THE HUNGER OF OLD WOMEN IN RURAL TANZANIA: CAN SUBJECTIVE DATA IMPROVE POVERTY MEASUREMENT?

BY LARS OSBERG*

Dalhousie University

On average, women in Tanzania are slightly less likely than men to say that they are "always/often without enough food to eat"—but this masks a much higher rate of self-reported food deprivation among elderly rural women. Official Tanzanian poverty statistics are, however, based on a methodology which presumes equal sharing per equivalent adult within the household. This paper combines subjective and objective micro-data from Tanzania's 2007 Household Budget Survey and 2007 Views of the People Survey. By imputing individual consumption based on the relative probability of self-reported food deprivation, it provides an example of the possible importance of one type of intra-household inequality—i.e., the hunger of old women—for poverty measurement. Implications include the complexity of gendered intra-household inequality and the importance of "technical" poverty measurement choices for public policy priorities, such as old age pensions.

INTRODUCTION

Participatory, qualitative approaches to the study of global poverty start from the general perspective that: "There are 2.8 billion poverty experts, the poor themselves" (Narayan *et al*., 2000, p. 2). By recording poor people's self-descriptions of their real life situations, a nuanced picture of interlocking deprivations can be painted. However, the disadvantage is that these insights cannot easily be added up, so such methods provide little guidance to policy makers about the relative size of poverty problems in different population groups. By contrast, quantitative measures of the level of poverty, which are typically computed from survey micro-data on total household income or consumption, require researchers to make important assumptions in order to generate statistical estimates—assumptions which may render invisible the real deprivations of some people.

Specifically, although the potential importance of inequality within the household[1] is almost invariably acknowledged, the typical procedure in quantitative work on poverty is then immediately to assume it away. Most poverty statistics are predicated on an assumed equal flow of resources to all household[2] members, because data are unavailable to gauge the extent of intra-household inequality in consumption. As Ravallion (1996, p. 1332) noted, 18 years ago: "Standard practice has been to assume that all family members are equal within a unitary-decision-maker model. The inadequacy of this has long been recognized. But our data are typically for the household's total consumptions." There has been little change since then—as Ferreira and Ravallion (2009, p. 601) put it: "we ignore intra-household inequality. Following common practice, such inequality is simply assumed away from our computations."

This paper asks whether qualitative survey response data can sometimes be used to help assess intra-household inequality and thereby augment standard quantitative estimates of poverty, if such modifications can sometimes alter measures of poverty, and if changed poverty estimates might be relevant for policy. Specifically, it starts from the fact that, when asked,[3] old women in Tanzania outside Dar es Salaam are much more likely than average to report "always/often not having enough food to eat"—a disproportionate self-report of deprivation that is not observed among comparable old men, or among younger women. However, this deprivation cannot be seen in official statistics, which paint a very different picture of poverty incidence.

Tanzania's National Bureau of Statistics is one of the statistical agencies in sub-Saharan Africa now using a food energy intake methodology to draw the official national poverty line. This methodology assumes that consumption is equally allocated among "adult equivalent" household members and that differences in presumed calorie needs can be used to determine the equivalence scale. Lower expenditure needs are therefore systematically assigned to young children, women, and the elderly.[4] By assumption, there is an equal likelihood of deprivation among all the members of any given household. Taken together, in the Tanzanian

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[1]Sometimes reference is made to Phipps and Burton (1995), Findlay and Wright (1996), Haddad and Kanbur (1990), or Cantillon and Nolan (2001), who demonstrated its potential importance in Canada, Italy, the Philippines, the U.S., and Ireland. Note that the first two papers used simulations based on assumed hypothetical variations from an equal-sharing rule to establish a range of possible variation in poverty measures—which at least simplified the interpretation of results. Haddad and Kanbur (1990) used individual estimates of food intake and assumed food requirements to calculate inequality in nutritional adequacy in the Philippines, but did not test for measurement error in either or both of food intake or food requirements. See also Alderman *et al.* (1995).

[2]In both our Tanzanian datasets, the household concept is based on "eating together." Interviewers were explicitly instructed to include domestic workers who fit this criterion, as well as co-resident family members.

[3]The Views of the People 2007 (henceforth VoP2007) Survey of REPOA (Research on Poverty Alleviation) (see http://www.repoa.or.tz/documents/Views_of_the_People_2007_Complete.pdf) sampled 4987 Tanzanian households, 3640 outside Dar es Salaam and 1347 in Dar es Salaam.

[4]The adult equivalence (EA) scale used assumes that males 13–14 and 19–59 and females 13–18 are 1.0 EA; women 11–12 and 19–59 are 0.88 EA; males are 0.8 EA if 11–12 or 60+ and are 1.2 EA if aged 15–18 but women older than 60 are only 0.72 EA. For children, boys 0–4 and girls 0–2 are 0.4 EA; girls 3–4 are 0.48 EA; boys and girls 5–6 are 0.56 EA and if 7–8 are 0.76 EA. See HBS (United Republic of Tanzania, 2008, p. 82).

context, this methodology implies that the measured poverty of elderly women is estimated to be not particularly different from that of the general population.

