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How Serious is the Neglect of Intrahousehold Inequality?

Lawrence Haddad and Ravi Kanbur

Ignoring intrahousehold inequality can lead to considerable underestimates of the true *levels* of poverty and inequality. But the estimated *patterns* of poverty and inequality across key socioeconomic groups are not affected dramatically.

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Haddad and Kanbur developed a framework for assessing the consequences of ignoring intrahousehold inequality in the measurement and analysis of poverty and inequality.

After applying this framework to data for the Philippines — based mainly on relative caloric intake in households — they concluded that:

• The result of neglecting intrahousehold inequality will probably be considerable understatement of the levels of poverty and inequality. With the Philippine data, measured levels of inequality and poverty were off 30 percent as a result of ignoring intrahousehold variation.

• *Patterns* of inequality revealed by household level data are somewhat different from patterns revealed by individual level data, but the differences seem not to be dramatic. To confirm these results, the exercise should be repeated with data from other countries.

Haddad and Kanbur's conclusions are likely to be of interest to those considering the costly task of surveys focused on intrahousehold patterns in developing countries. Unless policymakers are interested primarily in more accurate measurement of levels of inequality and poverty, the exercise may not be cost-efficient.

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How Serious is the Neglect of Intrahousehold Inequality?

by Lawrence Haddad
and
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* The Authors would like to thank seminar participants at Stockholm, Leicester, Essex, Bristol, and Warwick for their helpful comments.

1. Introduction

In the measurement of inequality and poverty, the significance of intra-household inequality clearly depends on the objective of the exercise. In the growing literature on this subject, the reason for investigating intra-household inequality is that the ultimate object of concern for economic policy is the well-being of individuals. Yet most policy, and most policy analysis, has until recently equated the well-being of individuals with the average (adult-equivalent) well-being of the household to which they belong. The assumption is thus that within a household resources are divided according to need. If this were true, then policy could concentrate on increasing the resources of poor households without getting enmeshed in an intra-household policy that may be difficult to design and even more difficult to execute. However, a growing body of empirical literature has begun to question whether resources within a household are indeed distributed according to need (see Sen, 1984; Harris, 1986; Behrman, 1987). The natural corollary is thus that conventional results on the extent and pattern of inequality and poverty as revealed by household level resources have to be re-examined.

There is, however, little in the way of quantification of how much of a difference the existence of intra-household inequality would make to conventional measures of inequality and poverty. Is the understatement (if any), likely to be large? Even if the understatement of the levels of inequality and poverty is large, are the patterns of inequality and poverty grossly different when one takes account of intra-household inequality? An answer to the latter question is important since policy design (e.g. directing resources to particular regions, crop groups etc.) often relies on the pattern of poverty and inequality (see, for example, the use by Anand (1983) of inequality and poverty decomposition to analyse the efficacy of various policies in Malaysia).

The object of this paper is to present a framework in which these questions can be addressed, and then to apply this framework, to a data set from the Philippines on intra-household inequality in nutritional status. Our empirical conclusions are likely to be of interest to those who are considering undertaking the costly task of an intra-household focused survey in developing countries. These conclusions can be stated very crudely but simply as follows:

(i) The neglect of intra-household inequality is likely to lead to a considerable understatement of the levels of inequality and poverty.

(ii) However, while the patterns of inequality revealed by household level data are somewhat different to those revealed by individual level data, these differences can be argued to be not dramatic.

The plan of the paper is as follows. The next section develops an analytical framework for assessing the impact of intra-household inequality on the levels of inequality and poverty. Section 3 applies this framework after introducing our data set. Section 4 concludes the paper.

2. A Theoretical Analysis

We suppose that the object of interest is the well-being of individuals, which is measured by some agreed standard (consumption, nutrition etc.) and denoted y. It is assumed that all relevant corrections and adjustments have been made and incorporated into y (e.g. price differences, needs differences etc.) so that it really does represent the variable on which social welfare is defined. Now let x be the average of y within a household. Thus the distribution of individuals by x would ignore intra-household inequality and it is the difference between this distribution and the distribution of y that lies at the heart of the analysis in this paper.

Denote the conditional density of y given x as $a(y \mid x)$. This captures inequality within a household whose average standard of living is x. If $p(x)$ is the marginal density of x in the population, then the density of y in the population, $f(y)$, is clearly

$$(1) \qquad f(y) = \int a(y \mid x)\, p(x)\, dx$$

where the integration is over the permissible range of x (perhaps non-negative).

Notice that by definition

$$(2) \qquad E(y \mid x) = \int y a(y \mid x)\, dy = x$$

where E represents the expectation operator.

Hence,

$$(3) \qquad E(y) = \int y f(y)\, dy = \int\int y a(y \mid x)\, p(x)\, dy dx$$
$$= \int E(y \mid x)\, p(x)\, dx = E(x)$$

Thus the mean of y is the same as the mean of x. In fact, it can be shown that the distribution of y is a mean preserving spread of the distribution of x. To see this, consider a convex function $h(.)$. Note that

$$(4) \qquad E\{h(y)\} = \int h(y)\, f(y)\, dy$$
$$= \int [\int h(y)\, a(y \mid x)\, dy]\, p(x)\, dx$$
$$\geq \int h(x)\, p(x)\, dx \qquad \text{by Jensen's inequality}$$
$$= E\{h(x)\}$$

What (4) tells us is that the expectation of all convex functions is greater under the distribution of y than under the distribution of x. It therefore follows (see Rothschild and Stiglitz, 1970) that $f(y)$ is a mean preserving spread of $p(x)$, which is a fairly obvious result.

Since $f(y)$ is a mean preserving spread of $p(x)$, it follows from Atkinson (1970) that the Lorenz curve of y will be unambiguously below the Lorenz curve of x on a Lorenz diagram. This is the sense in which inequality will always be understated by using only the household level information. The "Lorenz class" of measures (see Anand, 1983) will always be lower for x than for y - for example, the Gini coefficient or the Theil index will always be understated.

To illustrate the nature of the discrepancy, consider as a measure of inequality the coefficient of variation. Since the means of y and x are the same, in this case we might as well use the variance. Writing $V(y)$ as the variance of y, $V(x)$ as the variance of x and $V(y \mid x)$ as the variance of y conditional on x (i.e. the variance of well-being within a household whose average well-being is x), we know from the analysis of variance that

$$(5) \qquad V(y) = \int V(y \mid x)\ p(x)\ dx + V(x)$$

Thus the degree of discrepancy depends on what $V(y \mid x)$ looks like for different values of x. In effect, the right hand side of (5) decomposes the inequality of y into an intra-household component and an inter-household component. The size of the intra-household component - the discrepancy between $V(y)$ and $V(x)$ - is an empirical matter and in the following section we provide quantification of the discrepancy for a range of inequality measures, based on a particular data set.

