The Impact of Equivalence Scales on the Analysis of Income and Food Spending Distributions

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This article examines the effects of different income and food spending adult equivalence scales on estimated expenditure elasticities, on the demographic characteristics of the rich and poor, and on the percentage of household income spent on food by various income quintiles. Empirical results are found to be heavily influenced by the choice of equivalence scales. For example, elasticities varied by over 300%, and the demographic characteristics of the poor varied greatly.

Key words: adult equivalence scales, income distribution, food spending distribution, elasticities.

Kakwani has shown that the distribution of expenditures on a commodity is directly related to a distribution of income via the commodity's underlying Engel function. Given this linkage, the development of procedures for directly estimating expenditure elasticities from these distributions was a logical progression. Most studies using this technique have adjusted household income and expenditures by placing them on a per-person basis prior to constructing the distributions (e.g., Kakwani; Blaylock and Smallwood 1982). Using per-person adjustments, an extreme form of adult equivalence scale, raises a subtle, but important, point—does the choice of a particular adult equivalence scale for either income or food spending significantly influence estimated elasticities and other characteristics of the distributions?

One purpose of this article is to examine the sensitivity of elasticities estimated via Kakwani's techniques to the form one assumes for the underlying equivalence scale. I also investigate how the following may change with the choice of equivalence scales: (*a*) the demographic characteristics of the population subsets at the bottom or top of a food spending or income distribution and (*b*) the estimated percent of income spent on food by households in various percentiles of an income distribution.

From a pragmatic standpoint, two examples illustrate the problem. First, suppose that a given size household is considered "poor" in a distribution constructed using one type of equivalence scale and "not poor" using another. Second, suppose the use of alternative scales results in divergent percentages of the amount of income spent on food within various income groups—a frequently used measure of economic progress. In the first example, structuring programs to reach the poor is hindered by the lack of agreement concerning their identification, and in the second, measuring economic progress becomes ambiguous and controversial.

Lorenz and Concentration Curves

In studies of income distribution, the focus is on how income is distributed across the population. Conversely, in most studies of food spending distributions, the major focus is on how food expenditures are distributed across

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Views expressed in this article are not necessarily those of USDA or ERS. The author thanks several referees for their helpful and thought-provoking comments.

people's incomes.[1] The first step in studying a food expenditure distribution across income levels is to rank all households by their adult equivalent adjusted income. Once the households are ranked by equivalent income, the next problem is the choice of the equivalence scale to adjust nominal food expenditures. After food expenditures are adjusted, the cumulative distributions for food spending and income are constructed, and then one can calculate inequality measures, uncover the demographic characteristics of the richest or poorest segments of the population and their associated food expenditures, and estimate expenditure elasticities.

In mathematical terms, assume that adult equivalent household income, Y, is distributed with probability density function $f(y)$ and mean μ. The probability distribution function (PDF) of income is

$$(1) \qquad F(Y) = \int_0^Y (y)\, dy,$$

and represents the proportion of households having adult equivalent income less than or equal to Y.

The first moment distribution function (FMDF) of Y is

$$(2) \qquad F_1(Y) = \frac{1}{\mu} \int_0^Y y f(y)\, dy,$$

and represents the proportion of total adult equivalent income received by households having adult equivalent income less than or equal to Y. The relationship between $F(Y)$ and $F_1(Y)$ is called the Lorenz curve.

Assuming that $v_i(Y)$ is the implied Engel relation for the ith commodity and τ_i denotes the expenditure mean (per adult equivalent), then the FMDF for adult equivalent expenditure on the ith commodity is

$$(3) \qquad F_1[v_1(Y)] = \frac{1}{\tau_i} \int_0^Y v_i(y) f(y)\, dy,$$

and represents the proportion of total adult equivalent expenditures on the ith commodity by households having adult equivalent income less than or equal to Y. The concentration curve for the ith commodity is defined as the relationship between $F(Y)$ and $F_1[v_i(Y)]$. Equations (1), (2), and (3) form the basis for analysis of food spending/income distributions.

