Measuring Poverty Within The Household

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Existing approaches to poverty measurement suffer from a number of limitations. The collective household model can help overcome some of them.

Keywords: poverty, equivalence scales, collective model, resource shares, scale economies

Elevator Pitch

A key element of anti-poverty policy is the accurate identification of poor individuals. However, measuring poverty at the individual level is difficult since consumption data is typically collected at the household level. Per-capita measures based on household-level data ignore both inequality within the household and economies of scale in consumption. Equivalence scales provide an ad hoc way of accounting for the latter issue, but cannot address the former. The collective household model offers an alternative framework to estimate poverty at the individual level while accounting for both inequality within the household and economies of scale in consumption.

Key Findings

New Insights

- Intra-household inequality and economies of scale in consumption are critical to measuring poverty at the individual level.
- Poverty measures based on equivalence scales are mostly inadequate.
- The collective household model provides a framework to estimate individual poverty from household-level data.

Limitations

- The data requirements to estimate poverty at the individual level may be burdensome.
- The collective model per se does not account for differences in needs across household members (e.g., children and adults).
- Estimation of the collective model can be difficult, though recent advances have reduced these challenges.

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Authors' Main Message

Per-capita measures and equivalence scales, though practically useful to measure poverty, suffer from several limitations. The collective household model provides a promising framework to measure poverty at the individual level, with results suggesting that standard poverty measures may dramatically understate the poverty status of certain types of individuals and that many poor individuals may reside in non-poor households.

1 Motivation

Poverty measures should be consistent in the space of welfare: if two individuals have the same welfare, they should have the same poverty status (Ravallion, 2015). However, welfare is unobservable, so poverty measures must rely on proxies, with the most common one being consumption. In this article, we examine the use of consumption expenditures to measure poverty, and discuss practical issues of this approach.

Identifying poor individuals using consumption is challenging because consumption data is almost always collected at the household level. So, poverty rates are typically calculated based on per-capita expenditure, i.e., total household expenditure divided by the number of individuals that habitually reside in the household. If this measure is below the poverty line, then everyone in the household is poor; if not, then no one in the household is poor. It follows that per-capita poverty measures implicitly assume that there is equal sharing of resources within the household. These measures also ignore economies of scale in consumption and assume that individuals derive the same amount of welfare from the same value of consumption, regardless, e.g., of their age or gender. This begs the questions: how important are a) intra-household inequality in consumption and b) the demographic composition of the household for poverty measurement? And, if they do matter for accurate poverty measurement, how can they be accounted for?

In the following sections, we first provide an overview of existing approaches to measuring poverty and discuss how equivalence scales are often used to improve welfare comparisons across households with different demographic compositions. Next, we show that the collective household model provides a useful framework to overcome many weaknesses of standard poverty measures. We describe recent empirical applications and demonstrate how collective model estimates can improve upon equivalence scales. In the concluding section, we discuss some limitations of the collective framework and pathways to potentially overcome them in future work.

2 Standard Approaches to Poverty Measurement

Poverty measurement can be thought of through the lens of a consumer choice problem, where one first determines a utility threshold (u_z) that separates the poor from the non-poor, and then sets the poverty line to be the income necessary to reach this threshold. There are two challenges to this

approach: the first involves translating welfare into something that we can reliably measure, and the second requires determining where to set u_z and hence the poverty line.

Income or consumption are typically used as proxies for welfare: the higher the income or consumption, the higher the welfare. For poverty measurement in a developing-country setting, consumption expenditure is often preferred, as income fluctuates frequently, particularly in agricultural areas, and can be difficult to measure properly (Deaton, 1997). Consumption, however, has its own measurement issues, particularly when it comes to measuring prices, but is considered a better indicator than income for standards of living and well-being (Ravallion, 2015). Nevertheless, the problem remains as to whether the way to translate consumption expenditures into welfare is the same for each person. Specifically, if basic needs vary with demographic characteristics, such as age, gender, occupation, or geographic location, then a one unit increase in consumption expenditure will yield different increases in welfare for different individuals. In other words, some individuals may require fewer resources than others to reach u_z.

