How Serious is the Neglect of Intra-Household Inequality?

Lawrence Haddad
Ravi Kanbur

Reprinted from
The Economic Journal
Vol. 100, No. 402, September 1990

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036-1998 U.S.A.

Reprint No. 195

The Economic Journal, 100 (*September* 1990), 866–881
Printed in Great Britain

HOW SERIOUS IS THE NEGLECT OF INTRA-HOUSEHOLD INEQUALITY?*

Lawrence Haddad and Ravi Kanbur

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 and examine whether resources within a household are indeed distributed according to need (see Sen, 1984; Harriss, 1986; Behrman, 1989; Thomas, 1989). 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

* The authors would like to thank the International Food Policy Research Institute, Washington D.C. for access to the Philippine data set.

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 II applies this framework after introducing our data set. Section III concludes the paper.

I. 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 mean of the distribution of individuals by x is the same as the mean of y. However, the distribution of individuals by x would ignore intra-household inequality and it is the difference between 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

$$f(y) = \int a(y \mid x)\, p(x)\, dx, \tag{1}$$

where the integration is over the permissible range of x.

Consider a convex function $h(\cdot)$. Note that

$$\begin{aligned} \mathrm{E}[h(y)] &= \int\left[\int h(y)\, a(y \mid x)\, dy\right] p(x)\, dx \\ &\geqslant \int h(x)\, p(x)\, dx \quad \text{by Jensen's inequality} \\ &= \mathrm{E}[h(x)]. \end{aligned} \tag{2}$$

What (2) 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. It also 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 further the nature of the understatement, 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 $V(y|x)$ 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

$$V(y) = \int V(y|x)\,p(x)\,dx + V(x). \tag{3}$$

In effect, the right-hand side of (3) 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 *level* of inequality. What about the *pattern* 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 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 for the two groups we can write:

$$V(y) = \lambda_U V_U(y) + \lambda_R V_R(y) + \lambda_U \lambda_R [\mu_U(y) - \mu_R(y)]^2, \tag{4}$$

where λ_U and λ_R are population proportions in the two groups ($\lambda_U + \lambda_R = 1$) and μ represents the mean. The between group component of overall inequality in (4) is that involving the group means. The between group *contribution* is defined as

$$C_B(y) = \frac{\lambda_U \lambda_R [\mu_U(y) - \mu_R(y)]^2}{V(y)}. \tag{5}$$

The within group contribution is simply $1 - C_B(y)$. If we did not have individual level data but relied on household means, then

$$V(x) = \lambda_U V_U(x) + \lambda_R V_R(x) + \lambda_U \lambda_R [\mu_U(x) - \mu_R(x)]^2, \tag{6}$$

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

But it is easy to show 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 (3) we know that $V(y) > V(x)$, we have the result that

$$C_B(y) < C_B(x). \tag{8}$$

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 $V(\cdot)$, 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 overstatement 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? It can be shown (Haddad and Kanbur, 1989) that

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

$$\Longleftrightarrow$$

$$\left\{[V_U(y) - V_R(y)] > \left[\int V_U(y \mid x)\, p_U(x)\, dx - \int V_R(y \mid x) p_R(x)\, dx\right]\right\}. \tag{9}$$

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 an 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

$$P(y) = \int h(y, z) f(y)\, dy. \tag{10}$$

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

$$P(x) = \int h(x, z)\, p(x)\, dx. \tag{11}$$

But from (2) we know immediately that $P(y) \geqslant P(x)$ if $h(\cdot, z)$ is convex in its first argument.