This paper therefore suggests a methodology for combining subjective survey data with standard measures of consumption in estimates of poverty to allow for possible intra-household inequality which disadvantages elderly women. Section 1 uses self-reports of food deprivation to illustrate both the prevalence of disadvantage among elderly women outside Dar es Salaam and the complexity of gendered inequality within the family—Tanzanian women, on average, appear not to be disadvantaged in self-reported access to food relative to men, but a national average masks the substantial disadvantage of rural elderly women. Section 2 contrasts this evidence with the official methodology for construction of a food poverty line in Tanzania, which assumes equal sharing in the sense of equal expenditure per equivalent adult. Section 3 takes advantage of the commonly defined variables in the VoP2007 survey and the Household Budget Survey (HBS2007) of Tanzania's National Bureau of Statistics (United Republic of Tanzania, 2008) to estimate the probability of such hunger and uses that probability to calculate an imputed share of consumption within households which contain older women. Section 3 then calculates, using the HBS micro-data, the implications for measured poverty of imputed intra-household inequality. Section 4 discusses whether better measurement of poverty may be important for some policy issues (e.g., the relative priority of establishing an old age pension) even if aggregate poverty statistics are not much affected.

1. The Hunger of Old Women in Rural Tanzania

Many surveys—such as Tanzania's Household Budget Survey (on which official poverty estimates are based)—collect data on total household consumption from a single respondent in each household. This methodology implies that issues of within-household relative disadvantage cannot easily be addressed. However, REPOA's "Views of the People Survey" of 2007 (VoP2007) had a two-step randomization design which first obtained a randomly selected representative sample of households and then randomly selected a primary respondent from among the adults over age 25 in that household (Research and Analysis Working Group, United Republic of Tanzania, 2008). To the 502 respondents over age 60 (341 male, 161 female) thus randomly selected, a supplementary sample of 855 elderly respondents was added. The random selection within households procedure implied direct questioning of 2560 women over 25, as well as 2427 men in the primary sample—in the supplementary over-60 sample, 420 were male and 435 were female. Respondents were, among other things, asked: "Have there been times during the last year when you didn't have enough food to eat?" In Tanzania as a whole, 13.7 percent answered "Always/Often" and for the population as a whole, there is no evidence of female disadvantage.[5]

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[5]The other response categories were "sometimes" (37.97% of women, 40.09% of men) and "never." We do not analyze the percentage of the population who report "sometimes" not having enough food to eat because it can change at either margin and its interpretation is therefore ambiguous. (Both a decline in the fraction of the population that are food-secure and answer "never" and a decline in the fraction that are extremely deprived (i.e., answering "always/often") will tend to increase the proportion who answer "sometimes".)

TABLE 1
PERCENTAGE OF "ALWAYS/OFTEN WITHOUT ENOUGH FOOD TO EAT"

	Age 25–45	Age 46–59	Age 60+	All
Male	14.4	14.9	14.6	14.5
Female	11.2	16.2	23.0	12.9
Male and female	12.6	15.5	17.3	13.7
Dar es Salaam	4.0	5.0	9.9	4.6
Non-Dar es Salaam*	16.2	18.4	19.2	17.1
All Tanzania	12.6	15.5	17.3	13.7

*Arusha, Tanga, Lindi, Mtwara, Iringa, Singida, Rukwa, Shinyanga, and Mwanza regions.
Source: Authors' calculations, VoP 2007 micro-data.

As Table 1 reports, among all women in mainland Tanzania, 12.9 percent report food deprivation, compared to 14.5 percent of all men—a difference that *is* statistically significant.[6] Among men, the frequency of food deprivation is essentially constant by age group. However, the probability that a woman over 60 is "always/often" without enough food to eat is twice as high as the comparable chances of a woman aged 25 to 45 being "always/often" without enough food. Given the concentration of Tanzania's economic growth in the Dar es Salaam region in recent years, it is not a surprise that the frequency of hunger is greater in other areas—but the magnitude of the discrepancy in relative probability of being "always/often" without enough food is dramatic. An incidence of 17.1 percent outside Dar es Salaam contrasts with 4.6 percent in Dar es Salaam (i.e., 3.7 times greater).

Table 2 probes a bit deeper along the dimensions of gender, location, age, and living arrangement. It reports the relative frequency of "always/often" not enough food to eat, for respondents aged 60 or more, compared to the base probability (0.137) for a randomly selected Tanzanian adult. The bottom left corner entry for "All Respondents in Dar es Salaam," for example, indicates that such respondents have much less chance of being "always/often" hungry than average (i.e., about 0.34 of the average probability). This contrasts sharply with the relative probability for all elderly non-DSM women, whose chances of "always/often" not having enough food to eat are over two thirds (1.72) higher than the national average.

