Do the Poor Insure their Consumption More? Empirical Evidence from Uganda

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Using nationally representative household panel data, I study the difference in consumption insurance levels across the quintiles of the consumption, income, and wealth distributions in Uganda. I find that poor households present higher levels of consumption insurance compared to rich households. Across several econometric specifications, the coefficients capturing the transmission of idiosyncratic income changes to consumption are notably lower for households in the bottom quintiles of the consumption and wealth distributions than for those in the top quintiles. This pattern is primary driven by rural areas where the majority of Ugandan households reside. In contrast, in urban areas, the relationship is reversed, with the richest households (those in the top quintile of the income and wealth distributions) exhibiting higher levels of consumption insurance than the rest.
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1 INTRODUCTION

Poverty implies living with erratic earnings together with lacking access to formal insurance or credit systems, Collins et al. (2009). Nevertheless, in developing countries, and even in the poorest rural areas, households are not hand-to-mouth, but they are able to achieve relatively high levels of consumption insurance—e.g., Townsend (1994) or Udry (1994). In this paper, I study whether consumption insurance levels systematically varies across the economic levels within a developing country.

Answering this question contributes to the broader micro and macro debate on the trade-off between insurance and growth. At the micro level, several studies document

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the costs of informal insurance in areas such as education (De Magalhaes, Koh, and Santaeulalia-Llopis 2019), health (Robinson and Yeh 2012), migration decisions (Rosenzweig and Stark 1989), and labor, savings, and business decisions.[1] At the macro level, research documents a trade-off between insurance and growth across rural and urban areas (e.g., Munshi and Rosenzweig 2016) as well as across stages of development. Santaeulalia-Llopis and Zheng (2018) find that China's golden growth period was associated with a large decline in consumption insurance. Similarly, in ongoing work, De Magalhaes, Martorell, and Santaeulalia-Llopis (2019) show that poorer countries have higher levels of insurance than richer countries. This paper investigates whether the trade-off between insurance and growth observed across different economies also exists across households within the same economy—across the cross-sectional distributions.

To investigate this, I compute the insurance coefficients across the quintiles of Uganda's consumption, income, and wealth distributions, both for the entire country and separately for rural and urban areas. The insurance coefficients are computed following two different econometric specifications. In the first (CRRA specification), under complete markets and households with identical preferences characterized by a Constant Relative Risk Aversion (CRRA) utility function, the growth rate of individual consumption should depend solely on the growth rate of aggregate consumption. Thus, the insurance level is measured by the coefficient from a regression of the household consumption growth rate on the growth rate of idiosyncratic household income. Under full insurance, this coefficient should be zero; in the total absence of insurance, it should be one. In the second specification (standard specification), I follow the most common approach in the recent literature, as used by Chiappori et al. (2014), Kinnan (2021), Meghir et al. (2022), among others. Here, the insurance coefficient is obtained from a regression of the log of household consumption on the log of idiosyncratic household income. Similarly, if full insurance holds, household consumption should rely solely on aggregate consumption, meaning the coefficient on household income should be zero.

In terms of data, I use the Ugandan National Panel Survey (UNPS), a nationally representative household panel survey conducted under the World Bank's Living Standards Measurement Study and the Integrated Surveys on Agriculture (LSMS-ISA). The UNPS captures household consumption, income, and wealth dynamics, crucial for this analysis. Measuring income in poor countries is particularly challenging, especially be-

[1] In the context of Africa, where kinship networks are particularly strong, informal insurance, which is associated with high redistribution pressures, disincentive labor supply, asset accumulation, and entrepreneurship activity—see Platteau (2009) for a discussion. Baland et al. (2016) find that mutual help in extended families reduces labor supply and entrepreneurship of the younger siblings. Boltz, Marazyan, and Villar (2020) observe that households take out loans to signal themselves as liquidity-constrained and avoid sharing the accumulated wealth with relatives and friends. In lab experiments, individuals pay an extra price to hide their income from relatives and friends—e.g., Jakiela and Ozier (2016), Boltz, Marazyan, and Villar (2020).

cause many households rely on subsistence farming.[2] The ISA component of the survey accurately captures agricultural income, including production, costs, and farming assets, while the LSMS part provides detailed data on consumption, non-agricultural income, and wealth. This unique dataset allows for a detailed study of insurance levels across households at different economic levels in Uganda.

This paper finds that poor households in Uganda have higher levels of consumption insurance than richer households. As households move up the wealth and consumption distributions, the coefficient capturing the transmission of household-idiosyncratic fluctuations into consumption changes increases. Under the CRRA specification, we cannot reject the hypothesis of full consumption insurance for households in the bottom quintiles of both the consumption distribution (the first three quintiles, Q1, Q2, and Q3) and the wealth distribution (Q1 and Q3) at the national level. Under the standard specification, we cannot reject the hypothesis of full consumption insurance for households in the bottom quintile (Q1) of both the consumption and wealth distributions. Importantly, this national trend is not solely driven by urban-rural differences, as highlighted in studies by Munshi and Rosenzweig (2016) and De Magalhães and Santaeulalia-Llopis (2018). In fact, the relationship is mainly driven by rural areas, where over 70% of the population resides. In rural areas, poor households show significantly greater insurance levels than rich households. Conversely, in urban areas, a contrasting trend emerges: richer households—those in the top quintile of both the income and wealth distributions—exhibit higher (albeit unsignificantly different) levels of consumption insurance, with full insurance being supported among these households.

Under the standard specification, the estimated coefficients are larger than under the CRRA specification, indicating lower levels of consumption insurance insurance. Nevertheless, The relationship between insurance and economic levels is equally observed in both econometric specifications. In Uganda, and particularly in rural areas, across the consumption distribution and the wealth distribution, poor households have larger insurance levels than rich households. In urban areas, across the income distribution and the wealth distribution, the insurance levels of the households in the top quintile (Q5) of the distributions are larger than for the rest of the households.

The results are robust by running insurance test regressions without fixed effects, using the unbalanced panel, and testing insurance only for food consumption. Including or not fixed effects in the regressions have little effect on the estimated coefficients. Thus, the results are not driven by permanent different characteristics among rich and poor households. Using the unbalanced panel, the negative relationship between insurance and the wealth distribution in the whole country and rural areas is no longer observed. However, the rest of the relationships observed in the balanced panel are maintained. A potential explanation for the larger levels of consumption insurance

[2]Income measurement is further complicated by the prevalence of informal jobs and businesses, with earnings that fluctuate over time.

among the poor is that rich households could have different patterns of consumption in goods and services—as clothes, education expenditures, and medical expenditures—that do not necessarily need to exhibit a smoothed consumption for welfare maximization. Nevertheless, this potential confounder effect is rejected. Testing insurance only in food consumption delivers the same broad trends between insurance and economic levels as when testing insurance for total consumption.

The primary contribution of this work is to provide novel empirical evidence of a trade-off between insurance and economic levels across households within a developing economy.

1.1 Related Literature

This work contributes to the literature on insurance in developing countries. For instance, Townsend (1994) studied income and consumption patterns in some of the poorest villages in rural India and found that villagers' consumption responded relatively little to household-idiosyncratic income fluctuations. This result provided evidence of significant but imperfect insurance levels in village economies. Similarly, other studies documenting large yet imperfect insurance levels in developing countries include Deaton (1992) in Côte d'Ivoire, Ghana, and Thailand; Paxson (1993) in Thailand; and Udry (1990) and Udry (1994) in northern Nigeria, as well as De Magalhães and Santaeulalia-Llopis (2018) in Malawi, Uganda, and Tanzania.

Several explanations have been proposed and tested to understand the insurance arrangements in these contexts. These include endogenously incomplete market models with private information (Ligon 1998), limited commitment (Ligon, Thomas, and Worrall 2002), and limited commitment with storage (Laczó 2015) and (Ábrahám and Laczó 2018). Additionally, risk-sharing networks with frictions (Fafchamps and Lund 2003) and (Kinnan and Townsend 2012), along with models of endogenously incomplete markets and self-insurance schemes (Karaivanov and Townsend 2014), and studies including and testing hidden income (Kinnan 2021) have been examined.

By systematically documenting insurance levels across the cross-sectional distributions in Uganda, this study provides a new set of empirical results that can inform theories of risk-sharing and insurance arrangements in developing countries. Furthermore, it offers a novel perspective by highlighting the trade-off between insurance and economic levels within a low-income economy.

With respect to the latter point, this paper relates to the works documenting a trade-off between insurance and growth. For example, Munshi and Rosenzweig (2016) and De Magalhães and Santaeulalia-Llopis (2018) show that poor rural areas exhibit substantially higher levels of insurance than rich urban areas. Santaeulalia-Llopis and Zheng (2018) further document a trade-off between insurance and growth across different stages of development by studying the golden period of growth in China. Similarly, De Magalhaes, Martorell, and Santaeulalia-Llopis (2019) highlight the existence

of this trade-off between poor and rich countries globally.

This study adds to this body of literature by showing that the trade-off between insurance and economic levels is observed not only between economies but also among households within the same economy. Moreover, it reveals an inverse relationship between insurance and economic levels in rural and urban areas: in rural regions, higher economic levels are associated with lower insurance, whereas in urban areas, higher economic levels correlate with greater insurance. These findings provide further evidence of the distinct insurance mechanisms operating in urban and rural contexts.[3]

The paper is organized as follows: Section 2 discusses the data and the measurement of key variables. Section 3 presents the framework for testing consumption insurance across distributions, while Section 4 outlines the results. Finally, Section 5 evaluates the robustness of the findings, and Section 6 concludes the paper.

2 DATA

This study uses the first five waves of the Ugandan National Panel Survey (UNPS).[4] The UNPS is a nationally representative panel survey carried out by the Ugandan National Statistics and is part of the World Bank LSMS-ISA project. The Living Standards Measurement Study, LSMS, is a representative household survey with a focus on living standards and inequality. The Integrated Survey on Agriculture, ISA, are survey designed to capture all agricultural and livestock outputs, inputs, and wealth. The UNPS sample is approximately 3,200 households and it is currently the longest panel of the LSMS-ISA project. The first wave started in 2009–10, and its initial sample was visited for two consecutive years: 2009–10 and 2010–11. In the fourth wave, 2013–14, one-third of the initial sample was refreshed, and the fifth wave, 2015–16, uses the sample from 2013–14.

In this work, I use the balanced panel, and hence, all households in the data are observed during the five waves. The balanced panel has a total of 988 households. To study insurance levels separately for urban and rural areas, I construct balanced panels for each of the locations. The rural panel includes the households in the survey that resided in rural areas during all the waves (773 households). Similarly, the urban panel includes the households in the survey that resided in urban areas during all the waves (88 households).[5]

[3] Moll, Townsend, and Zhorin (2017) illustrate that many macroeconomic outcomes in rural and urban Thailand can be attributed to differences in underlying financial frictions—specifically, limited commitment in rural areas and moral hazard in urban areas.

[4] Uganda National Panel Survey, the World Bank.