So much for the measured <u>level</u> of inequality. What about the <u>pattern</u> of inequality? Suppose that our households could be split into two mutually exclusive and exhaustive groups U and R ("urban" and "rural"). A typical investigation of the pattern of inequality involves two questions: (i) Which group has higher inequality? (ii) What a fraction of inequality is accounted for by inequality within and inequality between these two groups? These questions are asked very commonly in inequality analysis (e.g. Theil, 1967; Anand, 1983; Tsakloglou, 1988) and they are important for policy design. Would the answers differ greatly if we ignored intra-household inequality?

Taking the second question first, using subscripts U and R in an obvious way we can write:

(6) $$V(y) = \lambda_U V_U(y) + \lambda_R V_R(y) + \lambda_U \lambda_R [\mu_U(y) - \mu_R(y)]^2$$

where λ_U and λ_R are population proportions in the two groups ($\lambda_U + \lambda_R = 1$) and μ represents mean. The between group component of overall inequality in (6) is that involving the group means. The between group contribution is defined as

(7) $$C_B(y) = \frac{\lambda_U \lambda_R [\mu_U(y) - \mu_R(y)]^2}{V(y)}$$

The within group contribution is simply $1 - C_B(y)$.

If we did not have individual level data but relied on household means, then

(8) $$V(x) = \lambda_U V_U(x) + \lambda_R V_R(x) + \lambda_U \lambda_R [\mu_U(x) - \mu_R(x)]^2$$

(9) $$C_B(x) = \frac{\lambda_U \lambda_R [\mu_U(x) - \mu_R(x)]^2}{V(x)}$$

But with a suitable adaptation of (3) it follows that $\mu_U(y) = \mu_U(x)$ and $\mu_R(y) = \mu_R(x)$. Thus the absolute value of the between group component is the same whether y or x is used. Since from (5) we know that $V(y) > V(x)$, we have the result that

(10) $$C_B(y) < C_B(x)$$

Hence the between group contribution to inequality is overstated and the within group contribution is correspondingly understated when intra-household inequality is ignored. While (for ease of exposition) we have derived the result for $V(.)$, it holds true for any measure of inequality where the between group component depends only on group means (for this approach to defining "decomposability", see Shorrocks, 1980). For example, it holds true for the well known Theil index of inequality, which forms the basis of many empirical studies. The extent of over statement or understatement is an empirical matter, and we shall investigate this in the next section in the context of our data set.

What of the ranking of groups by inequality? For this, note that

(11) $$V_U(y) = \int V_U(y \mid x)\ p_U(x)\ dx + V_U(x)$$

(12) $$V_R(y) = \int V_R(y \mid x)\ p_R(x)\ dx + V_R(x)$$

From these:

$$(13) \qquad V_U(x) - V_R(x) = [V_U(y) - V_R(y)] - [\int V_U(y \mid x)\, p_U(x)\, dx - \int V_R(y \mid x)\, p_R(x)\, dx]$$

Thus we get:

$$(14) \qquad \{[V_U(y) - V_R(y)] > 0 \Rightarrow [V_U(x) - V_R(x)] > 0\}$$

$$\Leftrightarrow$$

$$\{[V_U(y) - V_R(y)] > [\int V_U(y \mid x)\, p_U(x)\, dx - \int V_R(y \mid x)\, p_R(x)\, dx]\}$$

Similar results can be derived for other indices such as the Theil index. The general point is that, if intra-household inequality in the two groups are sufficiently similar, the rankings will be preserved. However, if intra-household inequality is very much greater in the group with higher overall inequality, then suppression of this intra-household variation could lead to a ranking reversal. Whether this actually happens or not is a empirical matter, and we will investigate it further in the next section.

We turn now to an analysis of poverty. The standard approach in the literature (see Sen, 1976) is to choose a poverty line and then define a poverty index based on the gap between the value of the variable measuring the standard of well being, and its critical value as given by the poverty line.

Define a 'gap function" as $h(y, z)$, where z is the poverty line. Then a general definition of a class of poverty indices (see Atkinson, 1987) is

$$(15) \qquad P(y) = \int h(y, z)\, f(y)\, dy$$

If we only had information on household averages then we would be forced to use

$$(16) \qquad P(x) = \int h(x, z)\, p(x)\, dx$$

But

$$\begin{aligned}(17) \qquad P(y) &= \int h(y, z)\, f(y)\, dy \\ &= \int [\int h(y, z)\, a(y \mid x)\, dy]\, p(x)\, dx \\ &\geq \int [h(x, z)]\, p(x)\, dx \qquad \text{if } h \text{ is convex in } y \\ &= P(x)\end{aligned}$$

Thus if $h(., z)$ is convex in its first argument, there is definitely an understatement of true poverty by using x.

To investigate this further, consider the class of poverty indices recently introduced by Foster, Greer and Thorbecke (FGT) in 1984. In terms of (15), their index assumes

$$(18) \qquad h(y, z) = \begin{cases} \left(\dfrac{z - y}{z}\right)^{\alpha} & ; \quad y \leq z \\ 0 & ; \quad y > z \end{cases}$$

Here, α is an index of poverty aversion. When $\alpha = 0$, P becomes simply the standard head count ratio or incidence of poverty measure. When $\alpha = 1$, P emphasises the average depth of poverty while with $\alpha > 1$, P is sensitive to intra-poor transfers.

Notice that with $\alpha \geq 1$, h(y, z) is convex in y . Thus (17) holds and we can be sure that the FGT index on x will understate true poverty. However, for $\alpha < 1$ h(y , z) is neither convex nor concave over its whole range so that Jensen's inequality can no longer be used. To investigate this further, consider $\alpha = 0$. Then

$$(19) \qquad P_o(y) = \int P_o(y \mid x)\ p(x)\ dx$$

$$\gtrless P_o(y \mid \mu(x))$$

according as

$$P_o(y \mid x) \text{ is } \begin{Bmatrix} \text{convex} \\ \text{concave} \end{Bmatrix} \text{ in } x .$$

Thus if the incidence of intra-household poverty is concave in x <u>and</u> the incidence of intra-household poverty at mean household consumption exceeds the incidence of poverty defined on x , then the latter will underestimate the true incidence of poverty. <u>But</u> if the incidence of intra-household poverty is convex in x and the incidence of intra-household poverty at mean household consumption is less than the incidence of poverty defined on x , then the latter will <u>overestimate</u> the true incidence of poverty.