Reading down the columns of Table 2 shows the influence of gender and living arrangement, within a given location, on the chances of self-reported deprivation of the elderly. The first column shows that within Dar es Salaam the female elderly have gender parity, compared to the male elderly, in their chances of "always/often" not having enough food—the male/female differences in relative probability in Dar es Salaam are not large and are not statistically significant.

However, gender parity for the elderly is definitely not the case in most of Tanzania (i.e., outside Dar es Salaam), where (considered all together) the female elderly are 72 percent more likely than the national average to report being "always/often" hungry. Since most elderly Tanzanians live in a household with

[6]The 95% confidence interval for men was 13.14% to 15.95%, and for women 11.63% to 14.23%.

TABLE 2

RELATIVE PROBABILITY OF "ALWAYS/OFTEN WITHOUT ENOUGH FOOD TO EAT"

	Dar es Salaam	Outside Dar	Tanzania
60+ living alone:			
Male	**	2.22	2.08
Female	**	3.0	2.53
60+ with spouse only	**	1.24	1.19
60+ with under 18s only			
Male	**	1.12	1.41
Female	**	1.62	1.24
60+ with 18–24 years			
Male	**	0.84	0.73
Female	**	0.77	0.91
60+ with adults 25–59			
Male	0.61	1.06	0.97
Female	0.57	1.65	1.35
All 60+			
Male	0.71	1.12	1.04
Female	0.61	1.72	1.44
Male and female	0.66	1.34	1.19
Non-elderly: male	0.26	1.26	1.05
Non-elderly: female	0.3	1.18	0.88
All respondents	0.34	1.25	1
Base probability: all survey respondents			0.137

**Sample size insufficient.

other adults aged 25–59 (see Table 3), this is largely because the multi-generation extended family appears to have very different implications for older men and for older women. The relative probability of reporting "always/often" hunger is about two thirds higher than the national average (1.65) among older women outside Dar es Salaam who live with other adults aged 25–59, but is virtually the same as the national average (1.06) among elderly men living in the same type of extended family situation. In fact, it is only when they live alone that older men have a higher chance than younger men in rural Tanzania of being "always/often" without enough food. Overall, women under 60 outside Dar es Salaam have lower chances than men (relative probability of 1.18 compared to 1.26) of reporting "always/often" being without enough food. Gendered inequality within the extended family appears to be sharply differentiated by age.

Observation of gendered inequality in the frequency of self-reported deprivation does not by itself establish causality or directly imply the nature of choices. Food deprivation could be the result of a power dynamic—older women might be disadvantaged by younger women when they lose control of the family cooking pot. It could also be that food deprivation is a voluntary choice—i.e., that old women "eat last from the pot" because of internalized social norms about caring for others. Our data do not enable us to differentiate these hypotheses formally—however, it is suggestive that self-reported relative well-being of female elderly within households is dramatically lower when other middle aged adults are present.

In Tanzania, as Table 3 indicates, 10.1 percent of the elderly live in skip-generation households with children, all of whom are under 18, and an additional 8.7 percent of the elderly live with young adults aged 18–24 (but with no

adults aged 25–59 present). When grandparents are living with grandchildren under 18, both male and female elderly are relatively likely to report always/often being without enough food (women especially so); the lack of family earning power is a plausible explanation. However, when the elderly live with grandchildren who are 18–24, the family unit can presumably share in the income earning potential of young adult household members, but the elderly are also more likely to retain relative authority within the family. In this context, when the female elderly have not surrendered control of the family cooking pot to a daughter-in-law or other woman of the next generation, both male and female rural elderly have less chance than the national average of being "always/often" without enough food (0.84 and 0.77, respectively—the male/female difference is not statistically significant). This contrasts with a relative probability of food deprivation of 1.65—over twice as great—when the female elderly live with other adults aged 25–59.

The 7 percent of elderly women who live alone outside Dar es Salaam report a probability of "always/often" hunger that is three times the national average—elderly men living alone are twice the national average. Hence, living alone predicts reported self-reported deprivation—but being female and over 60 in Tanzania outside Dar es Salaam is also strongly correlated with higher reports of "always/often" not having enough food to eat. Although self-reported food deprivation is disproportionately a female phenomenon among the elderly, the same gender disadvantage is not observed among the non-elderly.

2. Official Poverty in Tanzania

By the $1.25 a day (PPP) international criterion of poverty, two-thirds of Tanzanians were poor in 2007. The World Development Indicators estimate of the poverty headcount ratio is 67.9 percent, with an associated poverty gap of 28.1 percent. However, international conceptions of poverty are not particularly relevant for public discussions of poverty within Tanzania, which focus mainly on the Basic Needs Poverty Line of the National Bureau of Statistics (NBS). By this standard the poverty headcount ratio in 2007 was 33.4 percent of the population, with a 9.9 percent poverty gap.