Kakwani shows that expenditure elasticities can be estimated from the relationship between the Lorenz and concentration curves. To estimate elasticities, he first redefines the coordinates of the Lorenz and concentration curves in relation to the egalitarian line, defined by $F(Y) = F_1(Y)$ and represented by a diagonal line through the origin of the unit square. If P is any point on the Lorenz curve with coordinates (F, F_1), Kakwani defines the new coordinates:

$$(4a) \qquad \theta = \frac{[F(Y) - F_1(Y)]}{\sqrt{2}}$$

$$(4b) \qquad \phi = \frac{[F(Y) + F_1(Y)]}{\sqrt{2}}.$$

Therefore, θ represents the length of a perpendicular ordinate from P to the egalitarian line, and ϕ represents the length of an ordinate from the origin of the unit square along the egalitarian line. The new coordinate system for concentration curves is similar to that in (4) except $F_1[v_i(Y)]$ is substituted for $F_1(Y)$. Hence, the equations for the Lorenz curve and the ith good's concentration curve can be written as:

$$(5) \qquad \theta = h(\phi); \qquad \theta_i = h_i(\phi_i).$$

We use the modified Beta functional form as suggested by Kakwani to estimate (using OLS) the Lorenz curve:

$$(6) \quad \ln(\theta) = C + \alpha \ln(\phi) + \beta \ln(\sqrt{2} - \phi) + e,$$

where C, α, and β are parameters to be estimated and e is the equation error term.[2] The same general model is used to estimate the total food concentration curve. Expenditure elasticities can be calculated from the parameters of the estimated Lorenz and concentration curves (see Kakwani for the appropriate formulas).

Background on Adult Equivalence Scales

Adult equivalence scales for income are a sophisticated method of head counting typically employed to adjust household budgets to per-

[1] Studying a food expenditure distribution across incomes (however adjusted) implies that the incomes, not necessarily the food spending, of households at the bottom of the distribution are lowest (unless a strict monotonic relationship exists between income and food spending).

[2] A Box-Cox type model as suggested by Blaylock and Smallwood (1982) is a viable alternative functional form but would have unduly complicated the analysis for the purposes of this article.

mit welfare comparisons across different size households.[3] These scales attempt to account for the role that differences in household size make in the transformation of income into welfare (Lazear and Michael). Ideally, this transformation should account for family type goods, scale economics, division of labor, voluntary substitutions, etc. Some authors also believe it is appropriate to account for utility received from children (Pollak and Wales). These are termed unconditional scales since they treat a household's demographic composition as endogenous. These scales express the amount of income necessary to equate utility across households with different demographic characteristics by taking into account the utility associated with these characteristics. Consequently, if children have positive utility, it's possible that larger households may require less income than smaller ones to have the same level of utility. Aside from the near impossibility of estimating such scales, they also appear to be inconsistent with the equity values of the U.S. population (see Sharma and Price).

The common household and per capita adjustments can be viewed as the two bounds on the "true" adult equivalence scale. The household level model implies, among other things, that perfect economies of size exist, and the per capita form implies that no economies of size are present. Neither of these "scales" is grounded in any economic or sociological theory, but they are often used because of their ease of application.

In this study I use several types of equivalence scales for income: the Rothbarth and subjective because recent research tends to support these approaches and those implicit in the U.S. poverty lines because of their widespread use. I also use the per capita and household level adjustments, not because I think either is necessarily plausible but to illustrate the consequences of using these popular specifications.

Usually, scales are estimated from the consumption patterns of households of different size. As noted by Gronau, since there is no direct method of comparing the welfare levels of households with different demographic profiles, the consumption of specific goods is used as a proxy for welfare. In the case of the U.S. poverty lines, food is the chosen commodity. The choice of which goods to use as a measure of welfare is debatable.

Gronau recently has made a very convincing argument that the Rothbarth method is the only feasible and theoretically justifiable choice for estimating scales for welfare comparisons. This method is based on the idea that expenditures on pure adult goods correctly indicate adult welfare. Therefore, the correct compensation to pay for the addition of a child is that sum which restores expenditures on adult goods to the pre-child level. Gronau shows that all other traditional scales derived from expenditure data overcompensate larger households, thus rendering welfare comparisons meaningless. Despite its attractiveness, several problems are inherent in the Rothbarth scheme. First, one must identify the pure adult goods and, secondly, one must assume that the presence of children does not affect adult leisure or increase the costs of adult goods.

Another school of thought led by Goedhart et al., Kapteyn, and van Praag has cogently argued that subjective or introspective scales are the most viable type of scale. These scales are derived from direct questions to individuals asking the minimum income necessary to "make ends meet." Their principal attractiveness lies in their simplicity and the notion that individuals are better judges of their own situations than "experts." Since these scales are based on total expenditures or income, they implicitly leave room for voluntary substitution of goods as household size increases.