[5] In the balanced panel, 78% of the households resided in rural areas during all the waves, 9% in urban areas, and 13% of the households moved between rural and urban areas. For the unbalanced panel (used in the robustness section) the number of households is 4081, with the rural panel containing 2903 households and the urban panel 771 households.

Performing consumption insurance tests requires precise measures of household income and consumption across different periods. Moreover, If we are interested in how these consumption insurance levels change across the wealth distribution, we also need a precise measure of household wealth. The main strength of the LSMS-ISA data is that it provides nationally representative panel household data from which we can recover the consumption, income, and wealth dynamics.

2.1 Measuring Consumption

The UNPS has a detailed section on household consumption divided into 3 sections: food items (last 7 days), non-food and non-durable goods (last month), and durable goods (last year). For each item, households are asked for the value of consumption from purchases, from home production, and received in-kind or free. The consumption value from each item is the sum from the three sources. Then, I define household aggregate consumption as the sum of consumption value for all food items and non-durable items. For each wave, I trim total household consumption at the bottom and top one percent to avoid the presence of outliers.

2.2 Measuring Income

Measuring household income in developing countries is difficult, see Deaton (2005). Common to developed countries, self-reported income in surveys tends to have important amounts of measurement error. Yet, in the case of developing countries, a series of extra difficulties arise. Notably, a large fraction of households are self-employed which for them is both conceptually and practically more difficult to report the true value of their income than for salary workers. Moreover, most of these self-employed households are in agriculture where measurement is more difficult——especially when a substantial part of its production is not devoted to the market. Finally, earnings for farmers, as well as non-farming entrepreneurs, and salaried workers are more erratic in developing countries. Seasonality is substantial, while job or business opportunities might arise for a short period of time, it is rarely the case that individuals have a unique permanent job.

One of the main strength of the LSMS-ISA surveys is to offer comprehensive household income information for several countries in Sub-Saharan Africa. Income information is provided from the household questionnaire (LSMS) and the agricultural questionnaire (ISA).

2.2.1 Agricultural Income

The ISA survey section captures agricultural production and inputs with detailed questions on crops and livestock, organized by plot and animal group. From this data, ac-

curately calculating agricultural income involves making estimates, refinements, and modifications, which I will outline next.

Units conversions to kilograms. A first issue is to evaluate all crop production into a single and standard unit. Common in household surveys in the developing countries, households may report quantities in non-standard units ranging from sacks and dishes to pieces. Moreover, unit conversions can vary across crops and seasons——a 100 kg sack of maize won't necessarily weigh the same as a 100 kg sack of bananas, and even within the same crop, conversions may differ significantly between good and bad seasons. An advantage of the UNPS agriculture questionnaire is that it asks households to provide the conversion rate of their reported units to kilograms. Using this information, I calculate the median conversion rate for each unit, crop, and season combination.[6]

The monetary value of unsold production. In developing countries, a large part of agricultural production occurs at the subsistence level, with the production reserved for household consumption. In Uganda, more than 70% of agricultural production is not sold to the market but devoted to own consumption, stored, or gifted to other households.[7] Evaluating this unsold production is crucial for accurately measuring household income, yet assigning a price to it is difficult Deaton (2019). One approach is to use selling prices from the households that did sell, but these prices may not reflect the true opportunity cost of production. Sold items often represent only part of the harvest, with unsold parts like stems, leaves, and roots used as fuel or animal feed. Moreover, selling prices are measured right after harvest, when supply is high and prices are at their lowest. Following the approach in De Magalhães and Santaeulalia-Llopis (2018), I use median consumption prices at the district level to value unsold agricultural production. In the LSMS-ISA survey, households report both the selling and consumption values and quantities. Consumption prices allow us to capture better the shadow value of not selling the crop. Prices, whether at the selling or for consumption, can vary significantly across Uganda. Urban areas generally have higher food prices, and supply and demand differ by location. To account for these differences, I use median crop prices of the district of the household.[8]

[6]For crop-unit combinations with missing or extreme conversions, I use the median conversion rate from other seasons. While for the few cases that conversion rates cannot be computed, I apply direct unit-level conversion rates. For some units a reasonable approximations exist such as 100 kilograms sacks, 10 kilograms basket, etc. If a unit lacks a standard measure and its conversion is missing, I assign a standard value to minimize measurement error. These adjustments have little impact on overall calculations, as the difficulty in determining median rates usually stems from the few reported cases. However, these corrections ensure consistent conversions to kilograms for all crop-unit combinations across all seasons, helping to avoid underestimating or overestimating a household's agricultural production.

[7]See Rodriguez-Sala (2024).

[8]Uganda has 135 districts, though not all are covered in every survey wave. If district-level prices are unavailable, I use regional or national median prices. For crops do not have a consumption price—such as cotton or export crops like coffee, tea, or tobacco—I use selling prices.

Following these steps, the computation of household's agricultural revenue is the sum of the self-reported value of sells plus the unsold production value measured with the adjusted kilograms production times district median consumption prices.[9]

2.2.2 Business, Labor, and Other Earnings

Business earnings. The UNPS asks whether any household member operated any non-agricultural enterprise, shop, trading business, or profession over the past 12 months. In the affirmative case, households are asked for the number of months the enterprise was in operation, and for these months, the average monthly gross revenues, wage expenditure, raw materials expenditure, and other operating expenses—fuel, kerosene, electricity. With this information, each enterprise's profits are computed by monthly gross revenues minus costs times the number of months the business was in operation. Total household business income is the sum across all businesses operated by household members.

Labor earnings. In terms of formal and informal labor,for all household members five years old and above, the questionnaire asks for the labor supply and remuneration for the main job and a secondary job. Regarding the remuneration, the survey asks for the last cash payment and/or estimated cash value of in-kind payments for both the main and secondary job and the time that such payment covers. From that, I recover a weekly salary and I compute for each job, and each individual, the yearly labor income by multiplying the weekly salaries by the number of weeks and months the individual was reported to work during the last 12 months.[10] Thus, household labor income is the sum across household members of the yearly labor payments for the main job and a second job if existent.

Other Earnings. In the agricultural questionnaire, households are asked for livestock ownership, sales, and buys, its outputs, inputs, and expenditure. The computation of livestock profits is given by the sum of net sales of animals, sells of meat, milk, and eggs, the value of unsold production, minus the costs: hired labor, feeding, access to water sources, vaccinations, deworming, insects treatment, curative treatment. The value of unsold production is estimated by the consumption value of livestock products coming from own production reported in the consumption section of the household questionnaire. Finally, the household questionnaire also asks for other sources of income which consists of property income, investments, transfers, and other benefits.[11]

[9]For the waves 2013–14 and 2015–16 the self-reported sales values are unusually low indicating a measurement problem. To correct for that, instead of using each farmer's reported sell values, I compute their sell values by multiplying its kilogram sold production times the selling median district prices.

[10]To compute such averages, I assume that workers that reported payments in months worked four weeks in a month, those that reported in days worked 6 days a week, and those that reported in hours worked 60 hours per week. The last two numbers are based on the work of Tijdens (2012).

[11]Property income consists of net actual rents and royalties from buildings and land. Investments consist of interests received from bank accounts, shares, dividends, bonds, and treasury bills. Current

I trim household business profits, salary labor income, livestock, and other sources of income at 2.5% both tails because I found there tended to be more extreme values and the computation of such income sources entailed more assumptions. To be consistent with the model, I compute household total income as the sum of agricultural revenues, business profits, labor payments, livestock profits, other sources of income.

2.3 Measuring Wealth

Wealth is recovered both from the agriculture questionnaire and the household questionnaire. In the household questionnaire, interviewees are asked for the amount and estimated value of their household assets.[12] From the agriculture questionnaire, households are asked for the amount and the estimated value of farm infrastructure, machinery, and livestock. In terms of land, plot size is also asked for in all waves but the the value of plots is only asked in the first two waves—2009-10 and 2010-11.

Land valuation. In many regions of Africa, land markets might be missing or incomplete, see Gottlieb and Grobovšek (2019) or Chen, Restuccia, and Santaeulalia-Llopis (2023). Ownership of land is complex with an important role of traditional institutions, governments, and other non-market frictions. Under these circumstances, it might be difficult for households to have a good estimate of the market value of their land. Despite that, from the first two waves, the reported values of the plots do not seem unrealistic. In the survey, households are also asked how much they would get if they were to rent for one year the plot. The ratio of value versus rent seems to be coherent, with most values being between 5 and 75 meaning that a plot is valued from 5 up to 75 years of usage.

To value land for the rest of the waves, I compute per acre median prices of land given its characteristics and location from the second wave—2010–11. To do so, I first trimmed extreme observations on the size of the plot——at one percent——the per-acre price of the plot——at five percent——and the ratio of plot value and one year rent——at five percent. second, I compute median per-acre land prices grouping by counties and plot characteristics. In all waves, households are asked for the characteristics of each plot they hold in each season. They are asked for the location, ownership status, rights usage, and soil and water conditions of the plot. Given this set of categorical variables on plot characteristics, I obtain prices per each possible combination of them.[13]

transfers and other benefits consist of pension and life insurance benefits, remittances, income from the sale of assets (except livestock), and other transfers as inheritance, alimony, scholarships, and other unspecified income. 14housing and other buildings, non-agricultural land, furniture, household appliances, electronic devices, jewelry, vehicles, and other assets.

[12]Housing and other buildings, non-agricultural land, furniture, household appliances, electronic devices, jewelry, vehicles, and other assets.

[13]Uganda is divided in 167 districts, yet not all of them sampled in the UNPS. Distance to the plot: less than 15min, 15-30 min, 30-60 min, 1-2 hours, over 2 hours; tenure system: freehold, leasehold, Mailo (owned in perpetuity), customary; usage: own cultivated annual crops, own cultivated perennial

With this set of land prices computed with the 2010–11 wave, I compute the value of the land of the households for the rest of the waves by multiplying each plot size times its matched price, adjusted by inflation, in terms of the location and characteristics of the plot.[14]

The total wealth of Ugandan households is computed by the sum of the value of their household assets, land, livestock, and farm capital. I trim observations at the top one percent of the wealth.

2.4 Consumption, Income, and Wealth Summary

Table 1 presents per capita consumption, income, and wealth values for Uganda, broken down by the entire country (columns 2 to 4), rural areas (columns 5 to 7), and urban areas (columns 8 to 10). The Gini index, indicating inequality, is shown in parentheses. The table reports statistics for each survey wave, along with the average across waves.[15]

Uganda is one of the poorest economies in the world with the majority of households living on extremely low levels of consumption and income. Across all survey waves, average per capita consumption is $327, and income is $341, placing most households below the poverty line.[16] The disparity between rural and urban households is stark: average per capita consumption in rural areas is $279, while in urban areas it is 84% higher at $515. Income differences follow a similar pattern, with urban households earning significantly more. Although the average per capita wealth in Uganda is $721, the urban-rural wealth gap is smaller (urban households hold 23% more wealth) due to the high value of farming land in rural areas.