Determining u_z (which is often referred to as the *referencing problem*; Ravallion (2015)) is similarly challenging. Poverty is a subjective concept, depending highly on context and culture. Individuals within and across countries are unlikely to agree on what constitutes a poor household and poverty lines can vary considerably across countries. One possible solution to this issue could be to ask people about their welfare and use this information to infer a poverty line. For example, the often-used Minimum Income Question (MIQ) asks: "What income level do you personally consider to be absolutely minimal? That is to say that with less you could not make ends meet." While poverty lines set using subjective welfare-type questions may be appealing, they also have a number of limitations, a key one being that there are almost certainly latent factors influencing how people answer such questions that cannot be accounted for (such as personality or social norms).

An alternative, perhaps more objective, approach is to fix a basket of goods that an individual might need in order to meet some specified level of welfare (below which she is considered poor). Often, this basket will include food needed to support recommended dietary intakes and may be augmented with an allowance for non-food goods (essentially anchoring u_z to biological needs; Deaton (1997)). The value of this basket pins down the poverty line. One problem here lies with determining what should be included in the basket, and how large the non-food allowance should be.

Any poverty measure, either objective or subjective, still faces the same issue: whether or not it is consistent in the space of welfare. Household-level measures exacerbate this challenge: not only do households differ substantially in demographic composition and size, they may also not allocate household resources equally within the household. It may be possible that some household members have a substantially lower welfare relative to others. By using the standard per-capita approach, which assigns every household member the same value of consumption, and comparing every individual to the same poverty line, it is unclear whether welfare-consistent comparisons can be actually carried out. Furthermore, household-level measures do not allow for heterogeneity in poverty status *within* the household: so, if one member is poor, then all other members must be poor. As we show later on, this may not hold true in many circumstances.

Equivalence Scales

Different household members, along with different household types (e.g., with different demographic compositions), are likely to require different levels of consumption. On one hand, due to economies of scale in consumption, larger households may need fewer per-capita resources than smaller households to attain the same level of welfare: food waste per person, for example, is likely lower in larger households, and more people jointly consume goods that can be shared (such as energy goods). On the other hand, household members may differ in their needs. Children and the elderly, e.g., typically require less food than working-age adults to maintain a healthy diet, and individuals working in high-activity jobs may need more calories than those who do not. In households where food is a substantial portion of the budget or with higher than average dependency ratios, these differences are likely to have a non-trivial effect on poverty measurement.

Equivalence scales can be used to rescale total household consumption to address these issues. To account for both economies of scale and differences in needs (e.g., children need less than adults) in poverty measurement, one can calculate *equivalent consumption* as follows:

$$y_i^e = \frac{y_i}{(n_{ai} + \beta n_{ci})^\alpha}, \tag{1}$$

where y_i is household expenditure, n_{ai} is the number of adults in household i, n_{ci} is the number of children, β is the adult equivalence scale (i.e., children's needs as a fraction of adults'), and α captures economies of scale in consumption, with $\alpha, \beta \in (0, 1]$. The equivalence scale is the quantity in the denominator of equation (1). Note that equation (1) can be adapted to include different person types, such as the number of elderly members or working age male and female adults, and yields the per-capita household expenditure when $\alpha = \beta = 1$. For a four person household with two adults and two children, with $\beta = 0.5$ and $\alpha = 1$ (i.e., no economies of scale), y_i^e would be just one-third of y_i, hence significantly higher than per-capita expenditure. The presence of scale economies (e.g., $\alpha = 0.6$) would result in even higher equivalent consumption (roughly one-half of y_i).

The challenge is in setting accurate values for α and β, which requires knowledge of the needs of different individuals as well as the extent of consumption sharing within the household. An additional complication is that α and β are usually related: for instance, larger households tend to have more children relative to adults, as children cannot live alone but adults can. In practice, α and β are often chosen based on ad hoc assumptions. A common example of equivalence scales is the OECD scale (or Oxford scale), which equals 1 for the first adult household member, plus 0.7 for each additional adult, plus 0.5 for each child. So, a typical family of four, with two parents and two children, would be assigned an equivalence scale of 2.7. The square-root equivalence scale, which sets $\alpha = 0.5$ is also common. An alternative three-parameter equivalence scale is used in the United States and is given by $(1 + 0.8 + 0.5(n_c - 1))^{0.7}$ for single-parent households, and by $(n_a + 0.5n_c)^{0.7}$ for households with multiple adults.