To investigate this further, consider the class of poverty indices recently introduced by Foster, Greer and Thorbecke (FGT) in 1984. In terms of (10), their index assumes

$$h(y,z) = \begin{cases} \left(\dfrac{z-y}{z}\right)^{\alpha}; & y \leqslant z, \\ 0; & y > z. \end{cases} \tag{12}$$

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 $\alpha \geqslant 1$, $h(y, z)$ is convex in y 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 $\alpha = 0$. A necessary and sufficient condition can be derived if we specialise to

$$\left.\begin{aligned} y &= x+\epsilon, \\ \mathrm{E}(\epsilon) &= 0, \\ \mathrm{Var}(\epsilon) &= \sigma_\epsilon^2, \\ \mathrm{Cov}(x,\epsilon) &= 0. \end{aligned}\right\} \tag{13}$$

Then

$$\mathrm{E}(y) = \mathrm{E}(x),$$

$$\mathrm{Var}(y) = \mathrm{Var}(x) + \sigma_\epsilon^2.$$

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

$$P_0(y) \gtrless P_0(x) \quad \text{according as} \quad z \gtrless \mu. \tag{14}$$

This is in fact a special case of a more general result of Ravallion (1988), derived in a different context. 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 from (10) and (11) that

$$P(y) = \lambda_U P_U(y) + \lambda_R P_R(y); \quad P(x) = \lambda_U P_U(x) + \lambda_R P_R(x) \tag{15}$$

and the contribution of region U to poverty in the two cases is therefore

$$C_U(y) = \frac{\lambda_U P_U(y)}{P(y)}; \quad C_U(x) = \frac{\lambda_U P_U(x)}{P(x)}. \tag{16}$$

Thus

$$C_U(y) - C_U(x) = \frac{\lambda_U \lambda_R P_U(x) P_R(x)}{P(y) P(x)} \cdot \left[\frac{P_U(y)}{P_U(x)} - \frac{P_R(y)}{P_R(x)}\right]. \tag{17}$$

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.

II. AN EMPIRICAL ANALYSIS

II.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 (1989*a*). 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 1984–5, covering 448 households comprising 2,880 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. However, as Burke and Pao's (1976) review of alternative food intake enumeration methods notes, 'no one method was consistently advantageous over all others'. Chavez and Huenemann (1984) arrive at a similar conclusion. In addition, we have minimised problems of representativeness by using only four-round *averages* 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, 1986).

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, 1989*b*). Furthermore, the 24-hour recall intakes corresponded reasonably well 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 disaggregated into thirty-two age-gender-pregnancy status categories (details in Bouis and Haddad, 1989*a*).

We recognise of course the limitations of RDA's in the context in which we plan to use them (see, for example, Davidson *et al.*, 1979). These problems are not trivial, but until individual requirements for full functional capacity are available the best we can do is to use the RDAs, 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 adequacy 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,
ϕ_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 only collected at the household level on calorie intake. 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 2,880 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. The mean of ϕ over the 2,880 individuals in the sample is 0·87765, indicating that on average our sample is 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.

II.2. *Measurement and Decomposition of Inequality*

Fig. 1 compares the Lorenz curve of ϕ with those of ϕ_1 and ϕ_2. We showed in Section I that the Lorenz curve of ϕ_1 would be unambiguously closer to the line of perfect equality than the Lorenz curve of ϕ and this is shown to be the case