Other sufficient conditions can also be derived. It can be shown that if

(20) $y = h(x, \varepsilon)$

where ε is random and h is increasing and quasi-concave in its arguments, then $P_o(x)$ will understate true poverty if the poverty line is less than mean y, which is equal to mean x. (Ravallion (1988) derives this result in a different context.) A necessary and sufficient condition can be derived if we further specialise to

(21)
$$\begin{aligned} y &= x + \varepsilon \\ E(\varepsilon) &= 0 \\ Var(\varepsilon) &= \sigma_\varepsilon^2 \\ Cov(x, \varepsilon) &= 0 \end{aligned}$$

Then

$$\begin{aligned} E(y) &= E(x) \\ Var(y) &= Var(x) + \sigma_\varepsilon^2 \end{aligned}$$

If we further restrict ourselves to y and x being symmetric distributions (e.g. the normal distribution) then it follows easily that

(22) $P_o(y) \gtrless P_o(x)$ according as $z \gtrless \mu(y)$

Thus the x indicator overstates poverty if the poverty line exceeds the mean of y - we shall see an empirical verification of this result in our data set.

Let us now turn to the difference that can be made to an analysis of poverty patterns across mutually exclusive and exhaustive groups. As before, let these be indexed U and R , with population proportions λ_U and λ_R . We know that

$$(23) \qquad P(y) = \lambda_U P_U(y) + \lambda_R P_R(y)$$

and the contribution of region U to poverty, $C_U(y)$ is written

$$(24) \qquad C_U(y) = \frac{\lambda_U P_U(y)}{P(y)}$$

Similarly:

$$(25) \qquad P(x) = \lambda_U P_U(x) + \lambda_R P_R(x)$$

$$(26) \qquad C_U(x) = \frac{\lambda_U P_U(x)}{P(x)}$$

Thus

$$(27) \qquad C_U(y) - C_U(x) = \frac{\lambda_U \lambda_R P_U(x)\ P_R(x)}{P(y)\ P(x)} \quad \left[\frac{P_U(y)}{P_U(x)} - \frac{P_R(y)}{P_R(x)}\right]$$

We already know that if h is convex in y then $P_U(y) > P_U(x)$ and $P_R(y) > P_R(x)$, i.e. true poverty is understated in both groups when measured using x. However, for the measured contributions to poverty to be very different, the degree of understatement has to be greatly different in the two regions. In other words, intra-household inequality, and its pattern, has to be very different when comparing across the two groups. The same is of course also true when considering poverty ranking reversals. If $P_U(y) > P_R(y)$ and the pattern of intra-household inequality is the same or very similar in the two groups then $P_U(x) > P_R(x)$ will also hold. Only if the patterns are significantly different will ranking reversals take place. Once again, whether this happens or not is an empirical matter and we turn now to an investigation of our theoretical framework as applied to a particular dataset.

3. An Empirical Analysis

3.1 The Data Set and the Variables

Having developed a theoretical framework and some results on what difference the neglect of intra-household inequality can make to the measurement and decomposition of inequality and poverty, it is now time to investigate a specific dataset.

The data used in this study are described and evaluated fully in Bouis and Haddad (1989a). They come from a survey of the predominantly rural southern Philippine providence of Bukidnon. The survey was conducted in four rounds over a sixteen month period in 1984-85, covering 448 households comprising 2880 individuals. The only good for which we can identify individual consumption is food. Therefore we focus on food, converting dietary intake into calories and standardising by calorie requirements, to give calorie adequacy.

Calorie adequacy will be our measure of individual well being. There is now a large and controversial literature on the appropriateness of this variable for welfare and policy analysis. However, recall that our object is to investigate the consequences of neglecting intra-household inequality for the measurement of inequality and poverty. Food consumption is one of the few variables on which intra-household data can be collected and as such, is suited to our analysis.

Calorie intakes in our data set represent 24 hour recalls by the mother, of food eaten by individual family members. This information may be subject to a number of errors, both in overall quantity recall and allocative recall. Burke and Pao (1976) review the methodological evaluation literature for large scale surveys of individual diets. Using the evaluation criteria of reliability (small variable errors), validity (small biases), respondent burden, and data costs, they compare 24 hour recalls with dietary history, food weighing and inventory-record methodologies. They conclude that "no one method was consistently advantageous over all others". 24 hour recalls did well in terms of light respondent burden and ease of collection, but were biased to an extent primarily dependent on the skill and probing abilities of the enumeration team. The studies reviewed covered mainly developed countries, and we should note that different problems may arise from their application in less developed countries: toddler "snacking" away from home, for instance (although less varied LDC diets may strengthen the 24 hour recall method).

The position with respect to the 24 hour recall method is summed up by Chavez and Huenemann (in Sahn et al, 1984): "Because of the short time period, this method [24 hour recall] is more economical than the detailed method and the modified dietary history method. One day may or may not represent a 'typical' intake for the individual household. Twenty-four hour intakes of a large sample of households may, however, represent a typical daily intake for the community as a whole". We have minimised problems of representativeness by using only four-round <u>averages</u> of calorie intake for each individual in an attempt to make the dietary snapshots more typical. This technique has been used for a number of years by the USDA in its National Food Consumption Surveys (USDA, 1988).

Concerning measurement errors, two sources of evidence attest to the accuracy of our enumerators' data collection efforts. Firstly, calorie consumption figures calculated from two different methodologies (24 hour recall and food expenditure data) exhibited a high degree of correspondence at the means of the data (Bouis and Haddad, 1989b). Furthermore, the 24 hour recall intakes corresponded closely to a small, overlapping, subsample of food weighings conducted simultaneously (Corpus et al, 1987).

The denominator of the calorie adequacy ratio is calorie requirement. We use orthodox recommended daily allowance (RDA) calorie figures for a healthy Philippine population with requirements diasaggregated into thirty-two age-gender-pregnancy status categories (details in Bouis and Haddad, 1988). We recognise the limitations of RDA's in the context in which we plan to use them. Firstly, in a normal distribution of healthy individuals in a given age-gender-pregnancy-activity level group, 50% will have intakes below the RDA. This reflects the construction of RDA's as an average requirement (Davidson, et al, 1979). Secondly, the requirements take no account of an individual's unrestricted physical activity level. Even the crude classification into limited, moderate, and extreme physical activity is difficult to achieve in the absence of well collected time-activity data. Thirdly, the requirements take no account of individual adaptation to food availability in the form of activity patterns, longitudinal growth retardation and, to a lesser extent, basal metabolic rate adjustment.

These problems are not trivial, but until individual requirements for full functional capacity are available the best we can do is to use the RDA's, and note that they represent "an order of magnitude" (Achaya, 1983).

Our object is to assess the seriousness of neglecting intra-household inequality. In our data set, since we have individual level data we can "pretend" that we do not have this information by taking household averages. However, in the empirical context we now have a choice of whether to take the mean of individual adeuqacy ratios, or to take the ratio of the within-household mean of individual calorie intakes and individual requirements. There are thus three variables of interest: individual calorie adequacy, ϕ , mean individual calorie adequacy within the household, ϕ_1, and household calorie adequacy, ϕ_2 . More precisely, let

C_i = calorie intake of individual i

R_i = calorie requirement of individual i

$\phi_i = C_i/R_i$ = calorie adequacy of individual i

n_h = number of individuals in household h .