Not only are there substantial differences between rural and urban households, but inequality within these areas is also pronounced. The national Gini index for income averages 0.61, and even rural areas, despite being poorer, show high inequality with a Gini index of 0.59. However, the transmission of income inequality into consumption and wealth inequality is lower in rural areas, with Gini indices of 0.36 for consumption and 0.59 for wealth. In urban areas, this transmission is stronger, with a consumption

crops, sub-contracted out, fallow, grazing, woodlot; land quality: good, fair, poor; water source: irrigated, rainfed, swamp/wetland; and topography: hill, plain, slope, valley. When a price for a category–combination does not exist, I use median prices computed at coarser levels: I first fill in with median prices computed at county-quality-usage level, then at county-quality level, county level, district level, and, finally, with the national median per acre price.

[14] To be more consistent across waves, for the 2009–10 and 2010–11 waves, instead of using the reported value of the plots, I follow the same procedure and use the matched prices to estimate land value. Using the 2010–11 computed prices, the estimated land value for the 2009–10 wave correlates 0.51 with the household reported land values, and it has a very similar distribution in terms of mean, variance, and percentiles.

[15] The data is at the household level. Per capita values are calculated by dividing household totals by the number of household members.

[16] Figures are not adjusted for purchasing power parity (PPP).

Gini of 0.40 and a wealth Gini of 0.68. These findings align with those of De Magalhães and Santaeulalia-Llopis (2018).

Lastly, Uganda experienced significant economic growth during the survey period. While consumption and income dipped in 2010-11 and 2011-12, they rebounded in 2013-14 and 2015-16, with per capita consumption rising by 20% between 2009-10 and 2015-16.

Table 1: Per Capita Household Consumption, Income, and Wealth in Uganda

	National			Rural			Urban		
	Cons ($) ([0,1])	Income ($) ([0,1])	Wealth ($) ([0,1])	Cons ($) ([0,1])	Income ($) ([0,1])	Wealth ($) ([0,1])	Cons ($) ([0,1])	Income ($) ([0,1])	Wealth ($) ([0,1])
2009-10	319	300	706	263	258	671	523	454	832
	(0.4)	(0.61)	(0.64)	(0.36)	(0.6)	(0.61)	(0.4)	(0.59)	(0.72)
2010-11	275	255	600	235	224	576	447	387	704
	(0.41)	(0.6)	(0.61)	(0.37)	(0.59)	(0.6)	(0.41)	(0.58)	(0.66)
2011-12	290	276	697	258	251	644	430	384	928
	(0.41)	(0.59)	(0.64)	(0.38)	(0.59)	(0.61)	(0.4)	(0.58)	(0.7)
2013-14	372	383	818	319	322	784	567	605	942
	(0.37)	(0.6)	(0.6)	(0.33)	(0.59)	(0.58)	(0.38)	(0.58)	(0.67)
2015-16	382	491	783	322	401	767	608	828	839
(0.39)	(0.64)	(0.6)	(0.34)	(0.6)	(0.57)	(0.43)	(0.65)	(0.67)	
Average	327	341	721	279	291	689	515	532	849
	(0.4)	(0.61)	(0.62)	(0.36)	(0.59)	(0.59)	(0.4)	(0.6)	(0.68)

Notes: Household average (in 2013$) and Gini index within parenthesis. the measurement of consumption, income in the text. Wealth represents total household wealth including farm capital and land value. *Source:* UNPS: 09/10–15/16.

Table 2 presents the composition of consumption, income, and wealth for Ugandan households, while Table 3 (Appendix) breaks this down by rural and urban areas. Each wave reports household's average and the percentage of households in consumption categories (food and non-food items), income sources (agriculture, business, livestock, and labor), and wealth components (household assets, land, livestock, and farm capital).

Food dominates consumption, accounting for 63% of total expenditure—67% in rural areas and 59% in urban. Agriculture remains the primary income source, with 84% of households engaged in crop production. The lowest average agricultural earnings were $748 (2010-11), rising to $1,003 in 2015-16. Livestock income, earned by 20% of households, averaged $276 annually.

Table 2: Composition Consumption, Income, and Wealth: Rural Uganda

Wave	Consumption		Income				Wealth			
	Food	Nofood	Agric	business	Lvstk	Labor	Assets	Land	Lvstk	farmK
	($)	($)	($)	($)	($)	($)	($)	($)	($)	($)
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
2009-10	1025	714	824	795	285	964	1806	3104	910	-
	100%	94%	84%	49%	20%	46%	99%	68%	21%	-
2010-11	1073	607	748	905	245	1049	1881	2925	995	25
	100%	100%	83%	47%	22%	42%	100%	68%	22%	84%
2010-11	1181	612	989	1078	349	1024	2086	3648	1416	21
	100%	100%	81%	43%	20%	35%	99%	73%	21%	81%
2013-14	1095	606	870	1199	234	1052	1944	2550	895	19
	100%	100%	84%	44%	23%	35%	100%	75%	24%	86%
2015-16	1033	584	1003	1053	271	1855	1689	2326	908	17
	100%	100%	84%	46%	23%	35%	100%	77%	24%	88%

Notes: For each wave and category, table presents the household average ($) and proportion of households (%). *Food*, value of bought and non-bought food items; *Nofood* consists of non-food and non-durable goods. Income: *Agric*, agricultural revenues with sold and non-sold production; *Business*, profits from non-agricultural enterprises; *lvstk*, net income from livestock; salary earnings (formal and informal). Wealth: *Assets*, value of household assets; *Land*, estimated farming land; *lvstk*, owned livestock; *FarmK,* farming capital. *Source:* UNPS: 09/10–15/16.

Despite agriculture's prominence, income is diversified: 45.8% of households earn from non-agricultural businesses, and 38.6% from wage labor. In rural areas, over 90% of households report agricultural earnings (averaging $917.2), but non-agricultural businesses (42.8%, averaging $804.5) and wage labor (34.6%, averaging $928.6) also contribute significantly. Urban households rely mainly on business income (58.8%, averaging $1,570.8) and wage labor (45%, averaging $1,512), but a substantial share (48.6%) also engage in agriculture. Overall, both urban and rural households exhibit high income diversification, with most earning from two or more sources.

Wealth is primarily concentrated in household assets (averaging $1,881.2 across 100% of households) and land (averaging $2,910.6 for 72.2% of households). While 84.75% of households own farm capital, its average value is low, at $20.5. In rural areas, land (owned by over 80% of households) and household assets dominate wealth, with average land values of $2,988.4 and housing assets of $1,392.4. In contrast, urban households hold more wealth in household assets, averaging $3,799.8.

3 Consumption Insurance Tests

In the standard full-insurance framework, if markets are complete and there are no preference or demographic shocks, household consumption should depend solely on the average consumption in the economy. Under this condition, household consumption reacts to aggregate risk but remains unaffected by idiosyncratic risk (Altug and Miller 1990, Cochrane 1991, Mace 1991, Deaton et al. 1992, and, Townsend 1994).

To understand the relationship between insurance and economic progress, I conduct full-insurance tests across quintiles of the consumption, income, and wealth distributions. For each quintile, I estimate regressions where household consumption variation serves as the dependent variable and household–idiosyncratic income variation is the key explanatory variable. The analysis controls for aggregate shocks and household fixed effects, following the approach of Townsend (1994) and others.

I perform the tests in three groups of population: the entire population, rural population, and urban population. Much of the literature on insurance in developing countries evaluates insurance at the village level. In this context, full-insurance implies household consumption moves in tandem with the village average and is independent of household-specific shocks. However, villages and cities in developing countries are not isolated; they are part of broader regional and national economies.

Using the UNPS data, which is representative of Uganda's four main administrative regions——Northern, Western, Eastern, and Central——I conduct insurance tests at the regional level. This allows for a more comprehensive evaluation of households' ability to smooth consumption against income fluctuations, whether these fluctuations occur at the household or village level. If full insurance holds, household consumption

should respond only to regional aggregate shocks, not to idiosyncratic ones.[17]

Finally, I perform a set of insurance tests for two econometric specifications. The first assumes households have constant relatively risk aversion (CRRA) utility while the second follows the standard approach commonly used in recent literature. In both specifications, I control for household fixed effects. As a result, the coefficient on the explanatory variable—measuring idiosyncratic income fluctuations—excludes changes stemming from permanent household characteristics, such as preferences or other fixed traits.

Insurance tests: CRRA specification. Assuming households have homogeneous preferences and a CRRA utility function, full insurance implies that the growth rate of household consumption should only respond to the growth rate of regional average consumption. The derivation of this result is detailed in Appendix (A). Thus, to test consumption insurance in each quintile group Q_j where $j \in \{1,2,3,4,5\}$ of the consumption, income, and wealth distributions I examine whether $\beta_j = 0$ in the following regression

$$\Delta lnc_{itr} = \alpha \Delta C_{tr} + \beta_j \Delta lny_{itr} + F_i + e_{itr} \qquad \forall i \in Q_j, \quad j = 1, ..., 5. \tag{1}$$

Here, $\Delta C_{t,r}$ is the growth rate in average consumption from wave $t-1$ to wave t in region $r \in \{Northern, Western, Eastern, Central\}$. Δlnc_{itr} and Δlny_{itr} represent the growth rates in consumption and income for household i, with i belonging to quintile Q_j. F_i captures household fixed effects, and e_{itr} is the error term.

Insurance tests: standard specification. Most of the recent literature uses a slightly simplified version of the insurance test in (Cochrane 1991,Mace 1991,Townsend 1994) by test insurance not in growth rates but in log levels. That is it tests whether $\beta = 0$ in the following equation

$$lnc_{it} = \alpha C_{tr} + \beta lny_{it} + e_{it}. \tag{2}$$

Following this approach, I test for consumption insurance in each quintile group Q_j of the consumption, income, and wealth distribution by testing $\beta_j = 0$ in the regression

$$logc_{itr} = \alpha C_{tr} + \beta_j lny_{itr} + F_i + e_{itr} \qquad \forall i \in Q_j, \quad j = 1, ..., 5 \tag{3}$$

in which the variables have the same definition as in the CRRA case except that now the observations are not first-differences across waves. The results of estimating equations (1) and (3) across quintiles of the distributions and regions are presented in the following section.

[17] Measuring insurance at the regional level can offer a more accurate picture of households' capacity to buffer consumption against shocks. Households in the same village may face common shocks—such as climate events, pest infestations, or price fluctuations—which can obscure the true extent of consumption smoothing.

4 RESULTS

Figure 1 displays the estimates of β_j from equation (1) for the CRRA case, broken down by quintile groups (j)——ranging from the bottom quintile (Q1) to the top quintile (Q5)—across the three distributions: consumption (Figure 1 a), income (Figure 1 b), and wealth (Figure 1 c). The results are presented for the entire country (column 1), rural areas (column 2), and urban areas (column 3). In each figure, squared dots indicate the point estimates of β_j, while the vertical lines represent the 95% confidence intervals, calculated using clustered standard errors at the household level. N_Q denotes the minimum number of observations within each quintile group.