The most commonly used adult equivalent scale for U.S. analyses, aside from household or per-person specifications, is the one implicit in the U.S. poverty lines. The official poverty lines were developed by Orshansky in the 1960s. She took the costs of the Economy Food Plan (a minimum-cost diet developed by the USDA) and observed from the USDA 1955 Nationwide Food Consumption Survey that households with three or more persons spent about one-third of their income on food. She then multiplied the costs of the Economy Food Plan for households of different sizes by three to estimate what were to become the U.S. poverty guidelines. Thus, the household size adjustment factors are based solely on the added food costs associated with an additional family member. Compared to other major expenditure categories such as housing, food spending has far fewer economies of size. Thus, scales

[3] Scales are often conditioned on both household size and composition. As the principal purpose of this article is one of illustration, I only consider household size scales.

estimated from food expenditures overcompensate larger households (Deaton and Muellbauer; Gronau).

There appears to be less controversy surrounding the type of equivalent scale for use in adjusting total food budgets. Unlike scales for income, it is clear that scales for adjusting food budgets should be based on an analysis of household food spending (or consumption) because interest centers on comparing expenditures, not welfare, across different size households (e.g., Buse and Salathe; Price 1970). Furthermore, estimating total food expenditure scales, as opposed to commodity-specific scales, will implicitly account for voluntary substitutions as household size increases (e.g., hot dogs and hamburger for steak). Thus, traditionally estimated scales are probably appropriate. Furthermore, many of the scales estimated from different techniques appear to be fairly close in numerical value (Tedford, Capps, and Havlicek). The latter finding is probably related to the presence of fewer economies of size for total food spending than for many other commodity groups.

However, like the situation for income, the use of per capita and household level specifications for adjusting food expenditures continues to enjoy popularity despite the obvious fact that economies of size exist and, moreover, voluntary substitutions among different foods are made as household size increases.

Empirical Strategy

The specific questions to address are: How does the size distribution of food spending change if alternative sets of income and food equivalence scales are used, and what is the magnitude of any difference? Types of changes studied include those associated with the cumulative distribution functions, characteristics of the "poor," inequality, and estimated expenditure elasticities.

The data set is the interview portion of the Bureau of Labor Statistics' 1982 Continuing Consumer Expenditure Survey (CCES). The interview CCES is a nationally representative survey comprised of a panel of approximately 5,000 households, surveyed every three months over a one-year period. It collects expenditures on aggregate commodity groups as well as household demographic information. Total expenditures (a reasonable proxy for permanent income) is the income variable. After deletion of households with incomplete survey records, 3,340 usable observations remain.

The equivalence scales used are presented in table 1. The subjective scales are taken from Blaylock and the official poverty line scales from a Congressional Budget Office Report. The subjective scales show large economies of size and the poverty line scales much less. For example, the subjective scales indicate that a two-person household requires 20% more income than a one-person household, and a four-person household needs 43% more. In contrast, the poverty line scales indicate that a two-person household requires 28% more income and a four-person household 100% more income than a one-person household.

Blaylock also estimated a scale based on the Rothbarth method and found it relatively flat, implying large economies of size, and very similar to the subjective scale. Hence, I use the subjective scale in the remainder of this report. Other recent studies also have concluded, using a variety of procedures, that income equivalence scales are relatively flat (e.g., Chavas and Citzler; Danziger et al.).

The per capita specification indicates, of course, that a four-person household requires four times the income (or food spending) of a one-member household, and the household level model indicates that all households, regardless of size, need the same income to have identical welfare levels. These latter adjustments are applied to both income and food

Table 1. Adult Equivalence Scales

Household Size	Per Capita	Official[a]	Subjective[b]	Household	Food[c]
Equivalence: Four Persons = 100					
1 person	25	50	70	100	53
2 persons	50	64	84	100	66
3 persons	75	78	93	100	81
4 persons	100	100	100	100	100
5 persons	125	118	106	100	117
Equivalence: One Person = 100					
1 person	100	100	100	100	100
2 persons	200	128	120	100	125
3 persons	300	156	133	100	153
4 persons	400	200	143	100	189
5 persons	500	236	151	100	221

[a] Source: Congressional Budget Office.
[b] Source: Blaylock.
[c] Source: Blaylock and Smallwood (1986).

spending to permit comparisons with results using other scales.