$\phi_{1i} = \frac{1}{n_h} \sum_{i=1}^{n_h} \phi_i$ = mean of individual calorie adequacy within the household, which is assigned to each household member.

$\phi_{2i} = \frac{\sum_{i=1}^{n_h} C_i}{\sum_{i=1}^{n_h} R_i}$ = household calorie adequacy, which is assigned to each household member.

Referring to our theoretical discussion, ϕ corresponds to y and ϕ_1 to x . But in the empirical context we typically have to deal not with ϕ_1 but with ϕ_2 since information is collected at the household level on calorie intake and calorie requirement separately While ϕ_1 and ϕ_2 will differ, we shall see that the difference, and its empirical effect, is not very great.

These three variables are calculated for all 2800 individuals in our sample. We should note that all individuals within a household will have identical values for ϕ_1 . The same is true for ϕ_2 . Figure 1 shows the relative frequency plots for the three variables. Nor surprisingly, the range for ϕ is the largest of the three. Its distribution is skewed to the right but approaches

normality. The plot for ϕ_1 is less of a normal approximation than ϕ , while the plot for ϕ_2 is fairly similar to that of ϕ_1 .

The mean of ϕ over the 2880 individuals in the sample is 0.87765, indicating that on average our sample is significantly undernourished. The mean of ϕ_1 is by definition the same as the mean of ϕ . However, the mean of ϕ_2 is 0.88835, an excess of 1.2%, indicating slight negative correlation between calorie intake and calorie requirement. Our real object, however, is to examine and compare measures of inequality and poverty defined over ϕ , ϕ_1 and ϕ_2 . We start with inequality.

3.2 Measurement and Decomposition of Inequality

Figure 2 compares the Lorenz curve of ϕ with those of ϕ_1 and ϕ_2 . We proved in Section 2 that the Lorenz curve of ϕ_1 would be unambiguously closer to the line of perfect equality than the Lorenz curve of and this is shown to be the case in Figure 2a. The same comparison holds for ϕ_2 and ϕ , and in fact the Lorenz curves of ϕ_1 and ϕ_2 are almost identical.

Table 1 quantifies inequality differences with respect to five commonly used measures of inequality: the coefficient of variation, the log-variance, the Gini coefficient, the Theil index T, Theil's second measure L and the Atkinson equally distributed equivalent measure of inequality with inequality aversion parameter equal to 2. The exact definitions of these measures are to be found in Kanbur (1984). The first point to note is how close the measures based on ϕ_1 and ϕ_2 are to each other. With this in mind, we concentrate on the differences between ϕ and ϕ_1 .

As can be seen, the understatements of inequality when intra-household inequality is suppressed can be very large, ranging from around 60% for the log-variance, the Theil T , and Theil L and the Atkinson measure, to 35% for the Gini and the coefficient of variation. It may be tempting to attribute the difference to "within" household inequality, but such a precise attribution depends on whether or not the measure is "decomposable" in the sense of Shorrocks (1980). Only the two Theil measures satisfy the relevant conditions of strict sub-group decomposability.