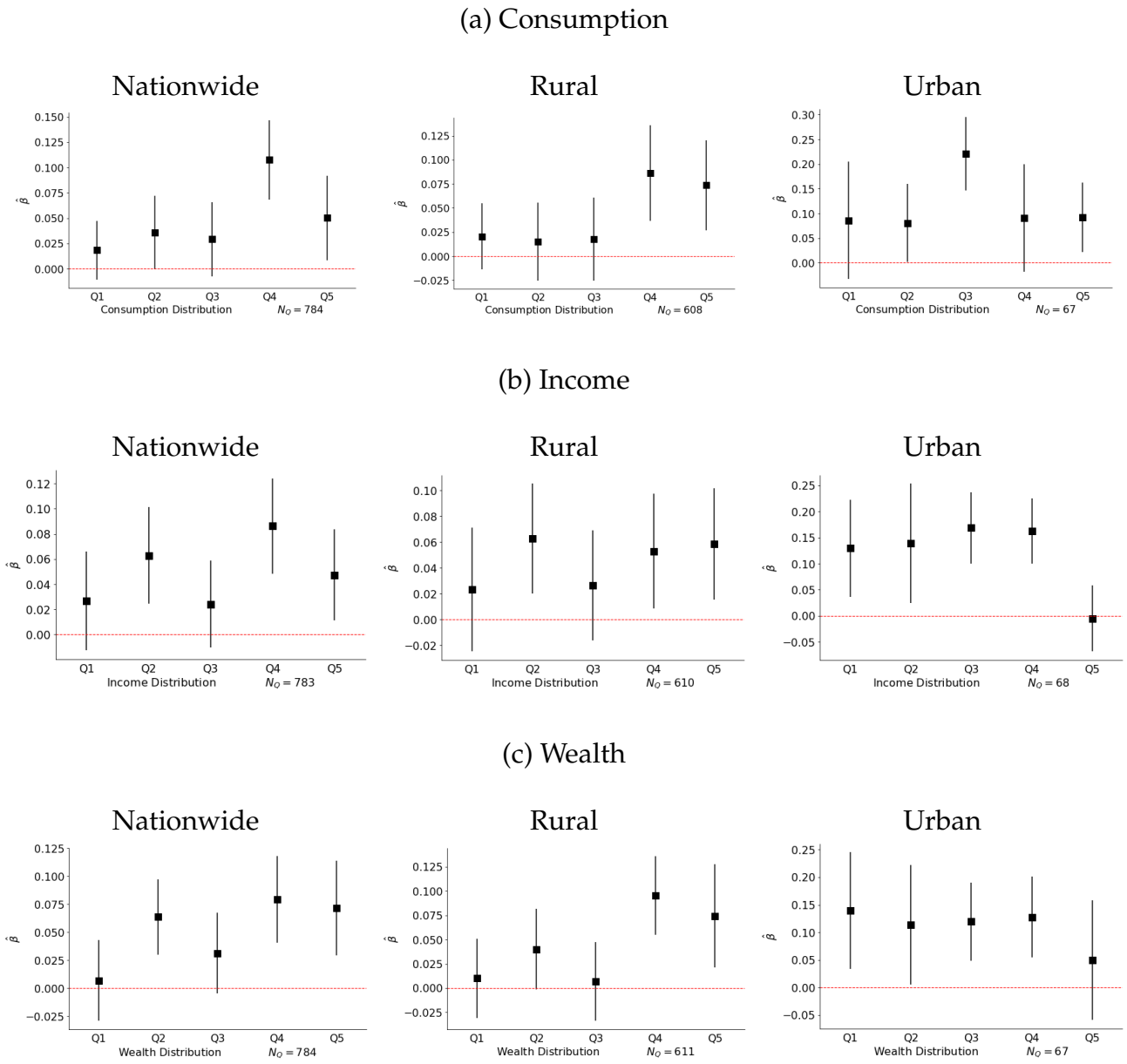
At the national level (Figure 1, column 1), a broad trend emerges: poor households tend to exhibit higher levels of insurance than rich ones. Specifically, the insurance coefficient for the bottom quintile (Q1) is 0.018, which is not statistically different from zero. The coefficients for the second and third quintiles (Q2 and Q3) are similarly low—0.035 and 0.029, respectively—with the third quintile also not statistically distinguishable from zero. In contrast, households in the fourth quintile (Q4) have an insurance coefficient of 0.107, which is more than three times higher than that of the bottom Q1 and significantly different from zero. The top quintile's coefficient is 0.050, also higher than those in the lower quintiles.

Across the income distribution, there is no clear upward or downward trend, with coefficients fluctuating between 0.024 and 0.086. However, the wealth distribution reveals a clear upward trend in insurance coefficients, similar to the consumption distribution. While household's in the bottom quintile shows an estimate of 0.006, indicating full insurance cannot be rejected, households in the top quintiles display much higher coefficients (0.079 in Q4 and 0.071 in Q5), leading to the rejection of full insurance for wealthier groups.

Interestingly, the patterns in rural and urban areas diverge. In rural areas (Figure 1, column 2), the negative relationship between economic status and insurance (with coefficients closer to zero indicating better insurance) is even stronger than the national trend. For the bottom and middle quintiles (Q1, Q2, and Q3), full insurance cannot be rejected, with coefficients near zero (0.02, 0.01, and 0.017, respectively). However, households in the top two quintiles (Q4 and Q5) have significantly higher coefficients (0.086 and 0.073), indicating a higher transmission of idionsyncratic income shocks into consumption. Again the insurance coefficients across the income distribution in rural areas shows no clear pattern, but wealth distribution follows a similar trend to consumption. Poorer households exhibiting lower transmission of idiosyncratic shocks into consumption. Coefficient estimates for the first quintiles (Q1, Q2, and Q3) are 0.010, 0.040, and 0.006, respectively, while Q4 and Q5 have much higher coefficients (0.095 and 0.07).

In urban areas (Figure 1, column 3), richer households generally show higher insurance levels, though this trend is less pronounced and limited by the low number

Figure 1: Consumption Insurance Coefficients across the Consumption, Income and Wealth Distributions, CRRA Specification



Notes: OLS estimates of β_j in $\Delta lnc_{itr} = +\alpha\Delta C_{tr} + \beta_j \Delta lny_{itr} + F_i + e_{itr}$ for each quintile group j—x-axis—of the consumption (a), income (b), and wealth (c) distributions. c_{itr} and y_{itr} denote consumption and income of household i in region r at period t, C_{tr} denotes average region-consumption and F_i denotes household fixed effects. N_Q denotes the minimum number of observations in each quintile. Red dotted-line marks full insurance. Standard errors clustered at the household level. *Source:* UNPS: 09/10–15/16, balanced panel.

of observations in urban areas.[18] For the consumption distribution, the relationship

[18]With the balanced urban panel, the number of observations is 88 households. For the unbalanced panel (see Figure 5 in the Appendix) the number of urban households observed in at least 2 waves is

is somewhat flat or even hump-shaped, with the Q3 showing the highest coefficient. In contrast, both the income and wealth distributions reveal a positive trend between economic status and insurance, with higher economic levels corresponding to lower coefficient's estimates. For the income distribution, coefficient's estimates for the quintiles from Q1 to Q4 range between 0.129 and 0.168, while the top quintile (Q5) has a much lower coefficient (-0.004), suggesting full insurance cannot be rejected. Similarly, in the wealth distribution, households in Q5 have a coefficient of 0.049, while for the quintiles Q1 to Q4 have higher values. Consistent with previous research (e.g., Munshi and Rosenzweig 2016, Santaeulalia-Llopis and Zheng 2018, De Magalhães and Santaeulalia-Llopis 2018, Meghir et al. 2022), urban households overall have lower levels of consumption insurance compared to their rural counterparts.

Figure 2 shows the estimates of β_j from equation (3) for the standard case, across quintile groups j in the consumption (Figure 2a), income (Figure 2b), and wealth (Figure 2c) distributions. The estimates are provided for the entire country (column 1), rural areas (column 2), and urban areas (column 3). Testing consumption insurance across quintile groups using the standard specification from the literature reveals similar broad trends as in the CRRA utility specification. In Uganda, households with higher levels of consumption and wealth tend to have lower levels of insurance, especially in rural areas. Conversely, in urban areas, households with higher income and wealth exhibit better insurance coverage.

While the overall trends remain consistent across both econometric specifications, the magnitude of the coefficients differs. Under the standard specification, the coefficients are notably larger—indicating less insurance—compared to the CRRA case. As a result, there are fewer quintile groups for which full insurance cannot be rejected. In rural areas (Figure 2, column 2), full insurance cannot be rejected for households in the bottom quintile of the consumption, income, and wealth distributions, with coefficient estimates ranging between 0.020 and 0.039. In contrast, households in the top quintiles (Q4 and Q5) exhibit much higher coefficients: 0.091 and 0.055 in the consumption distribution, 0.091 and 0.047 in the income distribution, and 0.082 and 0.066 in the wealth distribution.

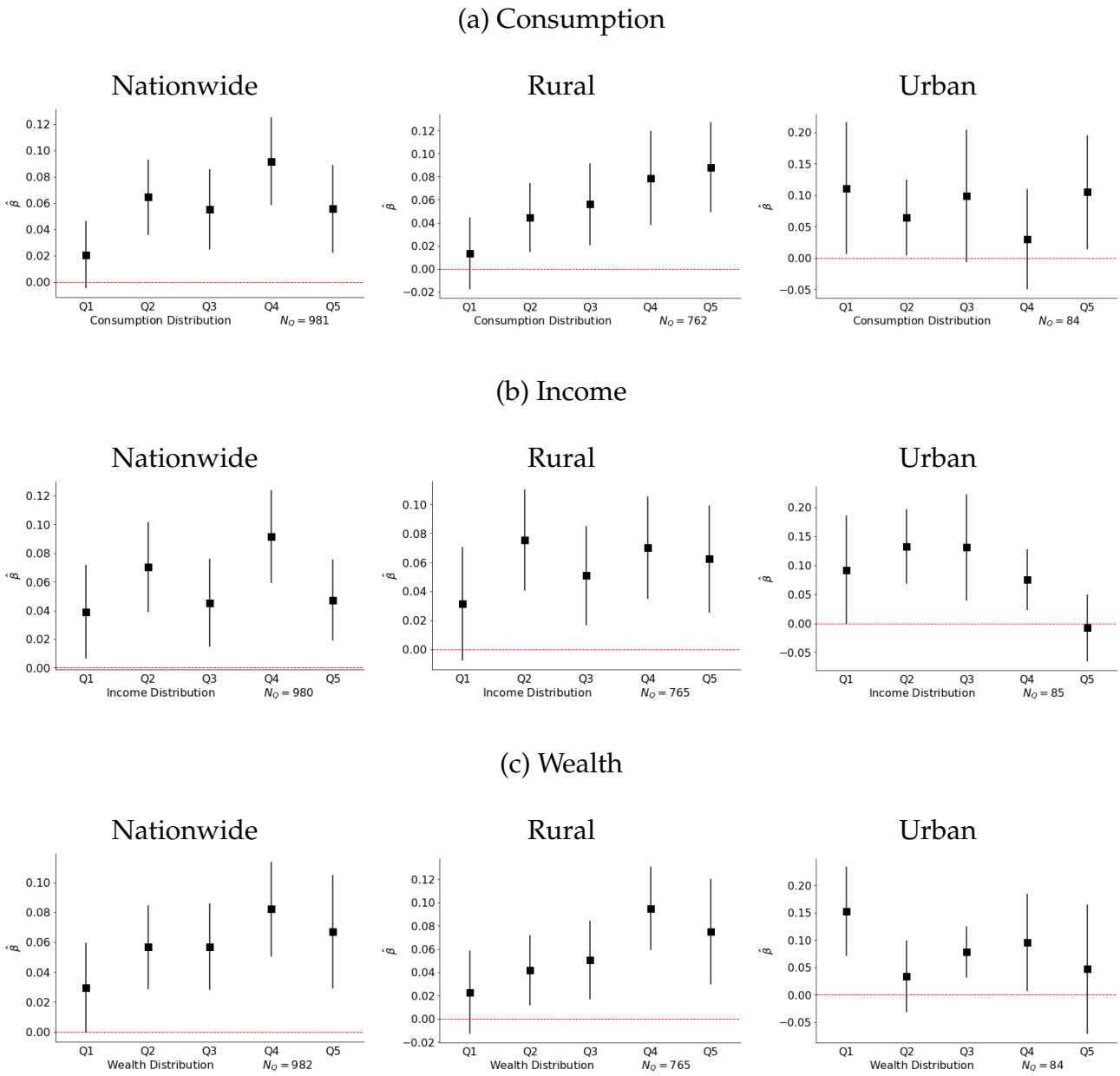
In urban areas (Figure 2, column 3), the smaller sample size results in wider confidence intervals, making it more difficult to reject full insurance for several quintile groups, despite larger coefficient estimates. Notably, for households in the top income quintile (Q5), the coefficient is -0.008, suggesting full insurance, while for wealth, the coefficient is 0.046, and full insurance cannot be rejected.

