THE INCOME UNIT AND THE ANATOMY OF INCOME DISTRIBUTION*

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This paper focuses on a neglected aspect of the treatment of the income unit in the construction of size distributions of income. If the size distribution is to be an indicator of the distribution of economic welfare, and if the economic welfare of each individual in society is to count equally, then conventional distributions are inconsistent with individualistic welfare functions. We estimate size distributions with each person's welfare weighted equally, and contrast these results with those weighting each household unit's welfare equally. The choice of weights is shown to affect both the level and the trend in income inequality.

Size distributions of income for any time period are constructed by assigning incomes to income units and then arraying the units by size of income. Measures of income inequality based on such constructions are then taken to be rough indicators of inequality in economic welfare. Economists are well aware that such measures are imperfect. Severe data limitations make the income concept, the income unit, and the income accounting period used in constructing size distributions of income far from ideal, and the welfare interpretation of income inequality measures is consequently suspect (see, e.g., Morgan, 1962). Economists have developed several methods for refining the income concept used in size distributions (e.g., Browning, 1976; Moon and Smolensky, 1977; Smeeding, 1977; and Taussig, 1973); and they have also recently begun to address the problem of moving from a size distribution of annual income to one of multiyear or even lifetime income (e.g., Benus and Morgan, 1975; Lillard, 1977). All these studies have provided valuable insights into the "anatomy of income distribution", but none has dealt adequately with an equally important topic, the treatment of the income unit.

For example, the income unit in conventional size distributions of income for the United States is usually taken to be either the Census family (all individuals living in the same household who are related by blood, marriage or adoption) or the unrelated individual, living either alone or in a household with other (unrelated) individuals or families, or both families and unrelated individuals

*This research was supported by the U.S. National Science Foundation under Grant No. APR77-01603 and by funds granted to the Institute for Research on Poverty by the Department of Health, Education, and Welfare pursuant to the provisions of the Economic Opportunity Act of 1964. Any opinions, findings or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the National Science Foundation. Chris Whitebread provided valuable assistance; Alan Harrison, Robert Haveman, Timothy Smeeding, and Eugene Smolensky provided useful comments on an earlier draft.

together. Distributions based on other income units, e.g., the individual income recipient, the household, or the spending unit, have also been constructed. But in the United States, the family and/or unrelated individual unit predominates, and the Current Population Survey (CPS) time series is the only reasonably consistent source of information on changes in income inequality over time.[1] The aggregate nature of the Census income unit has been criticized, and cited as a source of bias in the measurement of inequality. Kuznets (1974) and Danziger and Plotnick (1977) have shown that the failure to account for changes in the demographic composition of units (e.g., the increase in the number of single person units or units headed by the aged) has imparted an upward bias to the trend in measured inequality since World War II. The problem for welfare interpretations of changes in inequality measures is that living arrangements are an economic good and are endogeneous to the trend in the level of economic welfare. In the United States at least, people appear to have taken part of their improvement in economic welfare in the form of independent living arrangements. This historical trend includes both the long-established movement from the extended to the nuclear family unit and more recently the splitting of the nuclear family unit itself. Size distributions that treat the income units as exogenous obscure these changes.

The Appropriate Weighting of Income Units in the Size Distribution of Income

This paper focuses on a neglected aspect of the treatment of the income unit in the construction of size distributions of income. The choice of the family (or the household) as the income recipient unit is based on the fact that individual recipients in families generally pool their incomes and share, more or less equally, a common standard of living. Most economists have rejected the notion of an income distribution based on the incomes of individual recipients because such an index of inequality does not adequately measure personal welfare. Accordingly, conventional size distributions begin with an array of family (or household) incomes. The pooling of income by family members, however, does not mean that each family unit should be given an equal weight in the construction of the size distribution. In fact, conventional size distributions that weight each family unit equally violate the requirements for individualistic social welfare functions because they implicitly weight the welfare of an individual inversely to the size of the unit in which he or she lives. That is, the weight given to each income (welfare) in the measurement of income inequality is the same for all units, independent of their size. Thus the welfare of an unrelated individual is given equal weight to that of a family including, say, ten persons. From the obverse point of view, the welfare of a person in the larger unit is weighted at one-tenth that of the unrelated individual. Our own (nonrandom) sample of economists has not yet uncovered a

[1]The March Current Population Surveys, administered by the Bureau of the Census, gather demographic and economic information for a sample of about 50,000 households. Computer tapes containing the microeconomic observations needed to perform the computations in this paper have been made available annually since the 1968 Survey. For a complete discussion of the Current Population Survey data, see Danziger and Taussig (1977).

defender of this implicit social welfare function. Rather, they opt for an individualistic social welfare function in which every person's welfare has equal weight.