Figure 1. Relative Frequenc. ~:stributions for Ø, $Ø_1$, and $Ø_2$

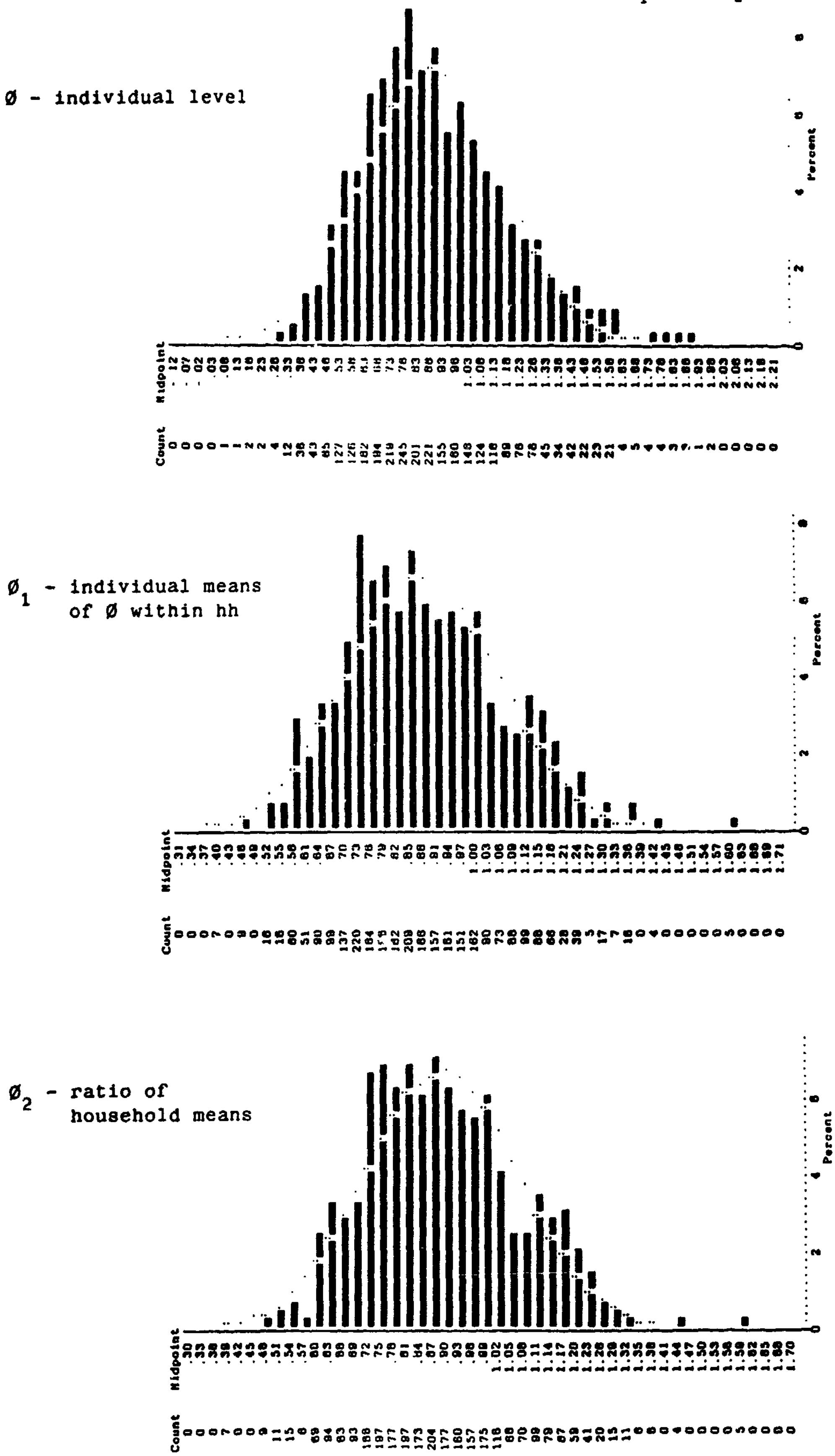
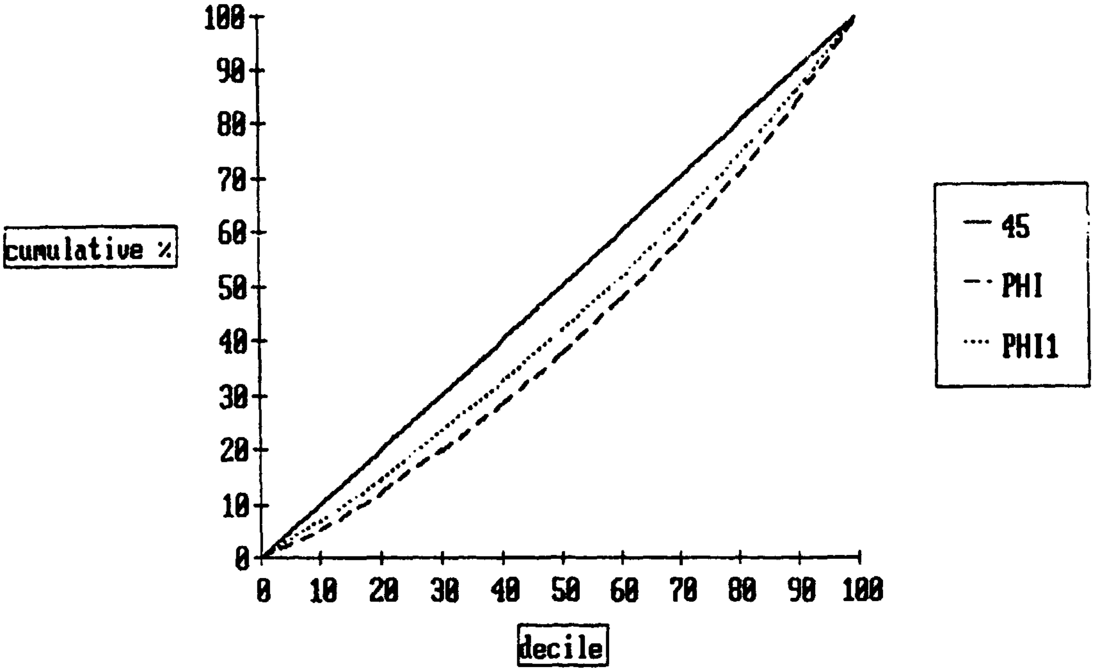
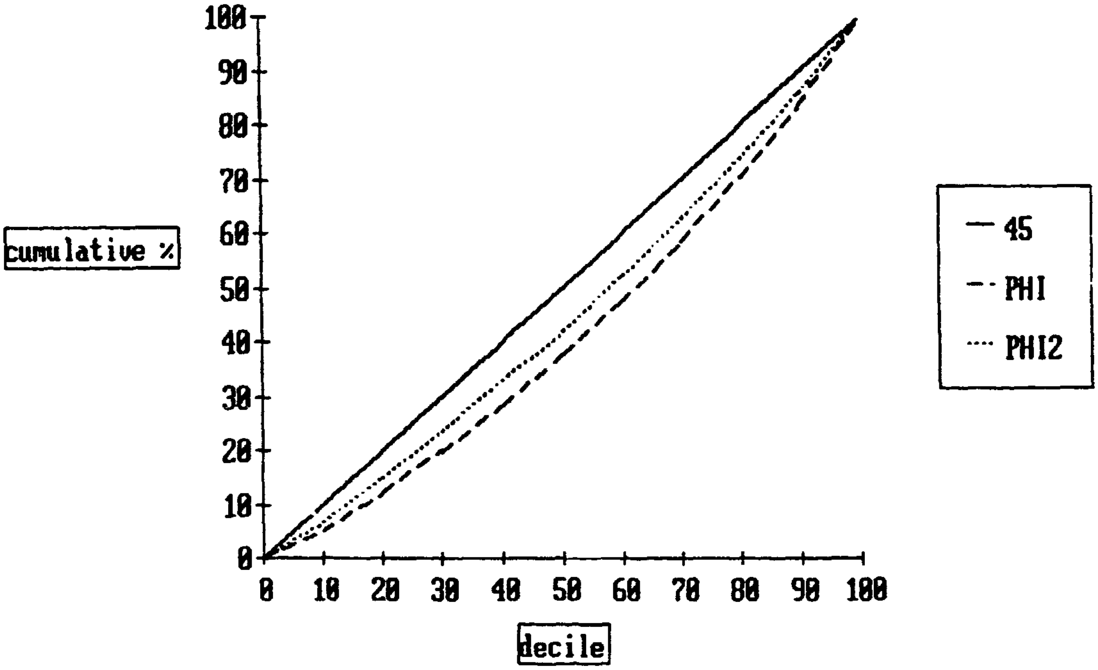


Figure 2. Lorenz Curves for Ø, $Ø_1$, and $Ø_2$





We turn now to the issue of the pattern of inequality as revealed by the data. It is traditional in inequality and poverty analysis to decompose inequality along key socio-economic dimensions. Thus Anand (1983) provides a profile of inequality in Malayasia along racial lines while Tsakloglou (1988) does the same exercise for Greece along regional lines. The exact nature of the profile depends on the policy question at hand. In the Philippine region of Bukidnon, one of the central issues has been the impact of a move from corn to sugar production on inequality and poverty. Bouis and Haddad (1988) provide a detailed analysis of the nutrition and income effects of the introduction of sugar can cultivation in the study area. Our object here is more limited - it is to investigate the sensitivity of the pattern of inequality, across the sub-groups identified by Bouis and Haddad (1989a) as being important, to the use of individual or household level data.

The first panel of Table 2 shows a decomposition of the Theil T index across three mutually exclusive and exhaustive types of households - corn producers, sugar producers and others. As can be seen, the 2880 individuals in the sample are divided as follows: 1565 in corn producing households, 1082 in sugar producing households and 233 in other households. It is immediately seen that if we compare inequality as measured by the Theil T index defined on ϕ (individual level data), inequality among individuals in sugar households is greater than that among individuals in corn households, while inequality among households that grow neither crop is greatest. A shift in favour of sugar, particularly if this creates landless labourers in the process is therefore worrying from the point of view of inequality. Would this conclusion have been greatly affected if we

Table 1. Inequality Measures for ϕ , ϕ_1 , and ϕ_2 .