Across both specifications, we observe a national trend where poorer households exhibit better insurance coverage in the consumption and wealth distributions, driven largely by rural areas where the majority of Ugandans reside. In urban areas, the relationship between insurance and economic levels is less clear, but there is a general

623. Note that with the much larger number of observations, the results are very similar, with a broad trend of higher insurance levels for richer households.

trend—particularly in the income and wealth distributions—indicating higher insurance levels for wealthier households. In the next section, I examine the robustness of these empirical results.

Figure 2: Consumption Insurance Coefficients across the Consumption, Income and Wealth Distributions, Standard Specification



Notes: OLS estimates of β_j in regression equation $lnc_{itr} = +\alpha C_{tr} + \beta_j lny_{itr} + F_i + e_{itr}$ for each quintile group j—x-axis—of the consumption (a), income (b), and wealth (c) distributions. c_{itr} and y_{itr} denote consumption and income of household i in region r at period t, C_{tr} denotes average region-consumption and F_i denotes household fixed effects. N_Q denotes the minimum number of observations in each quintile. Red dotted-line marks full insurance. Standard errors clustered at the household level. *Source:* UNPS: 09/10–15/16, balanced panel.

5 ROBUSTNESS

In this section, I present several regressions to assess the robustness of the results. All figures are located in the appendix. Most of the broad trends between insurance and economic levels observed in Section 4 remain consistent when we exclude fixed effects, use the unbalanced panel with more household observations, or focus on food consumption (instead of total consumption, which includes food and non-durable items). The main deviation occurs when using the unbalanced panel, where the previously noted negative relationship between insurance and wealth levels is no longer observed.

Regressions without Fixed Effects. To assess whether the previous results are primarily driven by permanent household characteristics that vary across distributions, I re-estimate the insurance tests under both the CRRA and standard specifications, but this time without controlling for fixed effects. Specifically, I test for $\beta_j = 0$ $j = 1, ..., 5$ in equations (1) and (3) without including household fixed effects (F_i). Figure 3 and Figure 4 display the coefficient estimates across quintiles of consumption, income, and wealth for each specification, respectively.

Somewhat surprisingly, omitting household fixed effects has minimal impact on the coefficient estimates in the CRRA specification. Figure 3 produces nearly identical plots to Figure 1. The trends in insurance coefficients across quintiles——both nationwide and within rural and urban areas——remain largely unchanged, as do the levels of the estimates and their confidence intervals.

A similar pattern emerges in the standard specification. The coefficient estimates and confidence intervals for each quintile of consumption, income, and wealth, across Uganda as a whole and within rural and urban regions, are nearly identical with or without fixed effects, with two notable exceptions. First, when household fixed effects are excluded, the negative relationship between higher consumption and lower insurance becomes more pronounced across the national consumption distribution (Figure 1a, first row). Second, the relationship between wealth and insurance flattens out, particularly at the national level and in rural areas. Overall, the inclusion or exclusion of fixed effects has little effect on the estimated insurance coefficients.

Unbalanced panel. In the previous regressions, I used a balanced panel consisting of households observed in all five waves of the UNPS. While this approach provides a longer time series (five periods) to compute changes in income and consumption, it restricts the sample to just 988 households, of which only 88 are from urban areas. This limitation not only affects the precision of the estimates but also reduces the representativeness of the consumption, income, and wealth distributions.

To address concerns about previous results being driven by small samples, I extend the analysis to an unbalanced panel. The unbalanced panel includes 4,081 households nationwide, with 2,903 from rural areas and 771 from urban areas. Of these, 3,700 households are observed in more than one wave (the minimum required for the CRRA

specification), comprising 2,670 rural households and 623 urban households.[19]

Figure 3 (CRRA specification) and 4 (standard specification) display the coefficient estimates across quintiles of consumption, income, and wealth for nationwide, rural and urban Uganda using the unbalanced panel.

Despite the significant change in sample size and composition, the main trends observed with the balanced panel persist in the unbalanced panel. Under the CRRA specification, the negative relationship between insurance and the quintiles of the consumption distribution remains for both nationwide and rural households. For urban households, the relationship remains flat, though there is no spike in the third quintile, and a new trend emerges of lower coefficients (indicating higher insurance) for higher quintiles. Across the income distribution, there continues to be no clear trend in insurance levels for nationwide and rural households, while for urban households, a positive relationship is evident, with coefficients decreasing from 0.129 and 0.133 for bottom quintiles Q1 and Q2, respectively, to 0.053 for the top quintile (Q5). The largest divergence between the balanced and unbalanced panels is found in the wealth distribution. While the balanced panel shows a negative relationship between wealth and insurance, the unbalanced panel reveals a flat relationship across wealth levels for both nationwide and rural households, though the positive relationship between insurance and wealth persists in urban areas.

In the standard specification, the unbalanced panel similarly shows a more pronounced negative relationship between insurance and consumption nationwide. While the coefficient for the bottom quintile is 0.0187, the top quintiles (Q4 and Q5) have coefficients of 0.076 and 0.065, respectively. For rural and urban areas, the trends mirror those seen in the balanced panel. Income continues to exhibit a flat relationship with insurance in both the balanced and unbalanced panels. Again, the primary divergence occurs in the wealth distribution, where the relationship flattens out for both nationwide and rural Uganda in the unbalanced panel.

Food consumption. The broad trends show us that poor households in Uganda insure their consumption more than rich households. A possible explanation for this could be the composition of consumption: richer households spend a larger proportion of their income on non-food goods and services—such as clothing, education, and medical expenses—which may not need to be smoothed year over year. Some non-durable items, like clothing, can last beyond a year, while education and medical expenses may fluctuate based on factors unrelated to income, like the age of children or unexpected health shocks.

Here, I perform insurance tests only for food consumption. If from other items we should not necessarily expect a smoother process for utility maximization, in terms of food consumption, we shouldexpect that if both poor and rich households can fully

[19] As with the balanced panel, rural households are defined as those residing in rural areas for all observed periods (similarly for urban households). Nationwide figures include rural, urban, and households that migrated between regions.

insure, then, their food consumption should not vary across years given idiosyncratic income fluctuations.

Figure 7 and Figure 8 display the insurance coefficients for food consumption across the consumption, income, and wealth distributions under the CRRA and standard specifications, respectively. The key takeaway is that the patterns of food consumption insurance closely mirror those of total consumption insurance. This suggests that the observed relationships between insurance and economic status across regions in section 4 are not driven not driven by differences in non-food consumption between poor and rich households.

Additionally, the results show that insurance for food consumption tends to be higher than for total consumption. On average, the coefficients are smaller, and in particular, we find more evidence of full insurance for food consumption. For instance, under the CRRA specification, full insurance cannot be rejected for the Q1, Q2, Q3, and Q5 of the consumption distribution, the Q1, Q3, and Q5 of the income distribution, and the Q1 and Q3 of the wealth distribution. In the standard specification, full insurance holds for the bottom quintile (Q1) of the consumption distribution, as well as for the bottom quintile of both the income and wealth distributions.

Across the different robustness checks, the estimates of the insurance coefficients and their significance do fluctuate. However, the overall trend remains consistent: higher economic levels are generally associated with lower insurance levels in both rural areas and nationwide. Likewise, the positive relationship between insurance and economic levels in urban areas persists across the various robustness specifications.

6 Conclusion

This paper provides novel empirical evidence of a compromise between insurance and economic levels across households within a developing economy. Studying insurance levels across the cross-sectional distributions of consumption, income, and wealth in Uganda, I find that poor households tend to ensure their consumption more than rich households. This result is driven by rural areas where the negative relationship between insurance and economic levels is highly pronounced. In urban areas, we do not observe such trade-offs, but the broad trend is towards richer households (particularly those in the top of the distribution) being able to insure more of their consumption.

Knowing the existence of such a compromise between insurance and growth is relevant for policymaking. Pro-growth policies may incur a welfare loss in terms of insurance reduction, and consequently, poor households might be reluctant to adopt pro-growth strategies.[20] Policies that improve financial access might alleviate the trade-

[20]The low adoption of products, technologies, or services that supposedly favor growth is a common observation in developing countries, from education choices, fertilizer usage, other agricultural investments, market participation, business practices, and other investments.

off. The empirical results from this paper also bring relevant information to the risk-sharing literature. Recent theoretical and quantitative works have included distinguished financial systems between rural and urban areas, consistent with previous literature and also the results of this work. A similar approach might be necessary for modeling insurance between poor and rich households in developing economies. Standard endogenous or exogenous incomplete markets models would hardly deliver the trade-off documented in this work.

The extent of the findings in this paper are limited to Uganda. Moreover, the inconsistent trend with the income distribution is hardly arguable from the fundamentals of the economy. Performing a similar exercise with other countries and richer datasets would help to extend or contract the general validity of the results presented here.

Data Availability: Uganda Bureau of Statistics. Uganda National Panel Survey (UNPS) 2009–2016. Ref: UGA_2005-2009_UNPS_v02_M, ..., UGA_2015_UNPS_v02_M. Datasets downloaded from the World Bank Microdata Library, UNPS 2009, 2010, 2011, 2013, and 2015 on 31/05/2019. The replication code (Python) is avaialable in this Github repository.