In Tanzania, the Basic Needs Poverty line is based on the Food Poverty Line, which defines a even deeper degree of deprivation. The Food Poverty Line was defined in HBS2007 (appendix A): ". . . based on the food basket consumed by the poorest 50 percent of Tanzanians. Median quantities consumed per adult equivalent were estimated for every food item, excluding alcohol and those that could not be assigned a calorific value. Median unit prices were also calculated. The calorific values of these foods were calculated. The food basket gives the *share* of consumption accounted for by each item. The *level* is set so that the sum of calories is 2200 per day, the minimum necessary for survival. The food basket defined by these two parameters is then priced to give the food poverty line."

The resulting estimate of the Food Poverty Line in 2007 was 13,098 Tanzania shillings (Tshs) for Dar es Salaam, 10,875 Tshs for other urban and 9574 Tshs for rural (on average 10,219 Tshs per equivalent adult per month) (see HBS2007;

United Republic of Tanzania, 2008, ch. 7, p. 1). At nominal exchange rates 10,000 Tshs was worth about US$7.68 and about $19.59 per month at PPP—by this criterion 16.4 percent of mainland Tanzanians were "food-poor" in 2007.

Clearly, the Food Poverty Line calculations omit the cost of cooking fuel and ignore the percentage of purchased food which is lost to spoilage or other waste and individuals' need to spend money on non-food items such as shelter and clothing. As well, the NBS food adequacy criterion of 2200 calories does not reflect the calorific demands of physical activity. For a 66-inch (168 cm) tall, 140-pound (63.5 kilo) 30-year-old male who is "rarely" physically active, the U.S. National Academy of Sciences recommends 2291 calories as sufficient—but physical activity for more than an hour a day would raise his required calories to 3210. The differential in calorie needs associated with even an hour of physical activity is far larger than that associated with age or gender—and the 75 percent of employed Tanzanians who work in agriculture use predominantly hand labor, with few inputs of machinery or motive energy, typically for much more than an hour a day. Because the food energy intake methodology of the NBS builds in the adult equivalency needs ratios reported in footnote 4, the male elderly are assumed to need 0.8 of an adult equivalent and female elderly needs are set at 0.72. Hence, a rural woman over 60 living alone in 2007[7] was only counted as food poverty line poor if her total expenditures were below 6893 Tshs per month, while a rural man aged 19–59 living alone was counted as food poor if expenditures were less than 9574 Tshs.

The Basic Needs Poverty Line is set at 37 percent greater than the Food Poverty Line by calculating the share of expenditure that goes on food in the poorest 25 percent of households (73 percent) and multiplying the food poverty line by the inverse of this share to allow for non-food consumption.

When people live in larger households, the total number of adult equivalents in each household aggregates the assumed differences between men, women, children, and the elderly in individual equivalence scale—so an overestimate of food needs for one demographic type will often be averaged with underestimates for others. The equivalence scale assumptions of the food energy intake methodology thus affect most strongly the official poverty status of small households of correlated types (i.e., one- and two-person elderly households) and large households primarily composed of young children.

Although Table 1 showed the elderly living alone to be particularly likely to report "always/often being without enough food to eat," the official food poverty rate calculations are based on poverty lines which are set lower for the elderly than for younger people. As a result, the single elderly are officially calculated to have half the food poverty line poverty rate of the general population, as Table 3 shows. For elderly couples, Table 1 showed the frequency of reporting "always/often without enough food to eat," to be about a fifth greater than average, but the

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[7]Seebens (2008) used the 2001 HBS expenditure data to show that female-headed households in Tanzania spend a significantly higher percentage of a given total expenditure on food than male-headed households. The interpretation he stresses is the likelihood that female-headed households spend more on children's food than male households; his general point is the infeasibility of inferring equivalence scales in Tanzania from observed food expenditure patterns in a defensible way. His results are also very hard to reconcile with the NBS weighting of women in equivalent adult units.

TABLE 3

LIVING ARRANGEMENTS AND OFFICIAL "FOOD POVERTY" POVERTY RATE; MAINLAND TANZANIANS OVER 60, 2007

Percentage of elderly living:	Male	Female	Total	Official "Food Poverty" Rate		
				Male	Female	All
Alone	7.3	9.1	8.2	0.10	0.07	0.08
With spouse only	14.6	8.4	11.4	0.02	0.01	0.02
With children age <18 and no adults 25–59	6.7	14.4	10.7	0.20	0.20	0.2
(Average household size)	3.9	3.3	3.4			
With young adults (18–24 and no adults aged 25–59)	6.1	9.9	8.1	0.23	0.19	0.20
(Average household size)	5.3	4.7	4.9			
With other adults (25–59)	64.8	56.1	60.3	0.17	0.17	0.17
(Average household size)	6.7	7	6.8			

official calculations of Table 3 put the food poverty rate at about one-eighth that of the general population. Tables 1 and 3 therefore tell very different stories about food deprivation among the elderly of Tanzania who live alone or in couples.