Variable	n	mean	Coefficient of Variation	Log Variance	Gini Coefficient	TheilT (base e)	TheilL (base e)	Atkinson Measure (ε=2)
ϕ	2880	.87765	.31419	.10897	.1754	.04873	.05078	.10229
ϕ_1	2880	.87765	.20386	.04257	.1148	.02059	.02083	.04127
(% of ϕ)			(65)	(39)	(65)	(42)	(41)	(40)
ϕ_2	2880	.88835	.19998	.04118	.1090	.01986	.02012	.03996
(% of ϕ)			(64)	(38)	(62)	(41)	(40)	(40)

had had information on calorie adequacy only at the household level? The answer is no. The inequality ranking of the three groups remains unchanged whether ϕ , ϕ_1 or ϕ_2 is used as the basis of inequality calculations. As was pointed out in Section 2, for ranking reversals to take place it has to be the case that patterns of intra-household inequality are vastly different from group to group - this is clearly not the case for our data set.

An alternative dimension to be considered is tenure status. As Bouis and Haddad (1989a) document, households which managed to overcome the barriers to entry of sugar cane cultivation (i.e. those who secured a mill contract, with sufficient credit, and were close enough to the mill so as not to make transport costs prohibitive) realised substantial increases in agricultural profits. However, for every household able to capitalise on the mill start-up there was a household that experienced a degradation in tenure status. Because of the low profits earned on corn cultivation, landowners unable to overcome the barriers to sugar cane cultivation were tempted into short-run capital gains through selling their land and then selling their labour. Some pre-sugar share-tenants were simply evicted by landowners eager to reap the sugar cane profits, and were replaced by migrant cane labourers.

The second panel in Table 2 provides intra-group inequalities based on ϕ , ϕ_1 and ϕ_2 for five tenure status groups. Once again, we see that the rankings remain unaffected. The lowest inequality is among households that have a mixed owner/renter status, with pure tenancy status coming next, followed by labourers, owners,

Table 2. Theil T Inequality Measures For Selected Subgroups Using ϕ, ϕ_1, and ϕ_2

GROUP	N	$\mu(\phi)$	$\mu(\phi_1)$	$\mu(\phi_2)$	$T(\phi)$	$T(\phi_1)$	$T(\phi_2)$
Corn	1565	.88379	.88379	.89338	.04736	.02019	.01953
Sugar	1082	.87938	.87938	.89144	.04999	.02065	.01980
No Crop	233	.82843	.82843	.84025	.05048	.02141	.02083
Within					.04859	.02046	.01973
Between					.00014	.00014	.00013
% Between					0.29	0.68	0.66
Owner	695	.89826	.89826	.90311	.05076	.02113	.01993
Mix	516	.89603	.89603	.90497	.04401	.01815	.01785
Tenant	758	.88679	.88679	.90000	.04728	.02017	.01964
Labourer	580	.84614	.84614	.86168	.04838	.02018	.01987
Other Ten	331	.84004	.84004	.85154	.05292	.02203	.02107
Within					.04837	.02024	.01959
Between					.00036	.00036	.00028
% Between					0.74	1.8	1.4
Corn Own	341	.89133	.89133	.89588	.05232	.02227	.02126
Corn Mix	310	.87277	.87277	.88165	.04223	.01715	.01693
Corn Share	549	.89237	.89237	.90350	.04491	.02022	.01996
Corn Lab	267	.87524	.87524	.88847	.04788	.01968	.01859
Sug Own	354	.90494	.90494	.91006	.04922	.01999	.01861
Sug Mix	206	.93104	.93104	.94007	.04529	.01835	.01795
Sug Rent	209	.87215	.87215	.89079	.05347	.01983	.01871
Sug Lab	313	.82131	.82131	.83882	.04787	.01967	.02023
Other Occ	233	.82843	.82843	.84025	.05048	.02141	.02083
Corn Othrnt	98	.86765	.86765	.87838	.05771	.02269	.02093
Within					.04814	.02001	.01938
Between					.00059	.00059	.00049
% Between					1.21	2.9	2.5

Notes:
1. "Other Ten" ≡ Other Tenure Status.
2. Abbreviations in third panel correspond to full labels given in Table 3.

and other tenure status households. This inequality ranking was maintained whether individual level or household level information was used. Clearly, then, the extra information of intra-household inequality does not affect the conclusion on patterns of inequality at this level of disaggregation, and therefore any conclusions that might follow on the consequence for overall inequality of the introduction of sugar cultivation.

The final level of disaggregation we tried was that given in the third panel of Table 2, where ten mutually exclusive and exhaustive groups of households are identified according to crop and tenure status. We would expect, of course, that as the diasggregation becomes finer and finer and groups become more homogenous, eventually ranking changes would begin to appear. Table 3 shows the ranks in question. Using ϕ the corn/mixed tenancy group is the least unequal while the corn/other rental arrangement group is most unequal. The same is true if we use ϕ_1 . With ϕ_2 the corn/mixed group is still least unequal but the corn/owner group is now most unequal. According to the ϕ and ϕ_1 rankings the corn/owner groups is 8th most unequal and 9th most unequal respectively. In order to get a quantitative feel for the extent of rank reversal we calculated Spearman's rank correlation coefficients. The rank correlation coefficient between ϕ_1 and ϕ_2 is 0.85, indicating very close association between the two ranks. That between ϕ and ϕ_1 is 0.72. The lowest value for the coefficient is between ϕ and ϕ_2 is 0.66. Thus we can conclude that the extent of rank changes when we switch from individual to household level data is significant but not dramatic.

Table 3: Theil T Inequality Rankings For Crop-Tenancy Groups By Household and Individual-Level Data

Group	Ranking By		
Least Unequal	ϕ	ϕ_1	ϕ_2
Corn mixed tenancy	1	1	1
Corn share tenant	2	7	6
Sugar mixed tenancy	3	2	2
Sugar labourer	4	3	7
Corn labourer	5	4	3
Sugar owner	6	6	4
Other occupation	7	8	8
Corn owner	8	9	10
Sugar renter	9	5	5
Corn other rental arrangement	10	10	9
Most Unequal			

Finally, from Table 2 we note the empirical confirmation of our theoretical result that the between group component of inequality will be unchanged whether ϕ or ϕ_1 is used, since this depends only on group means and the conditional mean of ϕ is the same as the conditional mean of ϕ_1 for any conditioning variable. Since the within group component of inequality is inevitably greater with ϕ than with ϕ_1, it follows that the contribution of this component to total inequality when ϕ is used is greater than when ϕ_1 is used. Correspondingly, with ϕ the contribution of the between group component is lower than with ϕ_1. In our dataset, these conslusions are unchanged when ϕ_1 is replaced by ϕ_2.