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A Complete Markets Tests Derivation

Under complete markets the Competitive Equilibria is Equivalent to the Pareto Optimal solution. Agents are identical in preferences. The economy has infinite time horizon and in each period a different state of the economy (s_t) is realized. s^t denotes the history of realized states from time 0 to time t. The Social Planner problem is

$$\sum_{i}^{N} \omega_i \sum_{t}^{\infty} \sum_{s^t} \beta^t \pi(s^t) u(c_i(s^t)) \tag{4}$$

the Lagrangian is

$$\mathcal{L}(c_i(s^t)) = \sum_{i}^{N} \omega_i \sum_{t}^{\infty} \sum_{s^t} \beta^t \pi(s^t) u(c_i(s^t)) - \lambda_t \{ \sum_{i}^{N} c_i(s^t) - \sum_{i}^{N} y_i(s^t) \} \tag{5}$$

And the first order conditions are

$$\left[c_i(s^t)\right] : \omega_i \beta_t \pi(s^t) u_{c_i}(c_i(s^t)) = \lambda_t \tag{6}$$

$$\left[c_j(s^t)\right] : \omega_j \beta_t \pi(s^t) u_{c_j}(c_j(s^t)) = \lambda_t \tag{7}$$

$$[\lambda_t] : \sum_{i}^{N} c_i(s^t) = \sum_{i}^{N} y_i(s^t) \tag{8}$$

dividing (6) by (7):

$$\frac{u_{c_i}(c_i(s^t))}{c_j(c_j(s^t))} = \frac{\omega_j}{\omega_i} \tag{9}$$

full risk-sharing implies that the ratio of marginal utilities of consumption across agents remains constant over time and states of the world.
Taking logs on FOCS

$$ln\omega_i + ln\beta^t + ln\pi(s^t) + lnu_{c_i}(c_i(s^t)) = ln\lambda_t \tag{10}$$

aggregating over all individuals

$$\sum_{i}^{n} \{ ln\omega_i + ln\beta^t + ln\pi(s^t) + lnu_{c_i}(c_i(s^t)) \} = Nln\lambda_t \tag{11}$$

$$\overline{ln\omega} + ln\beta + ln\pi(s^t) + \overline{u_{c_i}(c_i(s^t))} = ln\lambda_t \tag{12}$$

equating (6) and (12) we get:

$$lnu_{c_i}(c_i(s^t)) + \overline{lnu_{c_i}(c_i(s^t))} = ln\omega_i - \overline{ln\omega} \tag{13}$$

this is the main equation to perform insurance tests.

Setting Pareto weights equal across agents and assuming a CRRA utility function identical across agents, $u(c_i(s^t)) = \frac{c_i(s^t)^{1-\theta}}{1-\theta}$, then, the marginal utility is $u_{c_i}(c_i(s^t)) = c_i(s^t)^{-\theta}$ and (13) becomes

$$ln(c_i(s^t)^{-\theta}) - N^{-1} \sum_{i}^{N} ln(c_i(s^t)^{-\theta}) = 0 \tag{14}$$

$$ln(c_i(s^t) = \overline{ln(c(s^t)} \tag{15}$$

finally, substrating previous consumption we get:

$$\Delta ln(c_i(s^t) = \Delta\overline{ln(c(s^t)} \tag{16}$$

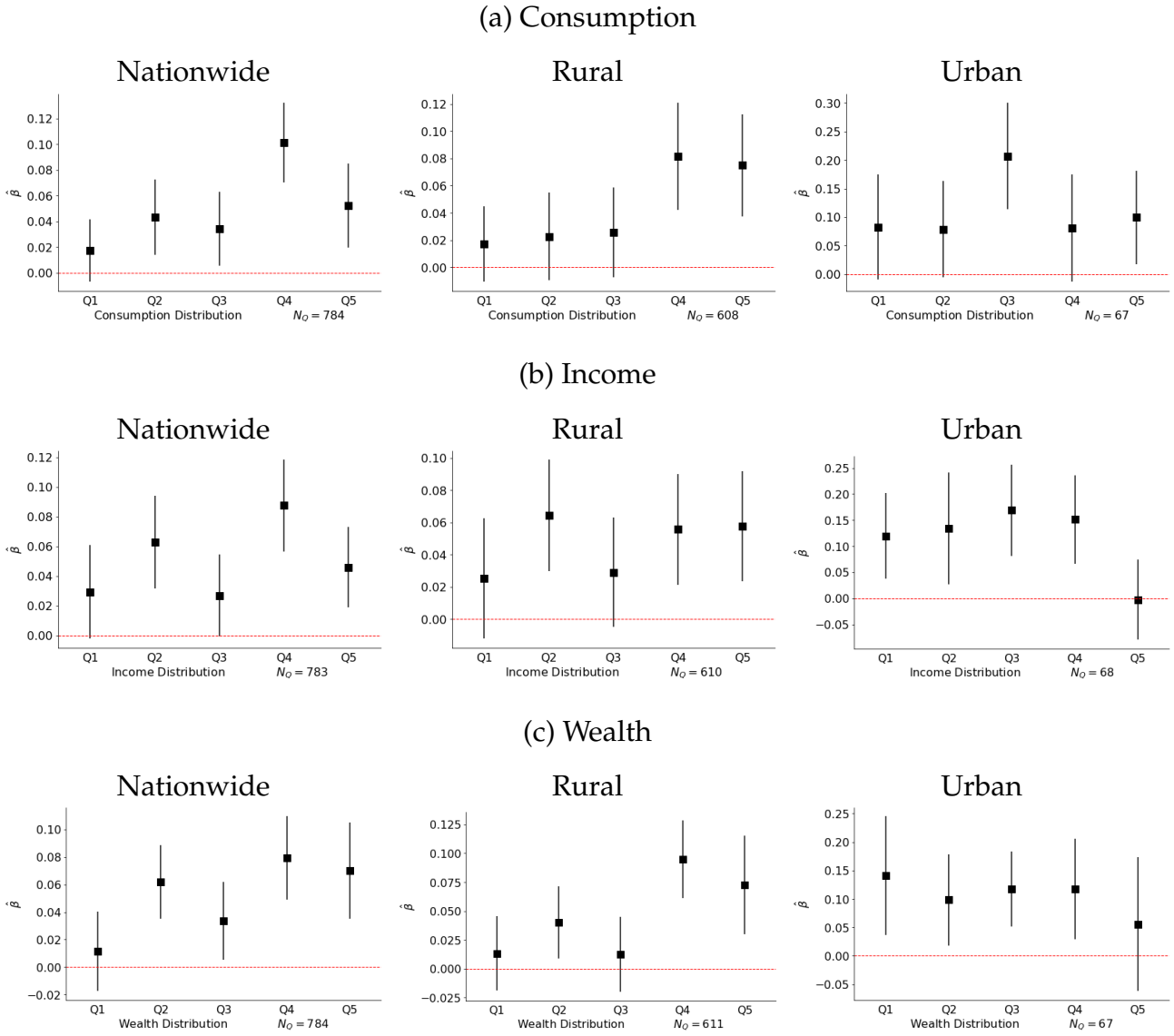
therefore, with the previous equation and using panel data, we can test complete markets test with the following regression equation

$$\Delta ln(c_i(s^t) = \alpha\Delta\overline{ln(c(s^t)} + \beta\Delta lny_i(s^t) \tag{17}$$

in which complete markets implies $\alpha = 1$ and $\beta = 0$.

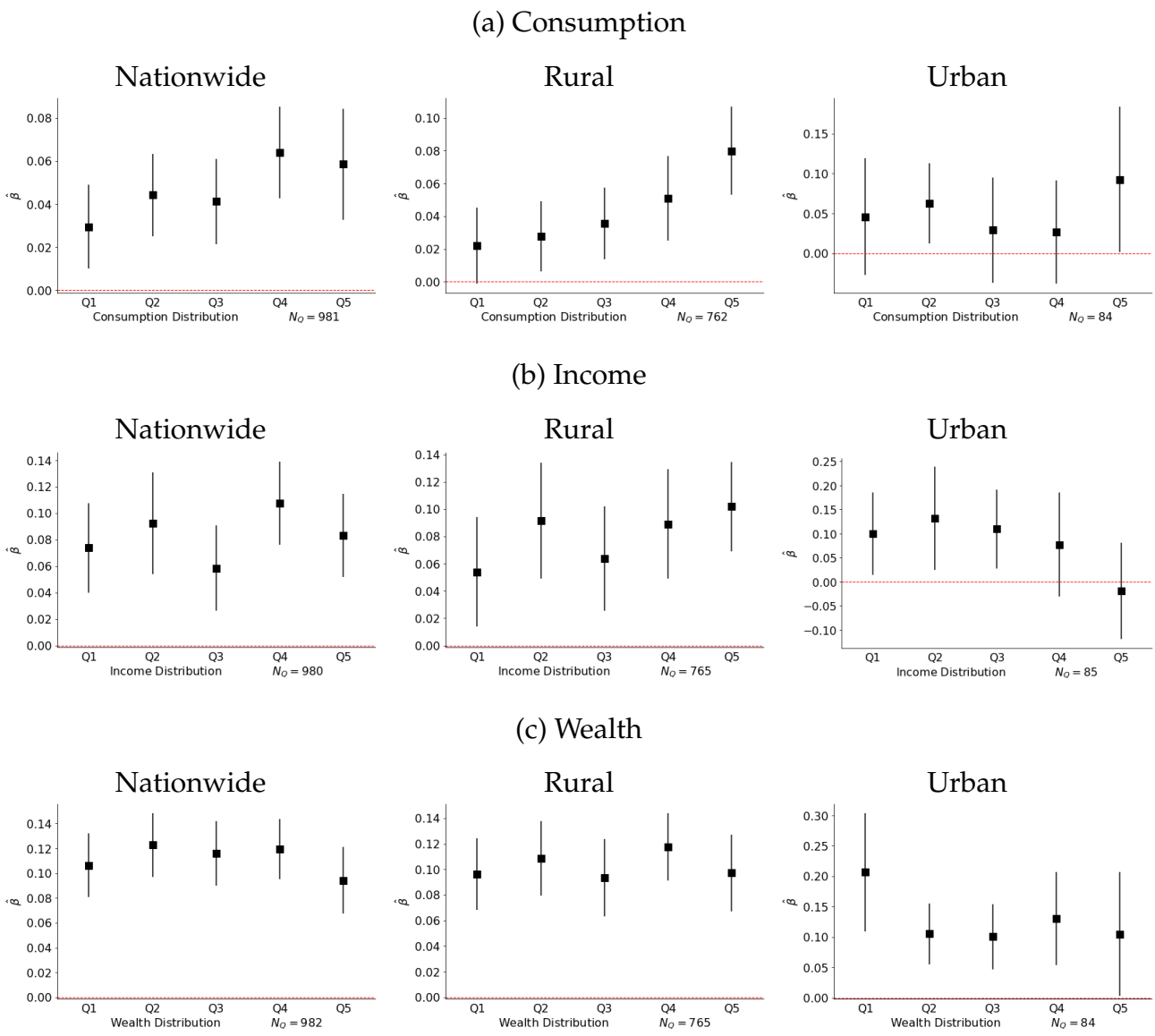
B FIGURES

Figure 3: Robustness Check: Regressions Without Fixed Effects, CRRA Specification