The dimensions of the problem are suggested by some simple empirical relationships. According to our estimates from CPS microdata for 1976, the mean unit size for all income units, including both Census families and unrelated individuals, was 2.73. For the lowest and highest income deciles, ranked by *Census unit* income, mean unit sizes were 1.54 and 3.71, respectively.[2] In other words, by this conventional ranking, the top decile included more than twice as many persons as the bottom decile. Mean unit sizes for intermediate deciles increased monotonically, almost linearly, between these two extreme values. If, however, we follow the pioneering study by Kuznets (1950) and rank all units by their *per capita* incomes, the resulting size distribution of Census units has an estimated mean unit size of 3.43 in the lowest, and 1.71 in the highest, deciles. The distribution of *per capita* income thus includes twice as many persons in the bottom decile as in the top decile. Changing the income concept from Census unit income to *per capita* income does not alter the fact that each method retains a comparison of deciles with widely varying numbers of persons.

These results reflect the pattern of relative mean incomes by unit size shown in Table 1. (The relative mean income of any group in the population is $u = u_i/u_j$, where u_i is the group's own mean and u_j is the reference group mean. In Table 1, u_j is the mean income of units of size 1). Table 1 shows the sensitivity of the mean income of Census units of varying size under three alternative definitions of income. For example, single-person units have the lowest relative mean Census

TABLE 1

RELATIVE MEAN INCOMES OF CENSUS UNITS BY SIZE OF UNIT, 1976[a]

	Definition of Income		
Unit Size	Mean Census Unit Income (1)	Mean *Per Capita* Income (2)	Mean Standardized Income[b] (3)
1	1.00	1.00	1.00
2	1.97	0.96	1.54
3	2.33	0.78	1.50
4	2.62	0.65	1.31
5	2.73	0.55	1.16
6	2.79	0.46	1.05
7	2.75	0.39	0.83
8+	2.46	0.28	0.76

Source: Estimated by authors from computer tapes of March 1977 Current Population Survey.

[a]Census unit here includes families and unrelated individuals.

[b]Census income standardized by equivalence scales implicit in Social Security Administration poverty lines for units of various size and composition.

[2]Kuznets (1976) has documented the same positive relationship between size of the family unit and rank in the income distribution for the United States in 1969 and for several other countries as well.

unit income (column 1), the highest relative mean *per capita* income (column 2), and a below average relative mean standardized income (column 3). Column 1 uses the income of the Census unit unadjusted for the size of the unit; use of this income concept as a measure of a unit's welfare implies that variation in the size of the unit through marriage, birth, death or otherwise does not effect the welfare of the unit, *ceteris paribus*. Column 2 takes the income concept to be the unit's income divided by the number of persons in the unit presumably sharing the income; use of this income concept as a measure of a unit's welfare implies, for example, that marriage or birth diminishes the welfare of the persons originally in the unit, *ceteris paribus*. The income concept in column 3 is, by construction, intermediate between columns 1 and 2 in its welfare interpretation.

The results shown in Table 1 only illustrate the consequences of varying the income concept. The controversial issue of defining equivalency scales or adjusting the income concept for the size and composition of recipient units is distinct from the issue of choosing how to weight the units. Most previous research has dealt only with the adjustment of the income concept, and has ignored the equally-important weighting issue. For example, Kuznets (1950) and Browning (1976) opted for measuring income on a *per capita* basis; they than ranked income units on the basis of their *per capita* incomes. Other authors, including Morgan and Smith (1969), opted instead for deflating the unit's income by a set of equivalence scales to obtain an income-to-needs welfare measure and then ranked units on the basis of this income-to-needs ratio. This same approach is implicit, of course, in the official United States Social Security (Orshansky) poverty lines.[3] On the other hand, Lebergott (1976, pp. 33–43) has argued cogently against a *per capita* or needs-adjusted income measure as an indicator of a unit's economic welfare.