3.3 Measurement and Decomposition of Poverty

In Section 2 we derived a number of theoretical results on the likely impact of intra-household inequality on measured poverty. The object of this subsection is to consider an empirical analysis based on our data set. Any measurement of poverty requires us to specify a poverty line. In the context of the variable of interest in this study - the calorie adequacy ratio - an appropriate poverty line is simply 1. All those with calorie adequacy ratio less than 1 can reasonably be argued to be undernourished or "poor" in the terminology of income poverty. We will concentrate attention on the class of poverty indices put forward by Foster, Greer and Thorbecke (1984). Adapting the notation of (15) and (18), these can be written as

$$P_\alpha = \int_0^1 (1 - \phi)^\alpha f(\phi)\, d\phi$$

where ϕ is calorie adequacy, f(.) its frequency density, and α is the poverty aversion parameter. We focus on $\alpha = 0, 1, 2$ in our discussion.

Table 4 presents values of P_o , P_1 , and P_2 based on ϕ , ϕ_1 , and ϕ_2 . We have already proved that for $\alpha \geq 1$ P_α for ϕ will exceed P_α for ϕ_1 . This is seen in the table. Ignoring intra-household inequality leads to an understatement of P_1 of 18.4% if ϕ_1 is used and 23.0% if ϕ_2 is used. Similarly, if P_2 is the accepted index of poverty then there is an understatement of 39.4% with ϕ_1 and 44.4% with ϕ_2 . Clearly, then, there is a dramatic understatement of poverty if intra-household inequality is ignored, for $\alpha \geq 1$.

However, notice with with $\alpha = 0$ the situation is the other way round, there is now a significant <u>overstatement</u> of poverty if intra-houshehold inequality is ignored. Using ϕ there are 70.2% of individuals below the calorie adequacy ratio of 1, while using ϕ_1 76.9% of individuals fall below this critical value - an overstatement of 9.4%. The explanation for this reversal is to be found in equation (22) of Section 2. Under certain conditions we showed that the incidence of poverty (or under-nutrition) will be overstated by household level data if the poverty line exceeds the population mean. This is exactly what happens in our data - the mean of ϕ (and ϕ_1) is 0.88 while the chosen poverty line is 1.00.

Table 4. Poverty Measures For ϕ , ϕ_1 and ϕ_2

Variable	n	Mean	P_o	P_1	P_2
ϕ	2880	.87765	.70243	.18640	.06759
ϕ_1	2880	.87765	.76875	.15201	.04093
ϕ_2	2880	.88835	.75764	.14355	.03756

Note: P_o , P_1 , and P_2 are the P_α class of indices where $\alpha = 0, 1, 2$

Table 5. P_α Poverty Measures For Selected Subgroups Using ϕ, ϕ_1, and ϕ_2

GROUP	N	$P_o(\phi)$	$P_1(\phi)$	$P_2(\phi)$	$P_o(\phi_1)$	$P_1(\phi_1)$	$P_2(\phi_1)$	$P_o(\phi_2)$	$P_1(\phi_2)$	$P_2(\phi_2)$
ALL	2880	.70243	.18640	.06759	.76875	.15201	.04093	.75764	.14355	.03756
Corn	1565	.69521	.18144	.06483	.75463	.14661	.03925	.73738	.13897	.03632
Sugar	1082	.70055	.18592	.06811	.77634	.15042	.04029	.77172	.14125	.03647
No Crop	233	.75966	.22203	.08369	.82833	.19571	.05516	.82833	.18494	.05097
Owner	695	.68345	.17584	.06342	.74964	.14021	.03716	.74964	.13459	.03495
Mix	516	.67636	.17171	.05930	.70543	.13731	.03354	.72093	.13092	.03137
Tenant	758	.68865	.17792	.06445	.76253	.14202	.03822	.74802	.13265	.03441
Labourer	580	.74310	.20589	.07605	.83276	.17269	.04884	.78276	.16133	.04424
Other Ten	331	.74320	.21676	.08159	.80967	.18633	.05270	.80967	.17582	.04822
Corn Own	341	.68622	.18359	.06663	.73607	.14803	.03970	.73607	.14226	.03797
Corn Mix	310	.71613	.18241	.06382	.70968	.15507	.03895	.70968	.14857	.03646
Corn Share	549	.68852	.17219	.06080	.76138	.13601	.03740	.74499	.12825	.03452
Corn Lab	267	.69288	.18820	.06766	.81273	.15036	.04007	.74532	.14009	.03578
Sug Own	354	.68079	.16837	.06034	.76271	.13269	.03472	.76271	.12720	.03204
Sug Mix	206	.61650	.15562	.05250	.69903	.11059	.02541	.73786	.10435	.02370
Sug Rent	209	.68900	.19298	.07404	.76555	.15781	.04037	.75598	.14421	.03412
Sug Lab	313	.78594	.22099	.08320	.84984	.19174	.05632	.81470	.17946	.05146
Other Occ	233	.75966	.22203	.08369	.82833	.19571	.05516	.82833	.18494	.05097
Corn Orthnt	98	.70408	.20423	.07661	.76531	.16404	.04685	.76531	.15414	.04168
Male	1484	.72372	.19017	.06863	.77089	.15058	.04016	.76146	.14262	.03691
Female	1396	.67980	.18240	.06648	.76648	.15353	.04175	.75358	.14453	.03826
Adult*	1191	.48615	.10074	.03259	.75231	.14757	.03957	.74139	.13920	.03633
Non Adult	1689	.85494	.24681	.09226	.78034	.15515	.04189	.76909	.14661	.03843

* Non-Adults are defined as individuals less than or equal to nineteen years of age in accordance with definitions employed by the National Nutrition Council of the Philippines for calorie requirements. (NNC, 1976).

Table 6. P_1 Poverty Rankings For Crop-Tenancy Groups by Household and Individual-Level Data

Group	Ranking By		
Least Poverty	ϕ	ϕ_1	ϕ_2
Sugar mixed tenancy	1	1	1
Sugar owner	2	2	2
Corn share tenant	3	3	3
Corn mixed tenancy	4	6	7
Corn owner	5	4	5
Corn labourer	6	5	4
Sugar renter	7	7	6
Corn other rental arrangement	8	8	8
Sugar labourer	9	9	9
Other occupation	10	10	10
Most poverty			

Let us turn now to the pattern of poverty across socio-economic groups. Table 5 presents group values of P_α indices. The first three panels of Table 5 use the same mutually exclusive and exhaustive groups as in Table 2. The policy relevance of these household level grouping has already been discussed in Section 3.2.