How much do changes in the values of α and β affect poverty measurement? Brown and van de Walle (2021) address this question in the context of poverty comparisons between male- and female-

headed households (MHHs and FHHs, respectively) in sub-Saharan Africa. They find that, based on per-capita expenditure, FHHs have lower poverty rates than MHHs. However, even small adjustments for scale economies can change these comparisons: the value of α at which FHHs would have higher poverty rates than MHHs ranges from 0.95 in East Africa to 0.15 in West Africa. Such sensitivity reflects the fact that FHHs are substantially smaller than MHHs, on average. By contrast, variations in adult equivalence scales matter less in this setting, as dependency ratios are relatively similar in FHHs and MHHs.

Intra-household Inequality in Resource Allocation and Poverty Measurement

Equivalence scales can be useful to capture differences in needs across individuals as long as these differences are stable within person types: e.g., if all children need less than working-age adults and by the same amount. However, the usefulness of equivalence scales breaks down when differences in needs are heterogeneous within person types, or if there is discrimination against certain individuals within the household. Importantly, equivalence scales assign the same value of consumption to each household member and so they cannot account for circumstances in which some household members have welfare values below u_z while others do not. In other words, they cannot account for intra-household inequality and for the fact that poor and non-poor individuals may reside in the same household.

So, how critical is intra-household inequality? As previously mentioned, assessing the scope of intra-household inequality in consumption is complicated by that fact that consumption data is typically collected at the household level. A handful of surveys have exceptionally collected data on individualized consumption, and intra-household inequality has been found to be far from negligible using these data. For example, studying Bangladesh, Bargain et al. (2019) find that that adults have substantially higher levels of food and clothing consumption relative to children, and women have slightly lower consumption levels relative to men. Focusing on food consumption in Bangladesh, Brown et al. (2021) found that intra-household inequality accounts for almost 50 percent of total inequality in caloric intakes, which is only partially accounted for by differences in caloric requirements by age, gender, and type of occupation. In Senegal, De Vreyer and Lambert (2018) estimate intra-household inequality to account for 14 percent of total consumption inequality.

Given the scarcity of individualized consumption data, researchers have relied on differences in nutrition-based anthropometric indicators (i.e., whether an adult is underweight or a child is stunted or wasted) to measure intra-household inequality. Even greater within-household differences emerge when using this approach. For example, Brown et al. (2019) find that around three-quarters of undernourished women and children in sub-Saharan Africa are not found in the poorest 20 percent of households. In other words, undernourished individuals are more likely to be found in households that are *not* poor rather than poor. Furthermore, it is not the case that all household members share similar nutritional outcomes, with many undernourished and well-nourished individuals residing in the same household.

3 The Collective Household Model

The demographic composition of the household and intra-household inequality are important dimensions for poverty measurement. In what follows, we describe how the collective household model can be used to account for these dimensions, and to measure poverty at the individual (rather than the household) level. We focus our discussion on recent formulations of the collective model by Browning et al. (2013) and Dunbar et al. (2013), who develop empirically tractable methods to understand the inner workings of the household. We provide a high-level overview of these methods as well as a discussion of recent applications that use them to improve poverty measurement.

Model Overview and Identification

In the collective household model, a household consists of different types of individuals, such as prime-aged men and women, children, and the elderly. Each individual has different preferences over goods, and may differ in their decision-making power within the household. The key assumption of the collective model is that the allocation of goods across individuals within the household is Pareto efficient. That is, no individual can be made better off without making another household member worse off.

It follows from duality theory and decentralization welfare theorems that the household program can be decomposed in two steps: i) the allocation of the household consumption expenditure across family members and ii) the individuals' maximization of their own utility subject to their own budget constraint. *Resource shares*, i.e., the share of household consumption expenditure allocated to each individual, provide an explicit measure of both the existence and extent of consumption inequality within the household. In this setting, a measure of individual-level consumption can be obtained by multiplying resource shares and total household expenditure.

The model also allows for goods to be public, private, or partially shared.[5] So, individual-level expenditures can be inflated by a scaling factor that accounts for economies of scale in consumption. The degree to which individual-level expenditure is inflated may be increasing in household size, as there are more opportunities for joint consumption in larger households. Unfortunately, neither resource shares nor economies of scale in consumption are observable in most household surveys, nor are they identified without additional assumptions.