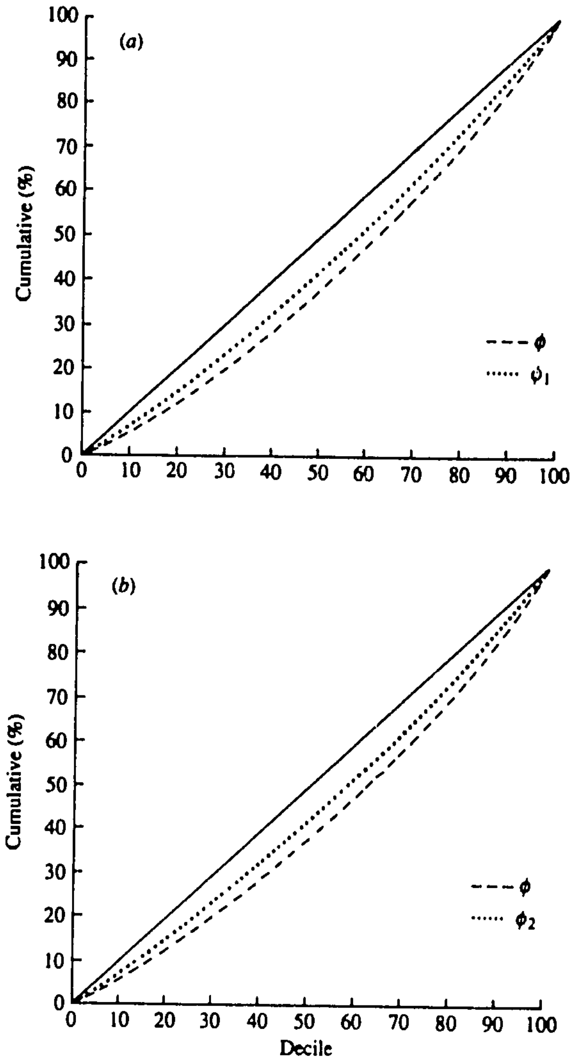

Fig. 1. Lorenz Curves for ϕ, ϕ_1, and ϕ_2.

in Fig. 1*a*. 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

Table 1

Inequality Measures for ϕ, ϕ_1, and ϕ_2

Variable	n	Mean	Coefficient of variation	Log variance	Gini coefficient	Theil T (base e)	Theil L (base e)	Atkinson measure ($\epsilon = 2$)
ϕ	2,880	0·87765	0·31419	0·10897	0·1754	0·04873	0·05078	0·10229
ϕ_1	2,880	0·87765	0·20386	0·04257	0·1148	0·02059	0·02083	0·04127
(% of ϕ)			(65)	(39)	(65)	(42)	(41)	(40)
ϕ_2	2,880	0·88835	0·19998	0·04118	0·1090	0·01986	0·02012	0·03996
(% of ϕ)			(64)	(38)	(62)	(41)	(40)	(40)

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.

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 Malaysia 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 (1989*a*) provide a detailed analysis of the nutrition and income effects of the introduction of sugar cane 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 (1989*a*) 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 2,880 individuals in the sample are divided as follows: 1,565 in corn producing households, 1,082 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 had had information on calorie adequacy only at the household

Table 2

Theil T Inequality Measures for Selected Subgroups Using ϕ, ϕ_1, and ϕ_2

Group	N	μ (ϕ)	μ (ϕ_1)	μ (ϕ_2)	T (ϕ)	T (ϕ_1)	T (ϕ_2)
Corn	1,565	0·88379	0·88379	0·89338	0·04736	0·02019	0·01953
Sugar	1,082	0·87938	0·87938	0·89144	0·04999	0·02065	0·01980
No crop	233	0·82843	0·82843	0·84025	0·05048	0·02141	0·02083
Within		—	—	—	0·04859	0·02046	0·01973
Between		—	—	—	0·00014	0·00014	0·00013
% Between		—	—	—	0·29	0·68	0·66
Owner	695	0·89826	0·89826	0·90311	0·05076	0·02113	0·01993
Mix	516	0·89603	0·89603	0·90497	0·04401	0·01815	0·01785
Tenant	758	0·88679	0·88679	0·90000	0·04728	0·02017	0·01964
Labourer	580	084614	084614	086168	0·04838	002018	0·01987
Other ten*	331	0·84004	0·84004	0·85154	0·05292	0·02203	0·02107
Within		—	—	—	0·04837	0·02024	0·01959
Between	—	—	—	—	0·00036	0·00036	0·00028
% Between	—	—	—	—	0·74	1·8	1·4
Corn own†	341	0·89133	0·89133	089588	0·05232	0·02227	0·02126
Corn mix	310	0·87277	0·87277	0·88165	0·04223	0·01715	0·01693
Corn share	549	0·89237	0·89237	0·90350	0·04491	0·02022	0·01996
Corn lab	267	0·87524	0·87524	0·88847	0·04788	0·01968	0·01859
Sug own	354	0·90494	0·90494	0·91006	0·04922	0·01999	0·01861
Sug mix	206	0·93104	0·93104	0·94007	0·04529	0·01835	0·01795
Sug rent	209	0·87215	0·87215	0·89079	0·05347	0·01983	0·01871
Sug lab	313	0·82131	0·82131	0·83882	0·04787	0·01967	0·02023
Other occ	233	0·82843	0·82843	0·84025	0·05048	0·02141	0·02083
Corn othrnt	98	0·86765	0·86765	0·87838	0·05771	0·02269	0·02093
Within				—	0·04814	0·02001	0·01938
Between	—	—	—	—	0·00059	0·00059	0·00049
% Between				—	1·21	2·9	2·5