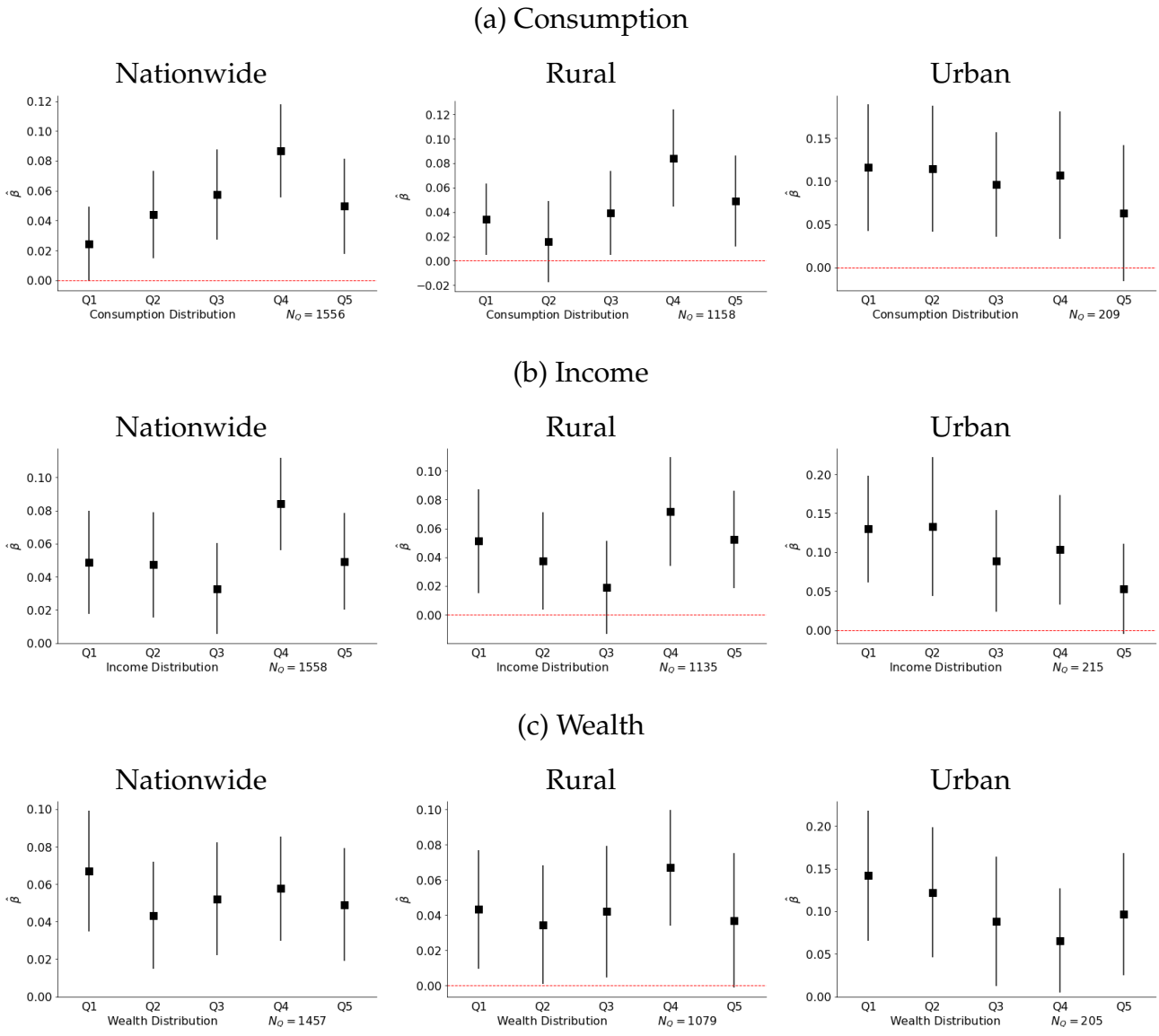
Notes: OLS estimates of β_j in regression equation $\Delta lnc_{itr} = +\alpha\Delta C_{tr} + \beta_j \Delta lny_{itr} + e_{itr}$ for each quintile j group—x-axis—of the consumption (a), income (b), and wealth (c) distributions. c_{itr} and y_{itr} denote consumption and income of household i in region r at period t, and C_{tr} denotes average region-consumption. N_Q denotes the minimum number of observations in each quintile. Red dotted-line marks full insurance. Confidence intervals computed with White's robust standard errors. *Source:* UNPS: 09/10–15/16, balanced panel.

Figure 4: Robustness Check: Regressions Without Fixed Effects, Standard Specification



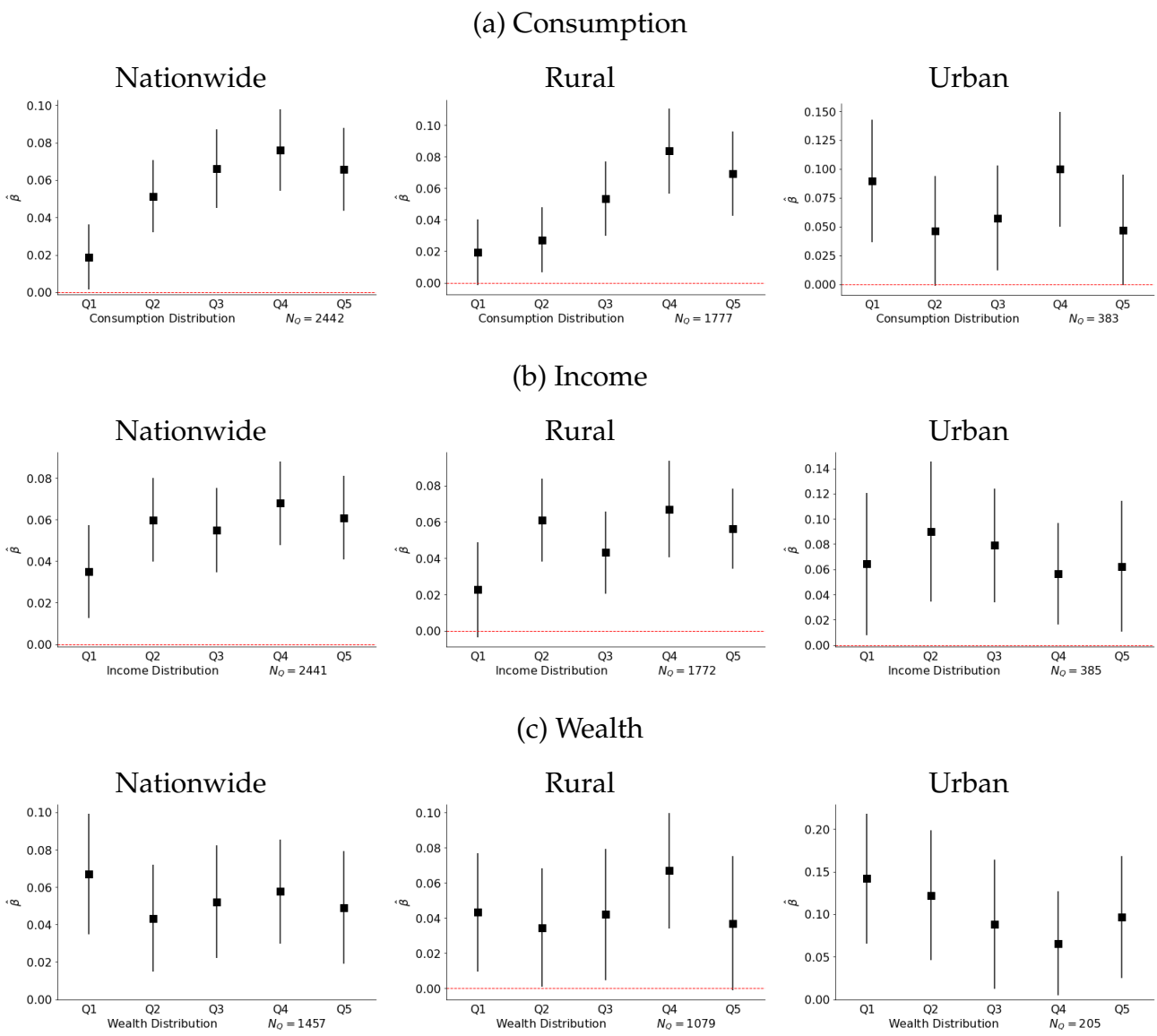
Notes: OLS estimates of β_j in regression equation $lnc_{itr} = +\alpha C_{tr} + \beta_j \Delta lny_{itr} + F_i + e_{itr}$ for each quintile j group—x-axis—of the consumption(a), income (b), and wealth (c) distributions. c_{itr} and y_{itr} denote consumption and income of household i in region r at period t, and C_{tr} denotes average region-consumption. N_Q denotes the minimum number of observations in each quintile. Red dotted-line marks full insurance. Red dotted-line marks full insurance. Confidence intervals computed with White's robust standard errors. *Source:* UNPS: 09/10–15/16, balanced panel.

