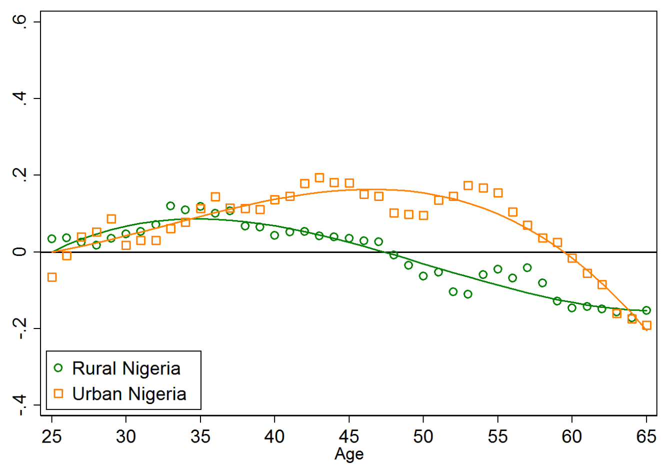
Notes: We plot consumption profiles of nutrient intake by minerals (iron and zinc) in the top panels, micro nutrients (vitamins A, B12 and C) in the center panels, and macro nutrients (fat and sugar) in the bottom panels. The left panels refer to rural areas, and the right panels refer to urban areas. In each panel, we overlay nutrient intake with calories and food expenditure profiles from Figure 6. See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 45. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials. All profiles are plotted in adult-equivalent terms.

Figure A4: Lifecycle Food and Nonfood Expenditure, Rural and Urban Nigeria

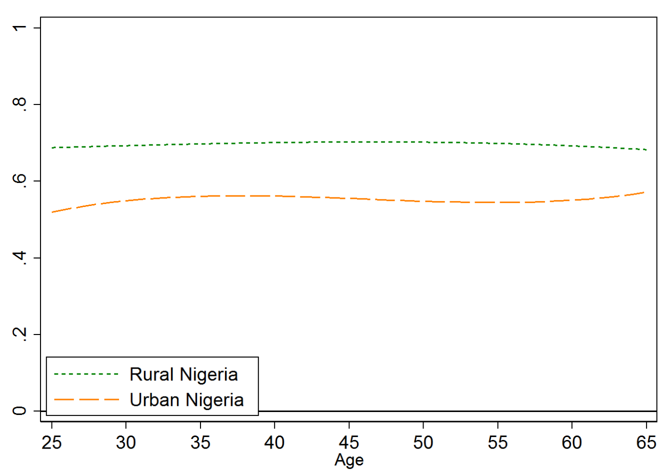
(a) Food Expenditure



(b) Nonfood Expenditure



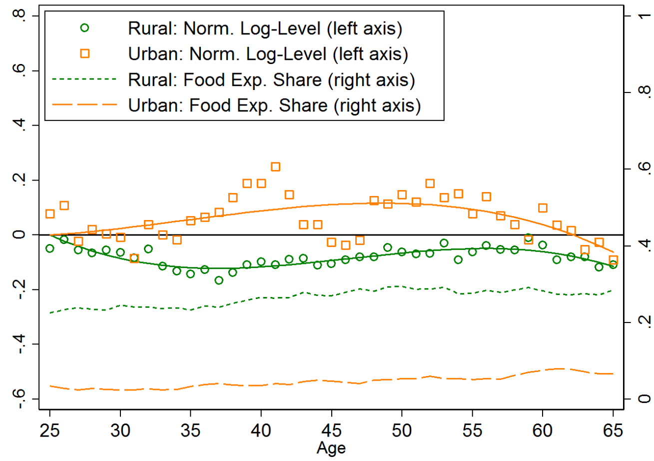
(c) Food Share of Total Expenditure



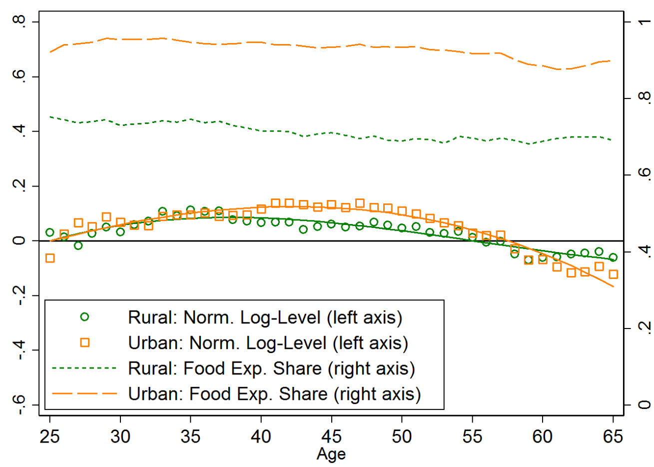
Notes: We use the two available waves of the Nigeria LSMS-ISA data 2010/11 and 2012/13. The expenditure profiles in rural and urban Uganda are decomposed into food and nonfood expenditure in respectively panel (a) and (b). We plot the food share of total nondurable expenditure in panel (c). The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials following the specification with time controls described in Section 3.3. All plotted variables are deseasonalized, annualized, and in adult-equivalent terms.