* 'Other ten' ≡ Other tenure status.
† Abbreviations in this panel correspond to full labels given in Table 3.

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 1, 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, again identified by Bouis and Haddad (1989*a*) as important in Bukidnon. 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 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 disaggregation becomes finer and finer and groups become more

Table 3

Theil T Inequality Rankings for Crop-Tenancy Groups by Household and Individual-Level Data

	Ranking by		
Group*	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

* Inequality increases from least to most down the Table.

homogeneous, eventually ranking changes would begin to appear. Table 3 shows the ranks in question. 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 while there are some rank changes when we switch from individual to household level data, the extent of the changes is not dramatic.

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 conclusions are unchanged when ϕ_1 is replaced by ϕ_2.

II.3. *Measurement and Decomposition of 'Poverty' (Defined as Undernutrition)*

In Section I 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.

Table 4

P_{α} Poverty Measures for Selected Subgroups Using ϕ, ϕ_1, and ϕ_2

Group	N	$P_0(\phi)$	$P_1(\phi)$	$P_2(\phi)$	$P_0(\phi_1)$	$P_1(\phi_1)$	$P_2(\phi_1)$	$P_0(\phi_2)$	$P_1(\phi_2)$	$P_2(\phi_2)$
All	2,880	0·70243	0·18640	0·06759	0·76875	0·15201	0·04093	0·75764	0·14355	0·03756
Corn	1,565	0·69521	0·18144	0·06483	0·75463	0·14661	0·03925	0·73738	0·13897	0·03632
Sugar	1,028	0·70055	0·18592	0·06811	0·77634	0·15042	0·04029	0·77172	0·14125	0·03647
No crop	233	0·75966	0·22203	0·08369	0·82833	0·19571	0·05516	0·82833	0.18494	0·05097
Owner	695	0·68345	0·17584	0·06342	0·74964	0·14021	0·03716	0·74964	0·13459	0.03495
Mix	516	0·67636	0·17171	0·05930	0·70543	0·13731	0·03354	0·72093	0·13092	0·03137
Tenant	758	0·68865	0·17792	0·06445	0·76253	0·14202	0·03822	0·74802	0·13265	0·03441
Labourer	580	0·74310	0·20589	0·07605	0·83276	0·17269	0·04884	0·78276	0·16133	0·04424
Other ten	331	0·74320	0·21676	0·08159	0·80967	0·18633	0·05270	0·80967	0·17582	0·04822
Corn own	341	0·68622	0·18359	0·06663	0·73607	0·14803	0·03970	0·73607	0·14226	0·03797
Corn mix	310	0·71613	0·18241	0·06382	0·70968	0·15507	0·03895	0·70968	0·14857	0·03646
Corn share	549	0·68852	0·17219	0·06080	0·76138	0·13601	0·03740	0·74499	0·12825	0·03452
Corn lab	267	0·69288	0·18820	0·06766	0·81273	0·15036	0·04007	0·74532	0·14009	0·03578
Sug own	354	0·68079	0·16837	0·06034	0·76271	0·13269	0·03472	0·76271	0·12720	0·03204
Sug mix	206	0·61650	0·15562	0·05250	0·69903	0·11059	0·02541	0·73786	0·10435	0·02370
Sug rent	209	0·68900	0·19298	0·07404	0·76555	0·15781	0·04037	0·75598	0·14421	0·03412
Sug lab	313	0·78594	0·22099	0·08320	0·84984	0·19174	0·05632	0·81470	0·17946	0·05146
Other occ	233	0·75966	0·22203	0·08369	0·82833	0·19571	0·05516	0·82833	0·18494	0·05097
Corn othrnt	98	0·70408	0·20423	0·07661	0·76531	0·16404	0·04685	0·76531	0·15414	0·04168
Male	1,484	0·72372	0·19017	0·06863	0·77089	0·15058	0·04016	0·76146	0·14262	0·03691
Female	1,396	0·67980	0·18240	0·06648	0·76648	0·15353	0·04175	0·75358	0·14453	0·03826
Adult*	1,191	0·48615	0·10074	0·03259	0·75231	0·14757	0·03957	0·74139	0·13920	0·03633
Non-adult	1,689	0·85494	0·24681	0·09226	0·78034	0·15515	0·04189	0·76909	0·14661	0·03843