Nonetheless, because three fifths of elderly Tanzanians live with other adults aged 25–59, and the assumption of equal sharing means that everyone living in the same household is assigned the same official poverty status, the official food poverty line poverty rate (17.0 percent) for co-resident elderly is necessarily very close to the population average (16.4 percent). Combined with the result that the elderly who live alone or in a couple are estimated (as discussed above) to have official food poverty rates well below the population average, the official poverty numbers thus imply that poverty among elderly Tanzanians, male or female, is not any worse than in the general population.

Because the food energy intake methodology implies that total household equivalent income can depend on the distribution of consumption within households, the equal sharing per equivalent adult assumption has strong theoretical implications. Equal sharing, per equivalent adult, is not consistent with maximization of total household equivalent income when the adult equivalency ratios used (as in the food energy intake methodology) imply that some types of individuals are more efficient than others in producing equivalent income from money expenditures. If efficiency differs, maximization of total equivalent household income would imply that households should allocate the most resources to the most efficient converters.

Suppose, for example, that an 18-year-old female (EA = 1) and a 1-year-old child (EA = 0.4) had household cash expenditure of 1000 Tshs monthly. Total adult equivalent household size is 1.4. Equality of adult equivalent income (at 714.30 Tshs each) occurs when the household allocates 285.70 Tshs to the infant and 714.30 Tshs to the mother, implying total household equivalent income of 1428.60 Tshs. But the household can increase total household equivalent income if more of the household income is spent on the more efficient converter—i.e., the child. Equal money expenditure (i.e., 500 Tshs) for mother and child would imply that the infant's adult equivalent consumption would become 1250 Tshs and the

mother's adult equivalent consumption would now be 500 Tshs, for a total of 1750 Tshs—and additional pro-child transfers would further increase equivalent household income, according to the food energy intake methodology. Note that when the number of adult equivalents depends only on the number of household members (as in the LIS equivalence scale, which calculates the number of equivalent adults in a household as the square root of household size), neither the age/gender composition of the household nor the distribution of consumption within the household affects total household equivalent income.

3. Imputing Consumption within Households: Methodology and Results

To estimate how much difference an equal sharing per equivalent adult assumption might make to poverty measurement among the elderly, we need to estimate the command over resources of those elderly who live in multi-person households but who do not share equally in total family resources.

This paper uses the notation that individuals ($j = 1, \ldots, m$) live in households ($i = 1, \ldots, h$ where $h < m$) and relies on the fact that somewhat similar questions[8] about food adequacy are asked in both the VoP2007 and the HBS2007. In the HBS2007, the referent is the household and in the VoP2007 individual respondents are asked. For one-person households, the referent in both surveys is therefore identical.

HBS2007 collects information on a sample of households. Data include total household consumption (C_i), the number of equivalent household members (n_i), and a vector of other household characteristics (X_i), one of which is a self-report measure of food adequacy (H_i) at the household level.

VoP2007 records the responses of a sample of individuals within households. The total consumption (C_i) of the household of which these individuals are a member and the individual consumption (C_j) of person j are not recorded. The data contain a self-report measure of individual food adequacy (H_j), the number of equivalent household members (n_i), and measures of a vector of household characteristics, X' of which overlap with the characteristics surveyed in HBS2007—i.e., $X' \in X$.

If $n_i = 1$, then the individual is the household, so we can use either notation $(H_i \mid n_i = 1) = (H_j \mid n_i = 1)$ and similarly $(C_i \mid n_i = 1) = (C_j \mid n_i = 1)$. We observe in HBS2007 the density $f_1(C_i)$ and cumulative distribution function $F_1(C_i)$ of the distribution of consumption of single person households.[9] The consumption of single person households is both a direct indicator of the economic well-being of those people now living in such households and an indirect indicator of the "threat

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[8]In the VoP2007, individual respondents are asked: "Have there been times in the last year when you didn't have enough food to eat?" The HBS2007 asked: "How often in the last year did you have problems of satisfying the food needs of the household?" In the HBS2007, always and often are separately identified as response categories, but not in the VoP2007. As Table 4 illustrates, the wording differences are not very important for the "always/often" response, but do matter for the "sometimes" response.

[9]Notation: when used without subscripts the density function $f(C_i)$ and cumulative distribution function $F(C_i)$ of the distribution of consumption refer to the entire population, while subscripts—e.g., $f_1(C_i)$ and $F_1(C_i)$ or $f_2(C_i)$ and $F_2(C_i)$—denote the distribution of consumption among single person households, two person households, etc.

point" of individuals within households, who can leave and become a single person household.

If $n_i > 1$, equal consumption (per equivalent adult) for all j individuals in household i can be defined as: $E_j^* = C_i/n_i$ but our research focus is the possibility that consumption is unequally distributed within households, such that for some $j \in i$, $C_j \neq E_j^*$.