A subjective type food scale is used which was derived from an analysis of a survey question asking respondents to evaluate their food supplies (Blaylock and Smallwood 1986). The scale shows somewhat similar economies of size as many other types of total food scales (e.g., Brown and Johnson; Price 1988).

The empirical strategy is as follows. First, denote household permanent income by Y and total food expenditures by F. Consider the following income equivalence scales: subjective, denoted by S; the official poverty line scales, denoted by O; per capita, PC; and household unadjusted income (i.e., scales all equal to one regardless of household size), denoted by H. I use the subjective food scale, SF; per person; and household level scales as denoted above for adjusting food expenditures. Consequently, the following income variables are defined: Y_S, Y_O, Y_{PC}, Y_H. Food expenditure variables are: F_{SF}, F_{PC}, and F_H. The various distributions are constructed in the following way. First, household income is adjusted by one of the scales and the household's total food spending by a given scale. The households than are ranked in ascending order of their equivalent incomes and grouped into percentiles (100 groups). The cumulative distributions for income and food spending then are constructed. Thus there are 12 different food expenditure distributions to be analyzed (four different income concepts each with the three corresponding food spending variables). The notation $F_{SF} \mid Y_{PC}$, for example, denotes that food spending has been adjusted by the subjective food scale given that income was placed on a per-person basis prior to constructing the cumulative distributions.

For many of the reasons given above, I believe that income and food spending adjusted by the subjective income and food scales, respectively, are the "most realistic" distributions studied and the ones to which the other distributions should be compared in judging their viability.

Empirical Results

Before we can make any meaningful comparisons among the alternative cumulative distributions [i.e., the FMDFs in equations (2) and (3)], we need to test whether or not they are statistically different from one another. A Kolmogorov test is an appropriate procedure. Roughly speaking, the more dissimilar the proportion of total income (food spending) contained in the same percentile across two distributions, the more likely the Kolmogorov test is to reject the hypothesis that the two distributions are the same. The test statistics for all pair-wise comparisons of the various food spending distributions and the income distributions are presented in table 2. First, consider the income distributions.

The null hypothesis that income when adjusted by the official scale, subjective scale, or left at the household level has the same cumulative distribution could not be rejected. On the other hand, the Kolmogorov statistics indicate rejection, at the 1% level, of the null hypotheses that the official, subjective, and household income variables have the same cumulative distribution as per capita income. Consequently, except for the per capita specification, if major objectives are to calculate inequality measures or the proportion of income earned by various percentiles of an income distribution, it appears likely that results would be similar regardless of the assumed household size adjustments.

However, similar cumulative distributions may place households with entirely different characteristics in the same quintile (see table 6). This is obviously important for the identification of poor households and has implications for the analysis of food expenditure distributions because they depend on both income and food expenditure equivalence scales. For example, when comparing household and per capita income distributions, it is generally found that relatively smaller households tend to be at the bottom of a household income distribution. Therefore, total household food spending tends to be lower and per capita food spending higher in the poorer percentiles of a household income distribution as compared to a per capita distribution. These relationships are essentially based on the high correlation existing among household size, income, and food spending in the U.S. and are helpful in understanding why some cumulative food expenditure distributions based on different (same) food equivalence scales may be similar (dissimilar) to each other.

Most of the food spending distributions are statistically different from one another at usual confidence levels. First, compare those cumulative food spending distributions that are

Table 2. Kolmogorov Test Statistics

	Income Distributions		
	Y_S	Y_O	Y_{PC}
Y_H	0.35	0.23	2.08*
Y_S	—	0.69	2.37*
Y_O	—	—	1.73*