What none of these authors makes explicit, however, is that the adjustment of the income concept for differences in unit size and composition is independent of the issue of how to weight the units. Indeed, they all proceeded to weight each unit's refined or unrefined income equally in their summary measure of income inequality, regardless of the size of the unit. For example, someone like Lebergott who chooses an income measure which is not adjusted for the size of the unit as the most appropriate indicator of the welfare of the individuals in the unit might well opt for assigning this unadjusted income to each person in the unit and constructing the size distribution with each person's income (welfare) weighted equally.

To our knowledge, only Atkinson and Harrison (1978) and Kuznets (1976) have recognized the distinction between the choice of income concepts and the choice of weighting schemes, and have attempted to use appropriate person weights in estimating summary measures of inequality. Neither study, unfortunately, had available appropriate micro data with joint observations of both the income (wealth) and the size (composition) of the unit. In this paper, we use the large, rich body of U.S. Census micro data on the incomes and demographic characteristics of household units to estimate size distributions for the three alternative definitions of income shown in Table 1. This data source allows

[3]The Orshansky poverty lines are essentially implicit equivalence scales used to determine poverty level incomes in the United States. See Orshansky (1965) for a discussion of the methods used to derive them.

the estimation of inequality measures based on weighting each *person's* income equally as well as that based on weighting each *unit's* income equally. The empirical results reported are limited necessarily to U.S. data and are intended primarily to illustrate the importance of the principle of weighting each person's welfare equally in the measurement of inequality.

Empirical Results

Table 2 reports estimates of summary statistics of inequality for six income distributions for the years 1967 and 1976. The summary statistics are the Gini

TABLE 2

Inequality Measures Under Alternative Treatments of the Income Concept and Income Unit, 1967 and 1976

Income Measure and Recipient Unit		1967		1976		1967–76% change	
		$\bar{y}_{10}/\bar{y}_1$[c]	Gini Coefficient	$\bar{y}_{10}/\bar{y}_1$	Gini Coefficient	$\bar{y}_{10}/\bar{y}_1$	Gini Coefficient
Census Unit[a] Income							
Census Unit	$(y[m])$[d]	26.7	0.3992	23.1	0.4061	−13.48	+1.73
Persons	$(y[n])$	16.9	0.3536	17.4	0.3658	+2.96	+3.45
Per Capita Income							
Census Unit	$(y/n[m])$	18.1	0.4122	19.4	0.4027	+7.18	−2.30
Persons	$(y/n[n])$	15.7	0.3963	17.4	0.3906	+10.82	−1.44
Standardized Income[b]							
Census Unit	$(y/n^*[m])$	19.4	0.3850	17.1	0.3786	−11.86	−1.66
Persons	$(y/n^*[n])$	14.8	0.3623	14.5	0.3592	−2.03	−0.86

Source: Estimated by the authors from computer tapes of the March 1968 and March 1977 Current Population Surveys.

[a]Census units include families and unrelated individuals.

[b]$y = y_i \Big/ \left(\frac{\text{pov line for this family}}{\text{pov line for family of four}}\right)$

[c]$\bar{y}_{10}/\bar{y}_1$ = Mean income of the 10th decile/Mean income of the first decile.

[d]Between 1967 and 1976 the number of census units grew from 63 to 78 million, or by 24 percent; the number of persons grew from 196 to 212 million, or by 8.5 percent.

coefficient and the ratio of the mean incomes of the top and bottom deciles $(\bar{y}_{10}/\bar{y}_1)$.[4] Let y_1 be the Census money income of the ith Census unit and n_i be the number of persons included in the unit. Also let n_i^* be the number of equivalent adults in the unit based on the equivalence scales implicit in the official U.S. poverty lines.[5] Then we can define three income concepts for each unit in the

[4]Some of the Lorenz curves of our distributions intersect and, in such cases, we will also report on the shapes of both Lorenz curves. For an analysis of the issues involved, see Atkinson (1970). Note that $(\bar{y}_{10}/\bar{y}_1)$ is also the ratio of the share of the top decile to the share of the bottom decile. Our results differ slightly from published Census data because we use reported incomes for all units. The reported income for those with $50,000 or more is thus $50,000. The Census Bureau uses an estimated income for these top units, so, in most cases, the published Ginis will be higher than those reported here. For example, in 1967, the published Gini is 0.400 while ours is 0.399.