Figure A5: Deconstructing Lifecycle Food Expenditure, Rural and Urban Nigeria

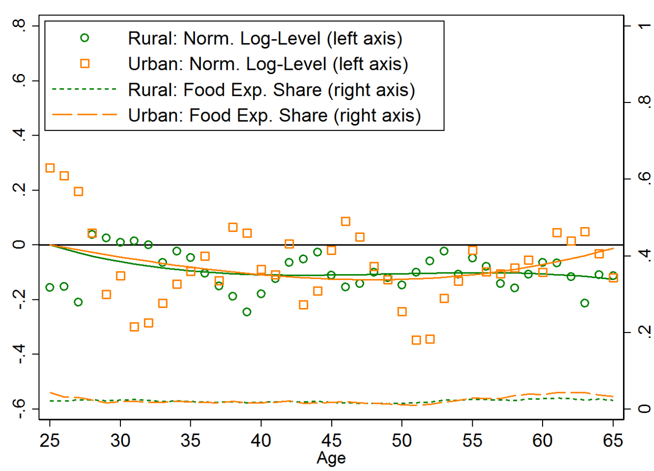
(a) Self-Farmed Food



(b) Food Purchases



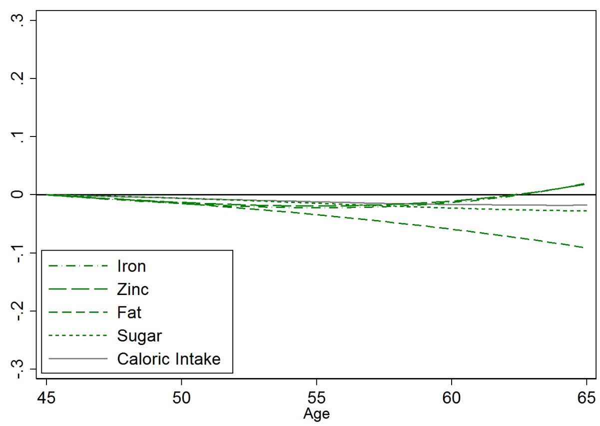
(c) Food Received as Gift



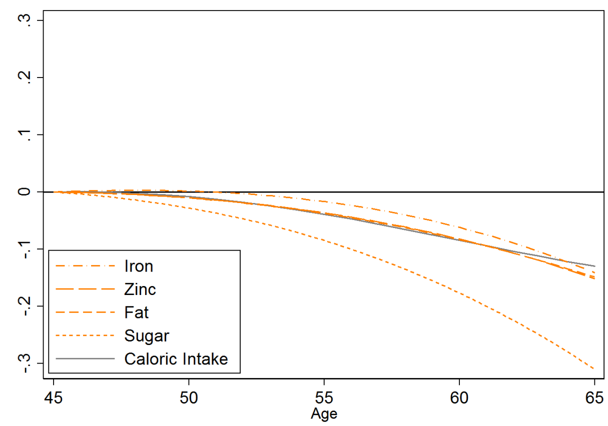
Notes: We use the two available waves of the Nigeria LSMS-ISA data 2010/11 and 2012/13. We break down food expenditure by its origin (left axis): self-farmed food in panel (a), food purchases in panel (b), and food received as gift in panel (c). In each panel we overlay the lifecycle profiles with the expenditure share out of total food expenditure (right axis). See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25 The graphs show estimated age dummies (marked with dots) and associated cubic polynomials following the specification with time controls described in Section 3.3. All plotted variables are deseasonalized, annualized, and in adult-equivalent terms.

Figure A6: Lifecycle Consumption and Its Quality in Old Age, Rural and Urban Nigeria

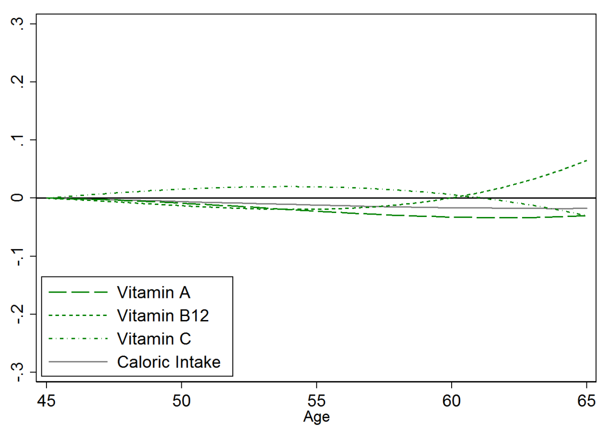
(a) Iron, Zinc, and Macronutrients in Rural Nigeria



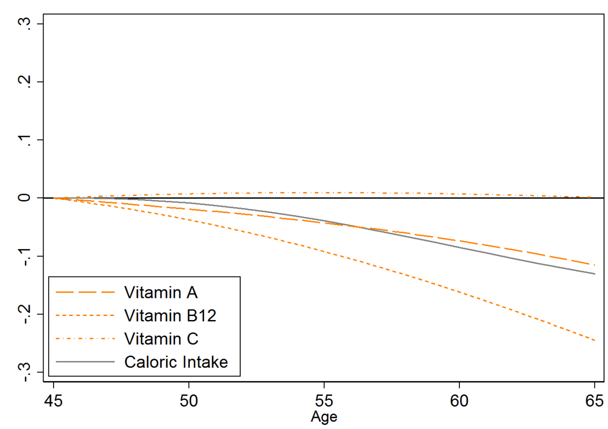
(b) Iron, Zinc, and Macronutrients in Urban Nigeria



(c) Micronutrients in Rural Nigeria



(d) Micronutrients in Urban Nigeria



Notes: We plot consumption profiles of nutrient intake by minerals (iron and zinc) in the top panels, micro nutrients (vitamins A, B12 and C) in the center panels, and macro nutrients (fat and sugar) in the bottom panels. The left panels refer to rural areas, and the right panels refer to urban areas. In each panel, we overlay nutrient intake with calories and food expenditure profiles from Figure 6. See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 45. The graphs show estimated age dummies (marked with dots) and associated cubic polynomials. All profiles are plotted in adult-equivalent terms.