Browning et al. (2013) identify resource shares and the extent of joint consumption by assuming preference stability across single individuals and individuals in married couples. Since data is available only at the household level, the idea is that one can use the observed behavior of singles to infer certain aspects of the unobserved behavior of couples. Subsequent work by Dunbar et al. (2013) achieve identification of resource shares (but not economies of scale in consumption) by comparing demand functions of *private assignable* goods (i.e., goods that are not shared at all, and the researcher observes which household member consumes them).[6] Importantly, this identification method does not infer rel-

[5] An example of a partially shared good is gasoline, which can be consumed jointly (e.g., when multiple individuals drive somewhere), or privately (e.g., when one drives alone).

[6] Clothing is often used as an assignable good.

ative total consumption from the relative consumption of a single good. Rather, it recovers what each individual's share of total expenditure is by placing restrictions on how preferences over an assignable good vary across either household members or household types.

Empirical Applications

Given its ability to shed light on within-household consumption, several recent studies have applied the collective household model to measure individual-level poverty. Below, we center our discussion around a subset of these studies.

We begin with the empirical analysis of Dunbar et al. (2013), who focus on measuring child poverty in Malawi. They estimate resource shares separately for men, women, and children, and document extensive inequality within the household. They find, for instance, that in a nuclear household with two children, the father, mother, and each child are allocated 42, 22, and 18 percent of the total household expenditure, respectively. The wide scope of intra-household inequality in Malawi results in per-capita measures dramatically understating poverty rates for children. Penglase (2020) extends the approach of Dunbar et al. (2013) to a setting with only partially assignable goods to estimate intra-household allocations between foster and non-foster children in Malawi, finding little evidence of inequality between them. Calvi (2020) studies resource allocation in Indian households and shows that women's resource shares relative to men's decline steadily after the age of 45, when on average women get as low as 65 percent of men's resources. As a result, at post-reproductive ages, poverty rates are significantly higher for women than men, which can help explain the disproportionately high mortality rates of older women in India.

A caveat to these works is that they do not estimate economies of scale in consumption. In other words, they provide estimates of individual *expenditure* rather than individual *consumption*. This distinction is not necessarily problematic, as households in both contexts primarily consume private goods such as food. Nonetheless, to accurately measure individual consumption, one would need to account for both intra-household inequality and joint consumption.

This is what motivates recent work by Calvi et al. (2020), who successfully identify both dimensions of consumption. Their method relies solely on observing expenditures on a single private assignable good and, unlike much of the existing literature, does not require data on single-person households. As a result, their approach is ideal for applications in developing-country settings, where individuals rarely live alone. Their empirical analysis focuses on Bangladesh and Mexico, with the goal of illustrating differences in consumption sharing across countries at different stages of economic development. In Bangladesh, they find a modest amount of consumption sharing, suggesting that ignoring economies of scale is not likely to lead to a large degree of error in individual consumption estimates. By contrast, they estimate significant economies of scale in consumption in Mexico, which, e.g., increase individual consumption in extended families or nuclear families with multiple children by 10 percent relative to nuclear families with one child.

4 Comparing Standard and Model-based Poverty Rates

Calvi et al. (2020) also compare poverty rates for Bangladesh and Mexico obtained using different consumption measures. Specifically, they juxtapose poverty rates based on per-capita expenditure, equivalent consumption, individual expenditure, and individual consumption. Figure 1 summarizes their findings. Each sub-figure features the estimates of individual consumption (their preferred measure) on the y-axis and alternative measures on the x-axis. Each dot in the scatter plot is an individual and the red lines correspond to the US$1.90/day poverty line. For individuals falling in the upper right or lower left quadrants, the two poverty measures coincide. That is, individuals who are classified as poor using individual consumption are also classified as poor when using the alternative measure. On the other hand, individuals falling in the lower right quadrant would be considered poor using individual consumption, but not the alternative measure. As shown in the figure, there is a large degree of poverty misclassification, especially when using per-capita expenditure and equivalent consumption. While the degree of poverty misclassification may vary substantially across contexts, these results show that accounting for intra-household inequality and economies of scale in consumption may matter greatly for poverty measurement. The collective household model can be used to compute poverty rates that encompass both dimensions.