[5]We use this particular set of equivalence scales for convenience and for illustrative purposes only. For a recent discussion of different equivalence scales, see Nicholson (1976).

population as either y_i, y_i/n_i or y/n_i^*.[6] These incomes can be assigned either to the whole Census unit and counted once in the distribution, denoted by "m", or to each person in the unit and thus counted n times, denoted by "n". Thus we have a total of six distributions to compare: three Census-unit-based distributions = $y(m)$, $y/n(m)$, and $y/n^*(m)$; and three corresponding person-based distributions = $y(n)$, $y/n(n)$, and $y/n^*(n)$. Each pair of distributions (e.g., $y(m)$ and $y(n)$) has an identical measure of a unit's income (economic welfare) but differs in the weight given to that income in constructing the size distribution.

The results reported in Table 2 clearly show that the *level* of income inequality is sensitive to both the choice of income concepts and the choice of weights. In both 1967 and 1976, a comparison of the summary statistics for the $y(m)$ and $y(n)$ distributions shows that weighting the conventional Census money income measure by persons instead of by Census units substantially reduces measured inequality. For example, the conventional 1976 Gini that weights Census unit incomes by the number of Census units is 0.4061. This declines to 0.3658 when Census unit incomes are instead weighted by the number of persons. The Lorentz curve for $y(n)$ lies completely inside the Lorenz curve for $y(m)$ for each of the three income concepts. Similar pairwise comparisons of the size distributions based on the y/n and y/n^* income concepts conform to this pattern. A comparison of the $\bar{y}_{10}/\bar{y}_1$ statistics for each income concept confirms the finding that weighting incomes by the number of persons, rather than by the number of units, reduces measured income inequality.

If the weighting concept is held constant, but the income concept is varied from Census unit income, to *per capita* income, to standardized income, the summary statistics also vary, but no consistent pattern emerges.[7]

The estimates in Table 2 also illustrate the point that the *trend* in measured inequality depends on both the choice of income concept and the method of weighting the income unit. We might conclude that income inequality increased between 1967 and 1976 if we limited ourselves to a comparison of Gini coefficient values for the unadjusted income (y) distributions, weighted either by Census units, $y(m)$, or by persons, $y(n)$. However, income inequality decreased if we compare Gini coefficients based on *per capita* income (y/n) or standardized income (y/n^*) distributions. Given the income measure, the effect of weighting by persons was to approximately double the rise or halve the fall in measured inequality during the period. The Gini coefficient comparison is somewhat misleading by itself, because the 1967 and 1976 Lorenz curves for the same distributions intersect in some cases. For example, inequality of *per capita* income measured by the ratio of the top to the bottom decile increased, but decreased according to the Gini coefficient.

[6]We deflate each y_i by the unit's poverty index, n_i^* to obtain an estimate of y_i/n_i^*. For example, based on the weighted average poverty lines for nonfarm, nonaged units, and setting n^* for a one-person unit at 1.0, a four-person unit will have an n^* of 1.97. Thus, the y/n^* measure divides the income of a family of four by 1.97, and is intermediate between the y and y/n measures which divide by 1.0 and 4.0 respectively. The poverty lines are given in U.S. Bureau of the Census (1977), Table 15.

[7]The inconsistent patterns may be due to the fact that the Lorenz curves in some of these comparisons intersect. Thus, a summary statistic which specifies an explicit inequality aversion would be more appropriate.

These complex changes in inequality over the period reflect rapid demographic change, as illustrated in Table 3. Changes in family size and composition were remarkable for so brief a time span. Mean Census unit size fell from 3.10 in

TABLE 3

COMPOSITION OF U.S. POPULATION BY CENSUS UNIT SIZE, 1967 AND 1976

Unit Size[a]	1967		1976	
	Units	Persons	Units	Persons
1	20.9%	6.7%	27.5%	10.1%
2	26.8	17.4	27.5	20.4
3	16.3	16.0	16.0	17.7
4	15.0	19.4	14.7	21.5
5	9.9	15.9	7.9	14.5
6	5.6	10.9	3.6	7.8
7	2.8	6.3	1.6	4.0
8+	2.6	7.5	1.3	4.0
All Units	100.0	100.0	100.0	100.0

Source: See Table 2.
[a]Mean unit size for 1967 is 3.10; for 1976, 2.73.