We define P_j^* as the probability of elderly individual j (in household i where $n_i > 1$) reporting that they "always/often" do not have enough food to eat and we estimate an empirical relationship $f(X_i')$ in VoP2007 between P_j^* and the characteristics X_i' of their household:

$$(1) \qquad\qquad P_j^* = f(X_i') + e_j.$$

We assume that if we had a good measure of individual consumption (C_j), it would predict P_j^* (the probability of individual j reporting "always/often" not having enough food to eat) with some accuracy and we describe this functional relationship $g(C_j)$ as:

$$(2) \qquad\qquad P_j^* = g(C_j) + u_j.$$

If (2) holds, then (where E is the expectations operator and we define e_j and u_j to be random error terms with mean zero):

$$\mathsf{E}\left(P_j^*\right) = g(C_j).$$

It follows that:

$$C_j = g^{-1}\left(\mathsf{E}\left(P_j^*\right)\right) = g^{-1}(f(X_i')).$$

Specifically, in the current context we know, from VoP2007, the population percentage $P^{**} = \int_{j=l..m} P_j^* \, d(j)$ reporting food deprivation. Using our estimate of equation (1), and the common variables X' in HBS2007, we impute P_j^* to all elderly individuals within households in that dataset. We then draw successively from the bottom tail of the distribution $f_1(C_i)$, assigning C_j in descending rank order of P_j^* up to the point where $F_1(C_i) = P^{**}$. We call this assigned level of consumption C_j^*. However, food deprivation does not necessarily indicate inequality within the household—sometimes everybody just shares equally in a very low household income—so we check whether $C_j^* > E_j^*$ or $C_j^* < E_j^*$. That is, we compare, for each elderly person, C^* with the equally distributed expenditure level $[E^*]$ obtained when total expenditure is simply divided equally among all adult equivalents in the household they live in. If $C^* > E^*$, this is the case where the elderly are hungry because everyone in the family is hungry, so we assign the elderly person E^* and recode $C_j^* = E_j^*$. If $C^* < E^*$ (the anti-elderly unequal intra-family distribution case), the elderly person is assigned C^* and income corresponding to the difference ($E^* - C^*$) is divided equally among all other household

TABLE 4

Single Person Households "Always/Often" and "Sometimes" Without Enough Food

	VoP2007		HBS 2007	
	% "Always/Often"	% "Sometime"	% "Always/Often"	% "Sometime"
Tanzania				
Male	13.3	45.8	16.7	7.1
Female	14.8	28.4	13.4	7.5
All	13.9	38.5	15.1	7.3
Dar es Salaam				
All	5.2	33.8	14.2	8.4
Non-Dar es Salaam*				
Male	15.7	50.6	16.7	7.2
Female	25	25	13.4	7.5
All	19	41.2	15.1	7.3

*Vop2007: Arusha, Tanga, Lindi, Mtwara, Iringa, Singida, Rukwa, Shinyanga, and Mwanza regions.

HBS2007: = VoP2007 plus Dodoma, Kilimanjaro, Morogoro, Pwani, Ruvuma, Mbeya, Tabora, Kigoma, Kagera, Mara, Manyara.

members and added to their consumption level.[10] That is, we assign C_j^* to the elderly individual and $E_j^* + \left(E_j^* - C_j^*\right)\big/(n_i - 1)$ to all other members of that household. We do not change the consumption estimated for any other individuals in HBS 2007—i.e., other individuals are assigned (as now) $C_j^* = E_j^*$. We call this distribution of imputed consumption $f\left(C_j^*\right)$.

We then compute poverty statistics using $f\left(C_j^*\right)$ and $f\left(E_j^*\right)$ and compare. As Table 4 indicates, the VoP2007 data imply that 19 percent of all Tanzanians living alone outside Dar es Salaam report "always/often" not having enough food to eat. (In the HBS2007 data, the comparable fraction is 15.1 percent.) If we use the VoP estimate and assume those "always/often" without enough food are the bottom 19 percent of the distribution of total expenditure of all single-person households outside Dar es Salaam, that can give us an estimate of the distribution of expenditure in the bottom tail of deprivation.[11]

Appendix A presents linear probability regression models results using VoP2007 micro-data to predict the probability of "always/often" not having enough food. In each panel, separate columns compare the regression results obtained for Dar es Salaam and for other regions. Using the coefficient estimates for the linear probability model, we compute for each person the calculated probability P* of "always/often" not having enough food to eat.[12] We then order

[10]In making these calculations, we count each person as one adult equivalent. Calculating impacts in this way enables us to separate each household's total consumption utility from the distribution of income within households. We compare unequal (anti-elderly) sharing with the presumption of equal sharing and assume pro-elderly unequal sharing to be quantitatively insignificant.

[11]This procedure addresses the question: What variables contained in both the VoP and HBS datasets best predict in the VoP the probability of "not having enough food to eat"? Because our purpose is imputation, not assessment of causality, it is not a disadvantage that a variable (like number of meals eaten per day) captures a linked dimension of the same issue.