Figure 5: Robustness Check: Unbalanced Panel, CRRA Specification



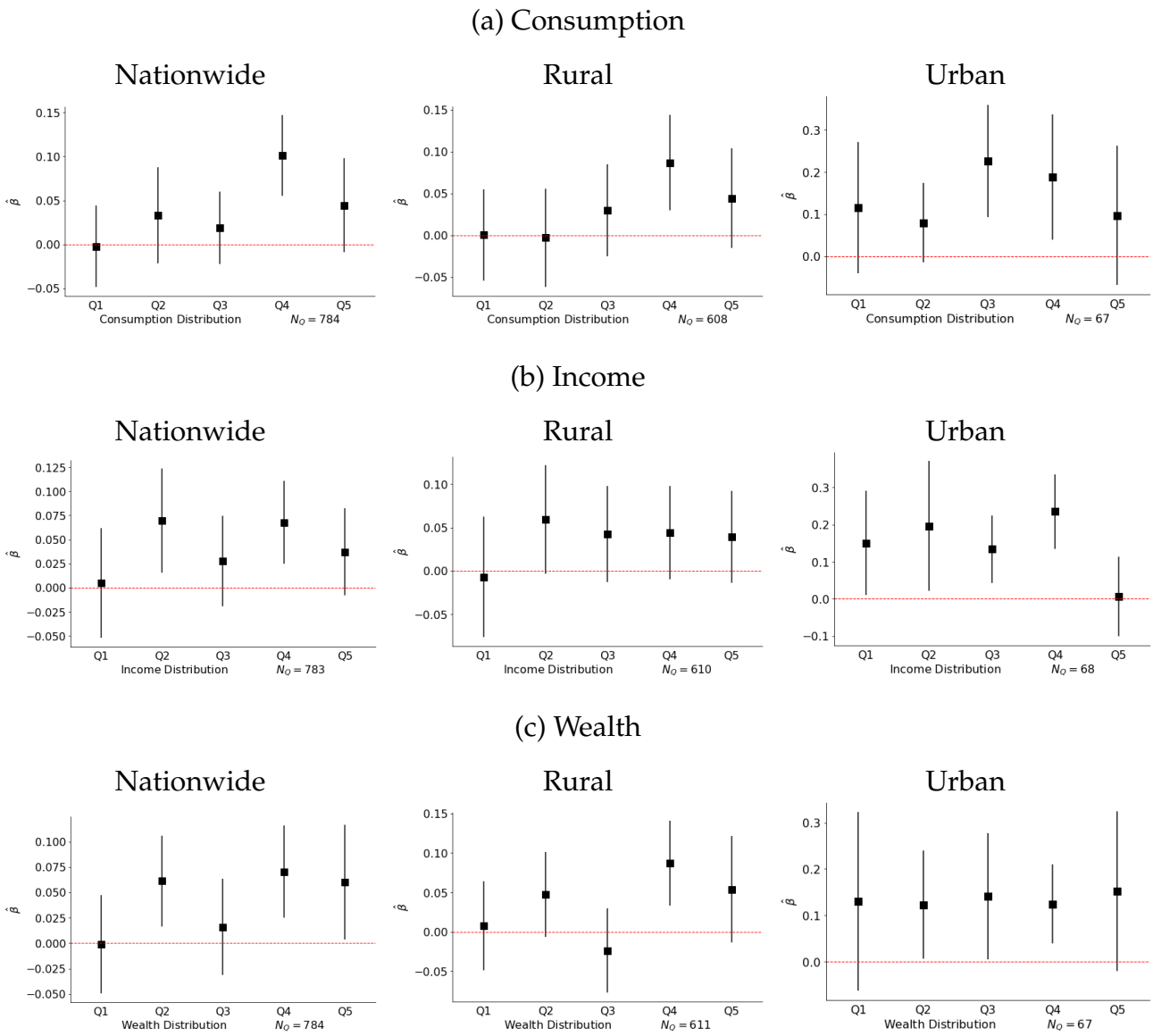
Notes: OLS estimates of β_j in regression equation $\Delta lnc_{itr} = +\alpha\Delta C_{tr} + \beta_j \Delta lny_{itr} + F_i + e_{itr}$ for each quintile j group—x-axis—of the consumption (a), income (b), and wealth (c) distributions. c_{itr} and y_{itr} denote consumption and income of household i in region r at period t, and C_{tr} denotes average region-consumption. N_Q denotes the minimum number of observations in each quintile. Standard errors clustered at the household level. Red dotted-line marks full insurance. *Source:* UNPS: 09/10–15/16, unbalanced panel.

Figure 6: Robustness Check: Unbalanced Panel, Standard Specification



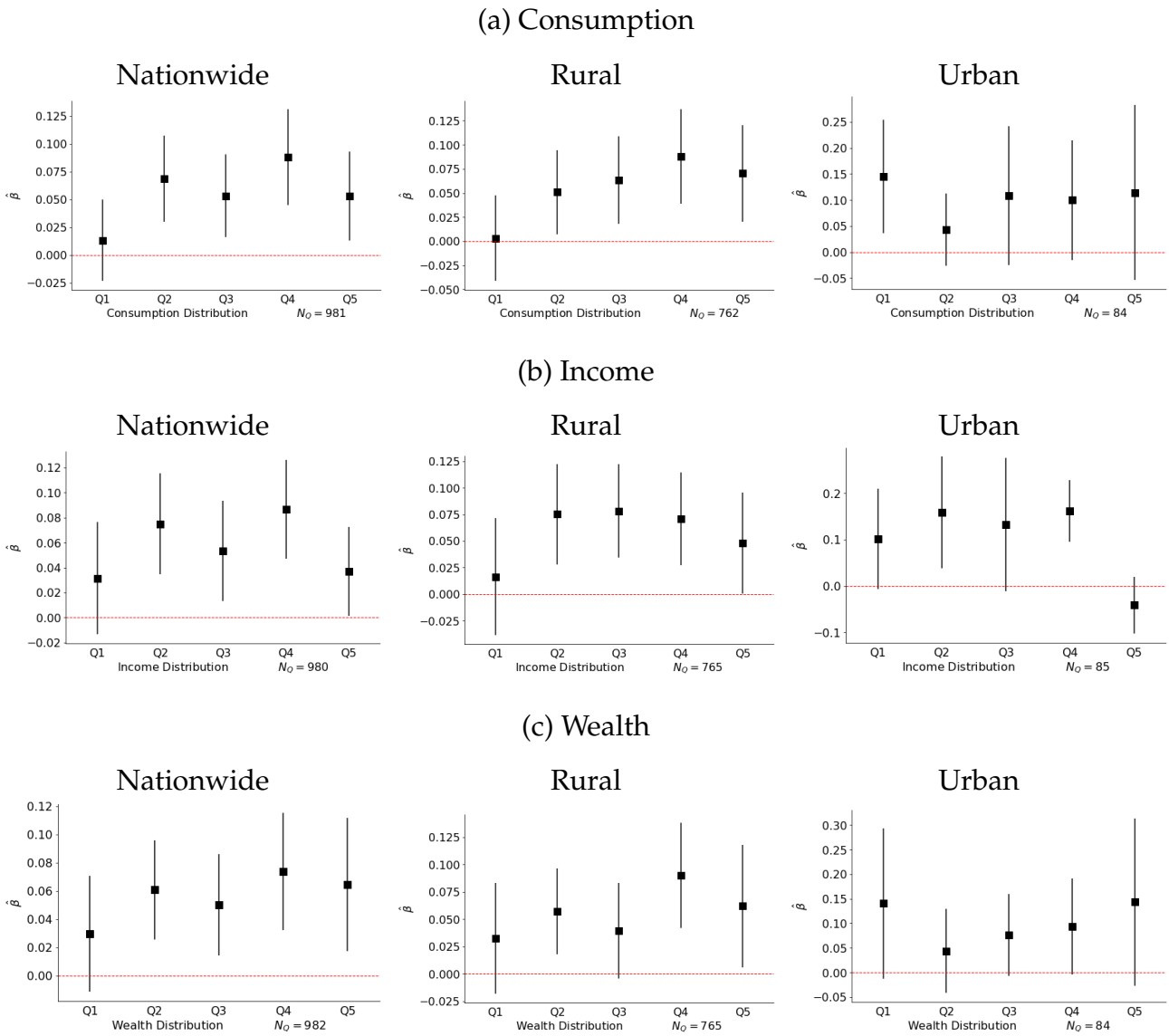
Notes: OLS estimates of β in regression equation $lnc_{itr} = +\alpha C_{tr} + \beta \Delta lny_{itr} + F_i + e_{itr}$ for each quintile j group—x-axis—of the consumption (a), income (b), and wealth (c) distributions. c_{itr} and y_{itr} denote consumption and income of household i in region r at period t, C_{tr} denotes average region-consumption and F_i denotes household fixed effects. N_Q denotes the minimum number of observations in each quintile. Red dotted-line marks full insurance. Standard errors clustered at the household level. *Source:* UNPS: 09/10–15/16, unbalanced panel.

Figure 7: Robustness Check: Testing Food Consumption Insurance, CRRA Specification



Notes: OLS estimates of β_j in regression equation $\Delta ln food_{itr} = +\alpha \Delta C_{tr} + \beta_j \Delta ln y_{itr} + F_i + e_{itr}$ for each quintile j group—x-axis—of the consumption (a), income (b), and wealth (c) distributions. $food_{itr}$ and y_{itr} denote food consumption and income of household i at period t, C_{tr} denotes region average consumption and F_i denotes household fixed effects. Standard errors clustered at the household level. *Source:* UNPS: 09/10–15/16, balanced panel.

Figure 8: Robustness Check: Testing Food Consumption Insurance, Standard Specification



Notes: OLS estimates of β_j in regression equation $lnfood_{itr} = +\alpha C_{tr} + \beta_j lny_{itr} + F_i + e_{itr}$ for each quintile j group—x-axis—of the consumption (a), income (b), and wealth (c) distributions. $food_{itr}$ and y_{itr} denote food consumption and income of household i at period t, C_{tr} denotes region average consumption and F_i denotes household fixed effects. Standard errors clustered at the household level. *Source:* UNPS: 09/10–15/16, balanced panel.

C TABLES

Table 3: Composition of Consumption, Income, and Wealth. Rural and Urban Uganda

Panel A: Rural Uganda										
Wave	Consumption		Income				Wealth			
	Food	Nofood	Agric	business	Lvstk	Labor	Assets	Land	Lvstk	farmK
	($)	($)	($)	($)	($)	($)	($)	($)	($)	($)
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
2009-10	965	566	853	619	290	759	1251	3162	922	0
	100%	96%	94%	46%	24%	42%	99%	79%	24%	0%
2010-11	1001	465	776	683	236	775	1341	2920	1015	25
	100%	100%	92%	44%	24%	39%	100%	78%	25%	93%
2011-12	1126	500	1010	918	354	866	1438	3616	1447	21
	100%	100%	88%	41%	23%	30%	99%	81%	24%	88%
2013-14	1051	513	902	929	236	833	1575	2613	908	19
	100%	100%	93%	41%	26%	31%	100%	85%	27%	95%
2015-16	998	487	1045	873	269	1410	1357	2381	935	18
	100%	102%	93%	42%	26%	31%	100%	87%	27%	96%
Panel B: Urban Uganda										
Wave	Consumption		Income				Wealth			
	Food	Nofood	Agric	business	Lvstk	Labor	Assets	Land	Lvstk	farmK
2009-10	1237	1262	618	1265	233	1486	3754	2566	793	0
	100%	89%	47%	60%	8%	58%	98%	29%	9%	0%
2010-11	1367	1196	523	1574	323	1787	4094	2979	809	23
	100%	99%	46%	60%	10%	59%	100%	29%	11%	48%
2011-12	1419	1095	818	1604	296	1391	4917	3943	1061	21
	100%	100%	49%	54%	8%	56%	99%	39%	9%	50%
2013-14	1259	949	655	1893	223	1530	3307	2015	775	19
	100%	100%	50%	58%	11%	52%	100%	37%	11%	54%
2015-16	1163	946	717	1518	2948	1366	2927	1872	706	12
	100%	100%	51%	62%	13%	48%	100%	39%	13%	55%

Notes: For each wave and category, table presents the household average ($) and proportion of households (%) for each category. *Food*, value of bought and non-bought food items; *Nofood* consists of non-food and non-durable goods. Income: *Agric*, agricultural revenues including sold and non-sold production; *Business*, profits from non-agricultural business and enterprises; *lvstk*, net income from livestock; labor income from salary labor (formal and informal). Wealth: *Assets*, value of household assets; *Land*, estimated value farming land; *lvstk*, value of own livestock; *FarmK*, value of farming capital. *Source:* UNPS: 09/10–15/16.