1967 to 2.73 in 1976, as the proportion of persons living in one- or two-person Census units rose by about 25 percent, from 24.1 to 30.5 percent. Consequently, the number of households rose more rapidly than the number of persons. During such a period, the trend in measured income inequality depends critically on the treatment of both the income unit and the weighting method.

THE INCIDENCE OF RELATIVE POVERTY AND AFFLUENCE

The various treatments of the income unit and the weighting method produce interesting empirical results on the relative economic status of various groups of persons in the U.S. population. For many purposes, it may not matter who is at the top or bottom of the distribution. The social welfare function might weight every person's welfare equally and anonymously and only the spread between top and bottom would matter. In some instances, however, we do care who is where in the distribution; e.g., whether the bottom decile is 100 percent black or the top decile 100 percent white, or how the relative incomes of some groups change over time. For these purposes, we examine the incidence of relative poverty or affluence, defined for this study as the percentage of a given group that falls in the bottom or top decile under alternative treatments of the income unit and the weighting concept.[8]

Table 4 gives these estimates of relative poverty and affluence for one-person and for six-person or more Census units based on our six alternative income size

[8]The results reported in the text on the incidence of relative poverty and affluence pertain only to the extreme of the various size distributions. We have also estimated, but have not reported here, qualitatively similar results pertaining to the bottom and top halves of the same distributions.

distributions. Who is relatively poor or affluent, like the degree of income inequality, depends on the choice of both the income concept and the weighting of incomes. According to the Census unit income, equal-person-weighted size distribution for 1976, $y(n)$, 41.2 percent of one-person Census units were relatively poor while only 1.0 percent were relatively affluent. According to the equal-person-weighted *per capita* $y/n(n)$ size distribution, however, only 7.6 percent of the one-person units were relatively poor while 23.8 percent were relatively affluent. By construction, the results for the $y/n^*(n)$ distribution are intermediate between those for the $y(n)$ and $y/n(n)$ distributions. The results for very large Census units show exactly the obverse pattern. The incidences of relative poverty and affluence for Census units with six or more persons are low and high respectively according to the $y(n)$ size distribution; the reverse holds true according to the $y/n(n)$ distribution. Finally, the trend in the incidence of relative poverty by size of Census unit in the 1967–76 period also depends on the choice of income measure and the weighting of incomes. For example, according to the $y(m)$ distribution in Table 4, the incidence of relative poverty among very large Census units increased from 2.1 to 2.6 percent between 1967 and 1976; according to the $y(n)$ distribution, it decreased from 5.3 to 4.4 percent. However, there was a downward trend in the incidence of relative poverty for one-person units for each of the six income distributions constructed for this study.[9]

The incidence of relative poverty and affluence for our six distributions also varies widely for other classifications of households. For example, in 1976, according to the Census unit distribution weighted by households, nonwhite relative poverty was 18.6 percent and 22.7 percent of the bottom decile consisted of nonwhite Census units. According to the *per capita* distribution, weighted by persons, nonwhite relative poverty was 27.5 percent, and the bottom decile of persons was 36.8 percent nonwhite. This large difference results because nonwhite units are of larger average size.

Another interesting breakdown of the population is by age, where the question is whether units headed by the aged (age 65 and over) are relatively poor or affluent when compared to the nonaged population. Units headed by the aged had lower unit incomes in 1976 but their units contained many fewer persons. The mean Census unit income for the aged was only $8,452, while the mean income per unit was $14,087 for the whole population; the mean unit size of aged units was only 1.61, as compared with 2.73 for the whole population. Thus, the mean *per capita* incomes of the aged and the nonaged in 1976 were remarkably close.[10] These patterns of income and unit size by age group are reflected in the incidence of relative poverty and affluence among the aged under alternative treatments of the income measure and income unit. The incidence of relative poverty for the aged was 24.6 percent in 1976, if Census unit incomes are weighted by persons, but only 5.9 percent if *per capita* incomes are weighted by persons. All of the six distributions produce one robust finding about the income status of the aged:

[9]This reflects the facts that about one-third of all one-person units consist of aged individuals and that rapid social security increases over the period improved the economic position of the aged.