[12]For the linear probability model, P* = XB + e, where X = vector of personal characteristics, B = coefficient estimates, e = random draw from normal distribution with mean zero and variance equal to unexplained variance in regression reported in Appendix A.

TABLE 5

"BASIC NEEDS" POVERTY IN TANZANIA IN 2007; IMPACTS OF SHARING AND EQUIVALENCE SCALE ASSUMPTIONS

	Poverty Rate		Poverty Gap		FGT $\alpha = 1$	
	Per Capita	NBS EA	Per Capita	NBS EA	Per Capita	NBS EA
All						
Equal shares	0.488	0.333	0.167	0.098	0.078	0.043
Unequal shares	0.49	0.335	0.169	0.100	0.08	0.044
Age 60+: Male						
Equal shares	0.442	0.331	0.153	0.098	0.075	0.045
Unequal shares	0.468	0.364	0.183	0.131	0.1	0.071
Age 60+: Female						
Equal shares	0.46	0.327	0.164	0.10	0.08	0.046
Unequal shares	0.495	0.367	0.192	0.13	0.101	0.067

all elderly persons in sequence of P^* and we do this separately for those living in Dar es Salaam or not.

As Table 1 reported, 9.9 percent of those aged 60 or over in Dar es Salaam, and 19.2 percent of those aged 60 or over outside Dar es Salaam, reported "always/ often" not having enough food to eat. We assume that the distribution of per capita consumption of the worst off elderly is the same as the distribution of consumption of the worst off single-person households observed in HBS2007. We assign the worst off 19 percent of the rural elderly (as ordered by P^*) a consumption level (which can be called C^*) corresponding to the consumption level of the equivalent rank of the distribution of consumption spending of non-DSM single-person households. We then repeat the same procedure for the elderly in Dar es Salaam up to the 10th percentile.

How much difference might unequal sharing with the elderly make to estimates of the level of poverty? Table 5 compares estimates of the basic needs poverty rate, poverty gap, and normalized poverty gap (also known as the Foster–Greer–Thorbecke Index of order 1) under the alternative assumptions of equal sharing and assuming that unequal shares for the elderly within the family can be modeled as described above. It reports poverty statistics using both per capita consumption and consumption per equivalent adult. It shows that the equal sharing assumption does matter for both males and females over 60—with larger proportionate impacts for the poverty gap and normalized poverty gap than for the simple head count ratio. However, Tanzania has a relatively young population—in the HBS data, only 6.1 percent of the population were over 60 in 2007. Hence, in Tanzania in 2007, the assumption of equal sharing within households for the elderly makes relatively little difference to estimates of poverty indices for the population as a whole, for either equivalence scale assumption.

4. DISCUSSION AND CONCLUSION

Although most of the poverty measurement literature has been based on definitions and perspectives established by researchers (see Osberg and Xu, 2008;

Ferreira and Ravallion, 2009), the well-established "Leyden tradition"[13] has long argued for using the income at which the typical survey respondent assesses themselves to be poor to define the poverty line. Self-assessed poverty has been compared with the incidence of poverty according to an objective consumption or income poverty line criterion (Ravallion and Lokshin, 2002) and, more recently, Ravallion et al. (2013) have proposed anchoring a measure of subjective poverty to household vignettes, as a way of circumventing the possibility that respondents differ systematically in the criteria for subjective self-identification of poverty. These approaches share the core idea that respondents are asked whether they subjectively feel poor in an overall sense.

Incorporating subjective information on specific deprivations into poverty measurement is a somewhat different problem. The World Bank's "Voices of the Poor" study (see Narayan et al., 2000) emphasized the multi-dimensionality of poverty and the importance of listening to the poor themselves as they describe the specific deprivations that they consider crucial, but such qualitative data cannot be clearly aggregated into evidence on trends or relative size. Although a theoretical strand of the quantitative poverty literature has for some time argued for explicit recognition of the multiple dimensions of poverty, it has not used subjective self-report data (e.g., Bourguignon and Chakravarty, 2003 examined deprivation of income and education in Brazil).

Can qualitative data on specific deprivations be used to augment quantitative estimates of poverty? This paper focuses on self-reports of hunger as a key dimension of poverty because not having enough food is: (1) a recurring theme in qualitative surveys of poor people (e.g., Narayan et al., 2000); (2) a common element in ordinary language definitions of poverty; and (3) a concrete aspect of their own daily life experience on which respondents can be expected to be well-informed. It has illustrated a methodology for augmenting quantitative estimates by using a qualitative survey response by individuals (self-reports of being "often/always without enough food") as an indicator of intra-household deprivation of a specific group of people (the elderly). The relative probability of such self-reports was used to impute the distribution of consumption within households, and aggregate poverty estimates using this imputed consumption were compared to the estimates obtained when equal sharing is assumed.