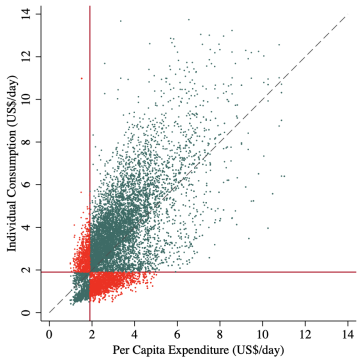
5 Limitations and Gaps

While the collective household model can help address some of the weaknesses of existing methods for poverty measurement, some limitations remain. First, none of the approaches we have discussed in this article (including the collective household model) can pin down what u_z really is, nor are they able to address the amount of resources each individual needs to attain it. To address this issue, one could set the poverty lines for children to a fraction of adults' (Dunbar et al., 2013) or rescale them based on caloric requirements by age and gender (Brown et al., 2021). Both approaches, however, are admittedly ad hoc, and could be improved on. Second, the model outlined in Section 3 is a model of household consumption behavior and ignores (by implicitly assuming separability) decisions about savings, labor supply, and home production. Future work should try to incorporate these components into the model. Third, future effort should focus on better understanding when and why identification strategies might fail, as discussed in Tommasi and Wolf (2018), and relaxing some of the modeling assumptions, as in Lewbel and Pendakur (2019). Fourth, the empirical implementation of the collective household model typically requires the estimation of highly nonlinear models, which has proven to be computationally difficult. Frameworks delivering simpler estimation models would be beneficial (Lechene et al., 2019).

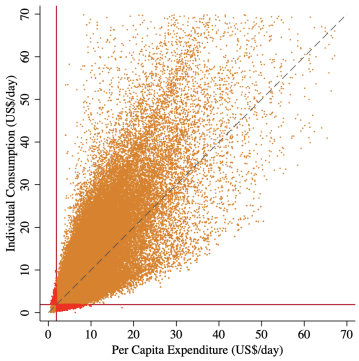
6 Summary and Policy Advice

Measuring poverty at the individual level is a critical task of anti-poverty policy. The collective household model provides a coherent framework to make advancements in this direction, and work by

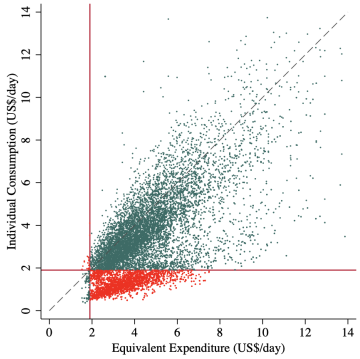
Figure 1: Poverty Rates and Poverty Misclassification



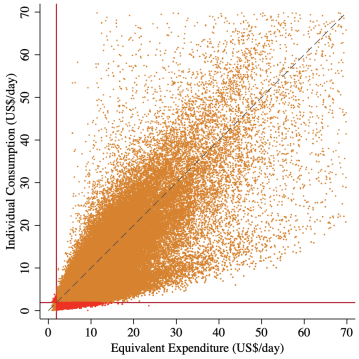
(A.1) Bangladesh: $\widehat{\eta}_{j,\tau} y/\widehat{s_\tau}$ vs. y/n



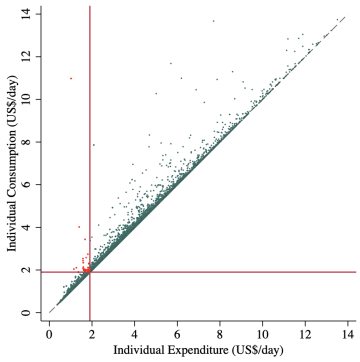
(A.2) Mexico: $\widehat{\eta}_{j,\tau} y/\widehat{s}_\tau$ vs. y/n



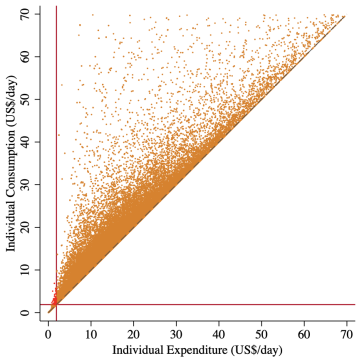
(B.1) Bangladesh: $\widehat{\eta}_{j,\tau} y/\widehat{s}_\tau$ vs. y/n_{eq}



(B.2) Mexico: $\widehat{\eta}_{j,\tau} y/\widehat{s}_\tau$ vs. y/n_{eq}



(C.1) Bangladesh: $\widehat{\eta}_{j,\tau} y/\widehat{s}_\tau$ vs. $\widehat{\eta}_{j,\tau} y$



(C.2) Mexico: $\widehat{\eta}_{j,\tau} y/\widehat{s}_\tau$ vs. $\widehat{\eta}_{j,\tau} y$