The theoretical significance of P_α rankings of sectors and groups has been discussed by Kanbur (1987) in the context of targeting and poverty alleviation. We note here that there are no ranking changes in the first or the second panel. As argued earlier, we would expect some rank changes to occur as the classification gets finer. However, even with 10 groups the changes are very small. Table 6 summarises the rankings for the P_1 measure. As can be seen, the three poorest and three least poor groups in the ranking are unchanged as between ϕ , ϕ_1 and ϕ_2 . The rank correlation coefficient between ϕ and ϕ_1 is (0.96) and that between ϕ and ϕ_1 is (0.96) and that between ϕ and ϕ_2 is (0.9). Clearly, then the neglect of intra-household inequality is not leading to dramatic changes in poverty ranking.

The groupings used so far, and those discussed in the theoretical section, are those defined at the household level. For some policy purposes, however, individual level groupings are required. The last two panels in Table 5 consider two such groupings which are of obvious interest - male/female and adult/non-adult. The adult/non-adult division reveals no P_α ranking differences as between ϕ , ϕ_1 and ϕ_2 . However, we find that male-female P_1 and P_2 rankings are reversed when comparing ϕ with ϕ_1 and ϕ with ϕ_2 . This could be potentially serious if targeting policy towards males and females (for example in supplemental feeding programmes) is to be based on the degree of observed under-nutrition in these groups. However, this is the only case, in all of the decompositions in Table 5, where rank reversal is potentially serious.

Finally, we consider group contributions to poverty based on ϕ , ϕ_1 and ϕ_2 . Table 7 presents this analysis. The first four panels in Table 7 show the similar contributions each group makes to overall poverty whether we use ϕ , ϕ_1 , or ϕ_2 . As we argued earlier, intra-household inequality would have to be very different when comparing across groups for the contributions to poverty to differ by much.

Although the only individual-level grouping that experiences a ranking reversal in Table 5 is the male/female classification, the difference between adult/non-adult poverty levels widens substantially as we move from poverty measures based on ϕ_1 and ϕ_2 , to those based on ϕ . This is emphasised in the bottom panel of Table 7, which shows the non-adult contribution to poverty measures based on ϕ be in the 70-80% range, but falling to 60% when ϕ_1 and ϕ_2 are used.

Table 7. Percentage Group Contributions to Pα Poverty Measures using ϕ , ϕ_1 , and ϕ_2

GROUP	N	$P_o(\phi)$	$P_1(\phi)$	$P_2(\phi)$	$P_o(\phi_1)$	$P_1(\phi_1)$	$P_2(\phi_1)$	$P_o(\phi_2)$	$P_1(\phi_2)$	$P_2(\phi_2)$
ALL	2800	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Corn	1565	53.8	52.9	52.1	53.3	52.4	52.1	52.9	52.6	52.5
Sugar	1082	37.5	37.5	37.9	37.9	37.2	37.0	38.3	37.0	36.5
No Crop	233	8.7	9.6	10.0	8.7	10.4	10.9	8.8	10.4	11.0
Owner	695	23.5	22.8	22.6	23.5	22.3	21.9	23.9	22.6	22.5
Mix	516	17.3	16.5	15.7	16.4	16.2	14.7	17.0	16.3	15.0
Tenant	758	25.8	25.1	25.1	26.1	24.6	24.6	26.0	24.3	24.1
Labourer	580	21.3	22.2	22.7	21.8	22.9	24.0	20.8	22.6	23.7
Other Ten	331	12.2	13.4	13.9	12.1	14.1	14.8	12.3	14.1	14.8
Corn Own	341	11.6	11.7	11.7	11.3	11.5	11.5	11.5	11.7	12.0
Corn Mix	310	11.0	10.5	10.2	9.9	11.0	10.2	10.1	11.1	10.4
Corn Share	549	18.7	17.6	17.1	18.9	17.1	17.4	18.7	17.0	17.5
Corn Lab	267	9.1	9.4	9.3	9.8	9.2	9.1	9.1	9.0	8.8
Sug Own	354	11.9	11.1	11.0	12.2	10.7	10.4	12.4	10.9	10.5
Sug Mix	206	6.3	6.0	5.6	6.5	5.2	4.4	7.0	5.2	4.5
Sug Rent	209	7.1	7.5	7.9	7.2	7.5	7.2	7.2	7.3	6.6
Sug Lab	313	12.2	12.9	13.4	12.0	13.7	15.0	11.7	13.6	14.9
Other Occ	233	8.7	9.6	10.0	8.7	10.4	10.9	8.8	10.4	11.0
Corn Othrnt	98	3.4	3.7	3.9	3.4	3.7	3.9	3.4	3.7	3.8
Male	1484	53.1	52.6	52.3	51.7	51.0	50.6	51.8	51.2	50.6
Female	1396	46.9	47.4	47.7	48.3	49.0	49.4	48.2	48.8	49.4
Adult*	1191	28.6	22.3	19.9	40.5	40.1	40.0	40.5	40.1	40.0
Non-Adult	1689	71.4	77.7	80.1	59.5	59.9	60.0	59.5	59.9	60.0

*Non-Adults are defined as individuals less than or equal to nineteen years of age in accordance with definitions employed by the National Nutrition Council of the Philippines for calorie requirements (NNC, 1976).

4. Conclusion

The object of this paper has been, firstly, to develop a framework in which the consequences of ignoring intra-household inequality for the measurement and decomposition of inequality and poverty can be assessed and, secondly, to apply this framework to a particular dataset. Our theoretical analysis suggested that potentially serious errors could be made so far as the levels of inequality and poverty are concerned. Empirically, we showed that this is indeed the case - the errors are of the order of 30% or more. In the case of poverty measurement we showed theoretically and empirically that for certain measures of poverty the errors could be of either sign - a careful analysis is therefore required before any claims are made as to whether poverty is understated or overstated.

So far as the patterns of inequality and poverty are concerned, our theoretical analysis was more equivocal - significant differences in the cross group patterns of intra-household inequality are required to reverse the true rankings of policy-relevant socio-economic groups by inequality and poverty, when intra-household inequality is ignored. Our empirical analysis lends support to this equivocation - the changes in patterns of inequality when intra-household inequality is ignored are by no means dramatic; sometimes, they hardly change at all.

There is clearly a need to further confirm our results for other data sets in other countries. We hope to have provided both a framework in which such analysis can proceed and a preliminary indication that the results are important to policy makers who are considering whether or not to launch a costly intra-household oriented survey. The conclusions based on our data set are that the collection of such data is important if the object is to get an estimate of the levels of inequality and poverty; but if the object is to discover the patterns of inequality and poverty across key socio-economic groups, the policy maker would do well to assess carefully the costs and benefits of such an exercise.

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