* 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).

We will concentrate attention on the class of poverty indices put forward by Foster *et al.* (1984). Adapting the notation of Section I, these can be written as

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

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

The first panel of Table 4 presents values of P_0, P_1, and P_2 based on ϕ, ϕ_1, and ϕ_2. We have already proved that for $\alpha \geqslant 1$, 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 $\alpha \geqslant 1$.

However, notice that with $\alpha = 0$ the situation is the other way round, there is now a substantial *overstatement* of poverty if intra-household 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 the discussion leading up to equation (14) of Section I. 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.

Let us turn now to the pattern of poverty across socio-economic groups. The next three panels of Table 4 use the same mutually exclusive and exhaustive groups as in Table 2. The policy relevance of these household level groupings has already been discussed in Section II.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. As can be seen from the relevant panel of Table 4, 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_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 4 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 4, where rank reversal is potentially serious.

Finally, we consider group contributions to poverty based on ϕ, ϕ_1 and ϕ_2. Table 5 presents this analysis. The first four panels in Table 5 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 4 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 5, 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 5

Percentage Group Contributions to P_α Poverty Measures using ϕ, ϕ_1, and ϕ_2

Group	N	$P_0(\phi)$	$P_1(\phi)$	$P_2(\phi)$	$P_0(\phi_1)$	$P_1(\phi_1)$	$P_2(\phi_1)$	$P_0(\phi_2)$	$P_1(\phi_2)$	$P_2(\phi_2)$
All	2,800	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
Corn	1,565	53·8	52·9	52·1	53·3	52·4	52·1	52·9	52·6	52·5
Sugar	1,082	37·5	37·5	37·9	37·9	37·2	37·0	38·3	37·0	36·5
No crop	223	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	4·1	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	1,484	53·1	52·6	52·3	51·7	51·0	50·6	51·8	51·2	50·6
Female	1,396	46·9	47·4	47·7	48·3	49·0	49·4	48·2	48·8	49·4
Adult*	1,191	28·6	22·3	19·9	40·5	40·1	40·0	40·5	40·1	40·0
Non-adult	1,689	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).

III. CONCLUSION

The object of this paper has been, first, 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 confirm our results further 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.

University of Warwick,

University of Warwick and World Bank

Date of receipt of final typescript: December 1989

REFERENCES

Achaya, K. T. (1983). 'RDAs: their limitations and application.' *Economic and Political Weekly*, vol. 18, no. 15, p. 587.

Anand, S. (1983). *Inequality and Poverty in Malaysia: Measurement and Decomposition*. Oxford: Oxford University Press.

Atkinson, A. B. (1970). 'On the measurement of inequality.' *Journal of Economic Theory*, vol. 2, pp. 244–63.

—— (1987). 'On the measurement of poverty.' *Econometrica*, vol. 55, pp. 749–64.