Note: The figure is taken from Calvi et al. (2020) and shows the extent of poverty misclassification. Panels A.1 and A.2 report their estimates of individual consumption against household per-capita expenditure. Panels B.1 and B.2 report their estimates of individual consumption against equivalent consumption. Panels C.1 and C.2 report their estimates of individual consumption against individual expenditure. Per-capita expenditure is obtained by dividing total household expenditure by the number of individuals in the household. Equivalent consumption is calculated by dividing total household expenditure by $1 + 0.7 * ((n_m - 1) + n_w) + 0.5 * n_c$ where n_j gives the number of men, women, and children for $j = m, w, c$, respectively. Individual expenditure is obtained by multiplying total household expenditure by resource shares. Individual consumption is obtained by dividing individual expenditure by scale economies. In Bangladesh, only households surveyed in 2015 are included. Reference lines correspond to the US$1.90/day poverty line. Dash lines identify the 45-degree lines.

policy-makers is underway to incorporate it into standard policy analysis (Lechene et al., 2019). Nevertheless, more information on individual-level welfare is needed. We hope this article will encourage the collection of richer and more detailed data, which may improve the identification and estimation of the collective household model and provide ways to validate its use for poverty measurement. As a final note, we encourage policy-makers to take within-family allocation (and its implication for poverty reduction) seriously. Relying on household-level targeting strategies for anti-poverty policy may mean that poor individuals in non-poor households will not be reached. In instances where intra-household inequality is expected to be substantial, different targeting approaches may be more effective in reaching the poor. In-kind transfers (such as school meals for children) may also be a valid alternative.

Competing Interests

The IZA World of Labor project is committed to the IZA Guiding Principles of Research Integrity. The author declares to have observed these principles.

References

BARGAIN, O., G. LACROIX, AND L. TIBERTI (2019): "Validating the Collective Model of Household Consumption Using Direct Evidence on Sharing," *IZA DP No. 11653*.

BROWN, C., R. CALVI, AND J. PENGLASE (2021): "Sharing the Pie: An Analysis of Undernutrition and Individual Consumption in Bangladesh," *Journal of Public Economics*, forthcoming.

BROWN, C., M. RAVALLION, AND D. VAN DE WALLE (2019): "Most of Africa's Nutritionally Deprived Women and Children are Not Found in Poor Households," *Review of Economics and Statistics*, 101, 631–644.

BROWN, C. AND D. VAN DE WALLE (2021): "Headship and Poverty in Africa," *World Bank Economic Review*, forthcoming.

BROWNING, M., P.-A. CHIAPPORI, AND A. LEWBEL (2013): "Estimating Consumption Economies of Scale, Adult Equivalence Scales, and Household Bargaining Power," *Review of Economic Studies*, 80, 1267–1303.

CALVI, R. (2020): "Why are older women missing in India? The age profile of bargaining power and poverty," *Journal of Political Economy*, 128, 2453–2501.

CALVI, R., J. PENGLASE, D. TOMMASI, AND A. WOLF (2020): "The More the Poorer? Resource Sharing and Scale Economies in Large Families," *IZA DP No. 13948*.

DE VREYER, P. AND S. LAMBERT (2018): "By Ignoring Intra-household Inequality, Do We Underestimate the Extent of Poverty?" .

DEATON, A. (1997): *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*, The World Bank.

DUNBAR, G. R., A. LEWBEL, AND K. PENDAKUR (2013): "Children's Resources in Collective Households: Identification, Estimation, and an Application to Child Poverty in Malawi," *American Economic Review*, 103, 438–71.

LECHENE, V., K. PENDAKUR, AND A. WOLF (2019): "OLS Estimation of the Intra-Household Distribution of Consumption," *IFS Working Papers, No. W20/06*.

LEWBEL, A. AND K. PENDAKUR (2019): "Ineffiecient Collective Households: Abuse and Consumption," *Mimeo*.

PENGLASE, J. (2020): "Consumption Inequality Among Children: Evidence from Child Fostering in Malawi," *The Economic Journal*.

RAVALLION, M. (2015): *The Economics of Poverty: History, Measurement, and Policy*, Oxford University Press.

TOMMASI, D. AND A. WOLF (2018): "Estimating household resource shares: A shrinkage approach," *Economics Letters*, 163, 75 – 78.