This paper focused on Tanzania because currently, as in many African countries, the food energy intake methodology draws official national poverty lines using (1) presumed physiological equivalence scales to impute the relative food needs of household members, and (2) assumed equal sharing per adult equivalent within households. In the specific instance of Tanzania, official poverty estimates have concluded that the poverty rate among the elderly in 2007 was about the same as in the general population (by assumption, male and female poverty in the same household is always identical). Important policy implications can be drawn from such a finding—for example, that anti-poverty initiatives (like a universal basic old

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[13]See Goedhart et al. (1977), van Praag et al. (1982), and Hagenaars (1986, 1991).

age pension) which primarily benefit the elderly have no particular claim to priority.[14]

Even though women in Tanzania are, over all, less likely than men (12.9 percent compared to 14.5 percent) to report "always/often" not having enough food to eat, older women outside Dar es Salaam in 2007 were much more likely to report such deprivation compared to younger Tanzanians, or compared to older rural men. This paper has argued that adjustments to individual consumption which correct for such intra-household inequality can change estimates of elderly poverty, even if the small percentage of Tanzania's population that is now elderly means there are small impacts on estimates of total poverty for the nation as a whole.

Estimated impacts such as those of Table 5 require caveats. The sample size of both VoP2007 and HBS2007 is too small to enable reliable distinctions among the many different tribal/ethnic cultural groups within Tanzania or the many differences between rural and urban areas outside Dar es Salaam. Nevertheless, one general lesson to be drawn is the complexity of gender-based disadvantage.[15] Because norms of inequality within households vary across cultures, neither the uniform assumption of zero intra-household inequality nor the simplistic assumption of uniform disadvantage will fit all cases. When direct measurement of access to resources within the household is not feasible, indirect inferences can be useful supplements (e.g., anthropometric data such as height for age or weight for height, consumption pattern analysis, or time use data[16]). This paper has tried to demonstrate that self-reports of food deprivation can also be used as a source of inference to estimate the extent of intra-household inequality.

Although Table 5 showed that aggregate measures of poverty in Tanzania were not much affected by neglect of elderly disadvantage in intra-household inequality, it also showed significant impacts for the elderly—who are currently a small percentage of Tanzania's population. This measurement issue therefore does not matter much for some purposes (like assessment of aggregate national poverty trends) but could matter considerably for other issues (like the relative priority of old age pensions).

Currently, Tanzania has no system of old age pensions or other public policy to deal with elderly poverty. A number of authors (e.g., Pal *et al.*, 2005; Hagemejer, 2009) have noted that high birth rates in sub-Saharan Africa imply a relatively young population, and a small percentage of elderly—which means that the current cost of implementing old age pensions would also be a relatively small fraction of GDP. For example, Mboghoina and Osberg (2010, pp. 8, 10) estimate

[14]Since most elderly persons live in extended families and share consumption, the non-elderly members of poor households are major beneficiaries of a basic pension system—see Case and Deaton (1998), Duflo (2003), and others for analysis of the South African case.

[15]Motiram and Osberg (2010a), for example, noted that within Indian families, younger women have substantially *less* personal and leisure time than the household matriarch. The power and status of older women within the household clearly varies substantially across cultures. Lovo (2013) provides a brief survey of how matri-lineal and patri-lineal, and matri-local and patri-local, inheritance patterns differ across ethnic groups within Malawi—with concrete implications, e.g. for soil conservation practices.

[16]For examples of how time use data can be used to examine intra-household inequalities, see Motiram and Osberg (2010a, 2010b) and associated references. For an anthropometric example, see Osberg *et al.* (2009).

that a universal old age pension for all Tanzanians over 60 set at the food poverty line would reduce overall poverty by 7.7 percentage points at a cost of 1.7 percent of annual GDP in 2010. This is a significant expenditure but it is also less than 1/20th of the five-year increment in GDP, at recent growth rates.[17] There are many competing priorities in poor countries, but some (e.g., Namibia, Botswana, Bolivia, Nepal) have decided that poverty among the elderly should be addressed by the introduction of a public pension system—so assessment of the need for such pensions is an important issue.

This paper has argued that perceptions of the relative prevalence of poverty among the elderly in Tanzania depend heavily on poverty measurement methodology—something which matters partly because it can affect the possible priority of pension initiatives. Although the NBS assumptions of equivalence scale, caloric needs, and equal sharing per equivalence unit together imply that deprivation among the elderly is about average for Tanzania, self-reports of food deprivation imply that poverty is considerably greater, particularly for elderly rural women. Given the extremely low incomes of the people involved, it is disquieting that these conflicting estimates of the relative deprivation of Tanzania's elderly depend so much on "technical" equivalence scale assumptions and the assumption of equal sharing of equivalent income. Incorporating data on self-reports of hunger into poverty measurement might be a useful improvement.

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[17]Real GDP in Tanzania grew on average by 7 percent annually during 2001–07 and by 6.4 percent annually during 2008–12, implying, at the lower (6.4 percent) rate, that the cumulative increase in GDP over a five-year period is 36.4 percent.

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SUPPORTING INFORMATION

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Appendix A: The Probability of Food Deprivation