[10]Wolfson (1979) also shows that in the Canadian context the economic position of the elderly is understated by the usual data. He also discusses some results which weight *per capita* incomes by the number of persons.

TABLE 4

INCIDENCE OF RELATIVE POVERTY AND AFFLUENCE BY SIZE OF CENSUS UNIT, 1967 AND 1976.

Income Measure and Recipient Unit		1967 Relative Poverty[a] Unit Size 1	1967 Relative Poverty[a] Unit Size 6 or More	1967 Relative Affluence[b] Unit Size 1	1967 Relative Affluence[b] Unit Size 6 or More	1976 Relative Poverty Unit Size 1	1976 Relative Poverty Unit Size 6 or More	1976 Relative Affluence Unit Size 1	1976 Relative Affluence Unit Size 6 or More
Census Unit Income									
Census Unit	$(y[m])$	33.7%	2.1%	1.4%	14.6%	26.4%	2.6%	1.4%	20.2%
Persons	$(y[n])$	50.2	5.3	1.2	11.3	41.2	4.4	1.0	15.8
Per Capita Income									
Census Unit	$(y/n[m])$	12.8	22.6	19.0	0.8	9.0	26.1	17.5	0.3
Persons	$(y/n[n])$	11.2	21.1	26.1	1.2	7.6	22.9	23.8	0.8
Standardized Income									
Census Unit	$(y/n^*[m])$	25.2	10.4	6.2	2.0	18.3	12.6	6.1	2.7
Persons	$(y/n^*[n])$	30.6	14.3	7.2	2.6	20.9	14.6	6.7	2.9

Source: See Table 2.

[a]Percentage of group in first decile.

[b]Percentage of group in tenth decile.

relative poverty among the aged declined sharply between 1967 and 1976. On the basis of these numbers, it is difficult to resist the conclusion that the sharp increases in Social Security retirement benefits and the advent of the Supplementary Security Income program for the aged in 1974 were successful in achieving their goals of improving the economic status of the aged.

Summary and Conclusions

If the size distribution of income is to be an indicator of the distribution of economic welfare, and if the economic welfare of each individual in society is to count equally, then conventional size distributions are inconsistent with social welfare functions. The units in such distributions are families or groupings of persons that range in size from an unrelated individual to 10 or more persons. Distributions that weight the incomes of all units once weight the welfare of persons in n-person units as just $1/n$th the welfare of persons living by themselves. To be consistent with individualistic social welfare functions, equal weight must be given to each person's income.

The choice of an appropriate measure of income for units that differ in size and composition is a separate, although related issue. We experimented with three income measures in this study: total unit income, y; *per capita* income, y/n; and a standardized income y/n^*. Others who have adjusted measures of inequality for differences in unit size have also made these income concept adjustments, but have neglected the choice of adjustments for weighting units of varying size. Thus, while we do not advocate any income concept as optimal, we do suggest that persons are the optimal choice for weights.[11]

Our study uses U.S. Census micro data to illustrate the empirical importance of the appropriate treatment of both the income concept and the choice of weights in investigating the anatomy of income distribution. Weighting unit incomes by persons rather than by units reduces measured inequality. The direction of the trend in inequality over the 1967–76 period depends on the income concept, while the choice of weights affects the size of this trend. Also important are the empirical implications for the *ranking* of specific groups in the population (e.g., the aged, nonwhites), in the size distribution.

[11]There are two other unresolved measurement issues closely related to the topic of our study. First, we have followed the conventional assumption that a unit's income is pooled equally within the units but not at all within or across households. Real-world pooling of incomes is much more complex and needs careful investigation. Second, the underlying income measure in our study is the conventional Census money income definition. Its deficiencies as even a rough measure of economic welfare are well known and can be corrected, at least to some extent. The treatment of the income unit and the income concept involve some overlapping problems; e.g., how to rank the relative economic welfare of two units with the same money income when one unit is a single person and the other is a married couple in which one spouse works at home rather than in the market for pay. To construct satisfactory income size distributions, such income measure and income unit problems must be dealt with jointly.

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