	Food Spending Distributions										
	$F_{PC} \mid Y_O$	$F_{PC} \mid Y_S$	$F_{PC} \mid Y_H$	$F_{SF} \mid Y_{PC}$	$F_{SF} \mid Y_O$	$F_{SF} \mid Y_S$	$F_{SF} \mid Y_H$	$F_H \mid Y_{PC}$	$F_H \mid Y_O$	$F_H \mid Y_S$	$F_H \mid Y_H$
$F_{PC} \mid Y_{PC}$	1.37**	2.49*	3.93*	2.64*	1.65*	2.07*	2.52*	6.70*	3.87*	2.08*	1.41**
$F_{PC} \mid Y_O$	—	1.84*	3.29*	1.88*	1.44**	1.42**	1.91*	6.07*	3.29*	1.44**	0.35
$F_{PC} \mid Y_S$	—	—	1.62**	1.17	0.90	0.47	0.09	4.22*	1.56**	0.46	1.40**
$F_{PC} \mid Y_H$	—	—	—	1.46	2.41*	1.98*	1.57**	2.77*	0.58	1.85*	2.95*
$F_{SF} \mid Y_{PC}$	—	—	—	—	1.02	0.52	0.16	4.23*	1.72*	0.59	1.59**
$F_{SF} \mid Y_O$	—	—	—	—	—	0.49	0.88	5.55*	2.11*	0.67	0.43
$F_{SF} \mid Y_S$	—	—	—	—	—	—	0.40	4.71*	1.88*	0.08	0.97
$F_{SF} \mid Y_H$	—	—	—	—	—	—	—	4.04*	1.39**	0.38	1.54**
$F_H \mid Y_{PC}$	—	—	—	—	—	—	—	—	2.83*	4.62*	5.78*
$F_H \mid Y_O$	—	—	—	—	—	—	—	—	—	1.79*	2.89*
$F_H \mid Y_S$	—	—	—	—	—	—	—	—	—	—	1.39**

Note: * Denotes significance at the 1% level. ** Denotes significance at the 5% level. Critical values: 1.63 at .01 level, 1.36 at .05 level. Y_S, Y_O, Y_{PC}, and Y_H denote, respectively, household income adjusted by (*a*) a subjective scale, (*b*) the official scale, (*c*) the number of persons in the household, and (*d*) no adjustment. F_{PC}, F_{SF}, and F_H denote, respectively, household food spending adjusted by (*a*) the number of persons in the household, (*b*) the subjective food scale, and (*c*) no adjustment. The notation $F_{PC} \mid Y_{PC}$ denotes, for example, that income was placed on a per capita basis prior to constructing the per capita food spending distribution.

defined over an identically constructed income distribution (i.e., using the same income equivalence scale). The test statistics indicate that all three of the food spending distributions defined over the per capita income distribution are statistically different from one another. The same is true for the food spending distributions defined over household income as well as the poverty line adjusted income distribution.

Only the food spending distributions defined over the subjectively adjusted income distribution are not statistically different. This may be caused by the subjective scale adjusting income such that actual household size is approximately the same across percentiles of the income distribution. This tends to equalize food spending, however it's adjusted, within given percentiles across the three food spending distributions.

Next turn to those food spending distributions adjusted by the same scale but defined across income distributions calculated with different scales. Results indicate that all per capita food spending distributions are statistically different from one another, and the same holds true for the household food spending distributions. Conversely, the three food-scale adjusted cumulative food spending distributions are statistically equivalent. Apparently, the food scale tends to equalize food spending across given percentiles of the four types of income distribution. For the remainder of the pair-wise test statistics, I will only briefly discuss some of those that are not statistically significant.

In general, those remaining food spending distributions that are statistically equivalent tend to be those in which the income adjustment in one distribution is offset by the food spending adjustment in the other and vice versa. As an example, take the distributions $F_{PC} \mid Y_S$ and $F_{SF} \mid Y_H$. The subjective income distribution tends to have similar household sizes across percentiles, and a household distribution has smaller households at the bottom than the top relative to the subjective. This implies that per capita food spending is less at the bottom and more at the top of a subjective income distribution than would be the case in a household income distribution. However, adjusting food spending by the food scale in a household income model tends to decrease food spending at the bottom and increase it at the top relative to the per capita food spending adjustment—thus contributing to the distributions $F_{PC} \mid Y_S$ and $F_{SF} \mid Y_H$ being statistically indistinguishable. Similar arguments can be made for many of the pairs of distributions not already discussed.

Although the empirical results presented are dependent on the data used, the proposition that food expenditure distributions constructed across income levels are heavily dependent on the adult equivalence assumptions made for both income and food spending is valid. Sometimes the cumulative food spending distributions are invariate to the specification of income, such as using the food scale to adjust food expenditures, and at other times are highly dependent, such as the per capita food adjustments. Even when distributions are similar, however, the statistical equivalence of two cumulative distributions does not imply that the same households are in the same percentile across distributions.