Behrman, J. (1989). 'Intrahousehold allocation of nutrients and gender effects: a survey of structural and reduced-form estimates.' In *Nutrition and Poverty* (ed. Siddig R. Osmani). Oxford: Oxford University Press.

Bouis, H. E. and Haddad, L. J. (1989a). *A Case Study of the Commercialisation of Agriculture in the Southern Philippines: The Income, Consumption and Nutrition Effects of a Switch From Corn to Sugar Production in Bukidnon*. Forthcoming Research Report, IFPRI, Washington, D.C.

—— and —— (1989b). 'Estimating the relationship between calories and income; does choice of survey variable matter?' IFPRI, mimeo, Washington, D.C.

Burke, M. and Pao, E. (1976). 'Methodology for large-scale surveys of household and individual diets.' USDA, Home Economics Research Report No. 40, Washington, D.C.

Chavez, M. and Huenemann, R. (1984). 'Measuring impact by assessing dietary intake and food consumption.' In *Methods for the Evaluation of the Impact of Food and Nutrition Programmes* (ed. D. Sahn, R. Lockwood and N. Scrimshaw). UNU.

Corpus, V. A., Ledesma, A., Limbo A. and Bouis, H. (1987). 'The commercialisation of agriculture in the Southern Philippines. Phase I Report.' IFPRI, mimeo, Washington, D.C.

Davidson, S., Passmore, R., Brock, J. F. and Truswell, A. S. (1979). *Human Nutrition and Dietics*, 7th edn. Churchill Livingstone.

Foster, J., Greer, J. and Thorbecke, E. (1984). 'On a class of decomposable poverty measures.' *Econometrica*, vol. 52, pp. 761–5.

Haddad, L. and Kanbur, R. (1989). 'How serious is the neglect of intra-household inequality? (What difference does it make to the measurement and decomposition of inequality and poverty?).' Discussion Paper 95, Development Economics Research Centre, University of Warwick, May 1989.

Harriss, B. (1986). 'The intra-family distribution of hunger in South Asia.' Forthcoming, in *Hunger and Public Policy* (ed. J. Dreze and A. K. Sen). Oxford: Oxford University Press.

Kanbur, R. (1984). 'The measurement and decomposition of inequality and poverty.' In *Mathematical Methods in Economics* (ed. F. van der Ploeg). Bognor Regis: Wiley.

—— (1987). 'Measurement and alleviation of poverty.' *I.M.F. Staff Papers*, vol. 30, pp. 60–85.

NNC (1976). 'Philippine recommended dietary allowances.' Part 1. National Nutrition Council of the Philippines.

Ravallion, M. (1988). 'Expected poverty under risk-induced welfare variability.' ECONOMIC JOURNAL, vol. 98, pp. 1171–82.

Rothschild, M. and Stiglitz, J. E. (1970). 'Increasing risk I: a definition.' *Journal of Economic Theory*, vol. 2, pp. 225–43.

Sen, A. K. (1976). 'Poverty: an ordinal approach to measurement.' *Econometrica*, vol. 44, pp. 219–31.

— (1984). 'Family and food: sex bias in poverty.' In *Resources, Values and Development* (ed. A. K. Sen). Oxford: Blackwell.

Shorrocks, A. F. (1980). 'The class of additively decomposable inequality measures.' *Econometrica*, vol. 48, pp. 613–25.

Theil, H. (1967). *Economics and Information Theory*. Amsterdam: North-Holland.

Thomas, D. (1989). 'Intra-household resource allocation: an inferential approach.' Yale University, mimeo, May.

Tsakloglou, P. (1988). 'Aspects of inequality and poverty in Greece.' Unpublished Ph.D. dissertation, University of Warwick.

USDA (1986). *Nationwide Food Consumption Survey Continuing Survey of Food Intakes by Individuals*. Human Nutrition Information Service, NFCS, CSFII, No. 86-3.