Presented in table 3 are Gini and concentration ratios for the various distributions as calculated over percentiles using Simpson's rule for numerical integration. A Gini coefficient measures the departure of the Lorenz curve from the egalitarian line and a concentration ratio measures the departure of a concentration curve from the egalitarian line. The coefficients are bounded between zero (perfect equality) and one (perfect inequality). The various ratios essentially reflect, in a single number, the difference in the percentages of na-

Table 3. Gini Coefficients and Elasticities

Distribution	Concentration Ratio	Expenditure Elasticity[a]
$F_{PC} \mid Y_{PC}$	.228	.687
$F_{PC} \mid Y_O$	.200	.763
$F_{PC} \mid Y_S$	.170	.696
$F_{PC} \mid Y_H$	.126	.500
$F_{SF} \mid Y_{PC}$	.168	.521
$F_{SF} \mid Y_O$	.181	.682
$F_{SF} \mid Y_S$	.177	.741
$F_{SF} \mid Y_H$	.162	.640
$F_H \mid Y_{PC}$	.070	.223
$F_H \mid Y_O$	.128	.458
$F_H \mid Y_S$	.180	.703
$F_H \mid Y_H$	.204	.778
	Gini	
Y_{PC}	.368	NA
Y_O	.330	NA
Y_S	.314	NA
Y_H	.320	NA

Note: For definitions of the variables, see note to table 2.
[a] Elasticity at the means.

Table 4. Lorenz and Concentration Curves

Curve	C	α	β	R^2
Y_S	−1.2698 (0.0033)	0.8511 (0.0017)	0.8064 (0.0026)	.99
Y_{PC}	−1.0763 (0.0042)	0.8705 (0.0026)	0.8431 (0.0040)	.99
$F_{SF} \mid Y_H$	−1.8364 (0.0071)	0.8401 (0.0055)	0.9988 (0.0059)	.99
$F_{PC} \mid Y_O$	−1.6033 (0.0054)	0.8332 (0.0036)	0.9743 (0.0045)	.99
$F_H \mid Y_{PC}$	−1.5485 (0.0050)	0.8212 (0.0034)	0.9159 (0.0043)	.99

Note: Numbers in parentheses are standard errors. For definitions of the variables, see note to table 2.

tional income (food spending) received (spent) by various percentiles across a given distribution.

The Gini coefficients are about equal for the poverty line, subjective, and household income models. This was expected since these distributions are not statistically different from one another. The Gini for the per capita income distribution is about 12% to 17% higher than for the others.

The concentration ratios vary between .07 for the $F_H \mid Y_{PC}$ distribution to .228 for the $F_{PC} \mid Y_{PC}$ model—over 300%. The concentration ratios for the food expenditure models adjusted by the food scale, regardless of how income is adjusted, are quite similar, ranging from .162 to .181. This is true for all the food spending distributions (regardless of the scale used) defined over income distributions adjusted by the subjective scale.

In general, the wide diversity found in the concentration ratios lends further evidence that specification of the adult equivalence scales is critically important. It appears that one could argue that inequality in income (or food spending) is high or low merely by the judicious choice of equivalent scales.

Estimated parameters for selected Lorenz and concentration curves using the modified beta functional form [equation (6)] are presented in table 4. The R^2s for all equations were consistently over .95. Mean food expenditure elasticities as calculated from the various models are presented in the last column of table 3. It should be noted that the elasticity for any given concentration curve, say $F_H \mid Y_H$, is estimated from the parameters of the concentration curve and the corresponding Lorenz

Table 5. Percent of Income Spent on Food by Quintile

Distribution	Quintiles 1	2	3	4	5
Y_{PC}	27.7	24.2	21.5	19.2	13.5
Y_O	27.4	22.8	21.7	19.5	13.3
Y_S	23.2	21.6	21.2	20.1	13.3
Y_H	23.0	21.5	20.8	19.5	13.4

Note: For definitions of the variables, see note to table 2.

curve, Y_H. In general, the closer a concentration curve lies to a Lorenz curve the larger the elasticity. In other words, the higher the value of the concentration ratio divided by the Gini coefficient the larger the elasticity.

The estimated food expenditure elasticities vary from a low of .223 for the $F_H \mid Y_{PC}$ model to a high of .778 for the $F_H \mid Y_H$ model, almost a 350% difference. Our preferred model, $F_{SF} \mid Y_S$, has an elasticity of .741. This variation in the estimated elasticities is a strong indication of the sensitivity of empirical results to alternative sets of equivalence scales. By carefully selecting the appropriate equivalence scale, one can derive elasticities that will confirm prior expectations. Therefore, results such as those presented by Blaylock and Smallwood (1982), which are based on per capita specifications for both income and food spending distributions, should be used with a measure of caution.

Presented in table 5 is the percent of income spent on food within income quintiles for the four income distributions. The household level model indicates that the poorest 20% of the population spent 23% of their income on food. The per capita distribution shows the highest percentage, almost 28%. This amounts to a 22% difference between these two models. The model used as a standard, $F_{SF} \mid Y_S$, indicates that the poorest quintile spent 23.2% of its income on food. Conversely, in the richest quintile the percent of income spent on food tends to be about the same, approximately 13.3%, regardless of the adjustment made to account for household size. The large percentage differences between some of the models in the percent of income spent by poor households on food highlights the potential difficulty in gauging economic progress over time using this statistic. For example, it is entirely possible that different scales could indicate opposite trends emerging with respect to the per-

Table 6. Household Characteristics of Poorest and Richest 20% of the Population

	Distribution							
	Poorest				Richest			
Characteristics	Y_{PC}	Y_O	Y_S	Y_H	Y_{PC}	Y_O	Y_S	Y_H
Average household size	4.3	3.3	2.5	2.0	1.9	2.4	2.9	3.3
Average age of head	42.0	45.5	47.8	47.5	43.6	43.9	43.0	43.1
Percent married	63.0	47.0	40.0	32.0	50.0	69.0	76.0	83.0
Percent black	24.0	21.0	19.0	16.0	6.0	7.0	6.0	7.0
Percent with head over 64 years	15.0	24.0	31.0	31.0	12.0	9.0	6.0	5.0
Percent headed by a female	33.0	43.0	45.0	48.0	27.0	16.0	13.0	10.0
Percent single	9.0	31.0	39.0	40.0	43.0	22.0	15.0	8.0

Note: For definitions of the variables, see note to table 2.

centage of income spent on food, as well as in inequality.

Presented in table 6 are selected household demographic characteristics of individuals in the bottom and top 20% of each type of distribution. Recall that since food expenditure distributions are studied over income levels, the reason an individual is at the top or bottom is because of his/her income. In general it appears that certain individuals can be considered rich or poor regardless of the income distribution used. For example, more blacks than their population percentage tend to be poor regardless of the income distribution used. Poorer households in a per capita distribution tend to be younger, married, and have relatively larger household sizes compared to the other distributions. Conversely, poorer individuals in the household income distribution are generally older, live in households headed by a female, and are often single. This graphically illustrates the need for researchers to make their assumptions regarding the treatment of different size households clear.

Concluding Remarks

The primary goal of this article is to encourage researchers to examine more closely the adult equivalent scales used in the analysis of income and food spending distributions. To this end, I examined the impacts of income and food expenditure equivalence scales on: (*a*) food expenditure elasticities, (*b*) the percent of household income spent on food, and (*c*) which households can be considered rich or poor. In general, choice of scales can have profound effects in all three areas. For example, estimated expenditure elasticities varied from a low of .223 to a high of .778 depending on the scale used. Likewise the percent of income spent on food varied from almost 28% for the poorest households in the per capita income distribution to 23% in the household income distribution. In a household income distribution, poor households tended to have one member and be headed by a female, while in the per capita income distribution, poorer households tended to be married couples with children. These differences can have major effects on program management and policy.

Income adjusted by the subjective or official scales was distributed the same as household level income. Consequently, if large economies of size exist, as empirical evidence seems to indicate, the household level income model is a convenient and simple model to employ. Because of the absence of scale economies in the per capita model, empirical results from this model were considerably different. Consequently, the per capita income adjustment is not recommended for the type of empirical work studied here.

For a given income distribution, empirical results can vary depending on the food equivalence scale chosen. Since food spending has far fewer economies of size than income, we can probably reject household level food spending as a satisfactory type of adjustment. For preliminary analysis, a per capita food adjustment may be satisfactory although I lean toward using some type of estimated food scale.

Pragmatically, much policy analysis looks at changes over time. Although not addressed here, the use of different scaling approaches could lead, for example, to different conclusions with respect to the evaluation of trends of families in poverty or the percent of income they spend on food. This is an area that needs to be explored.

[*Received January 1990; final revision received January 1991.*]

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