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POVERTY AND HOUSEHOLD SIZE*

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The widely held view that larger families tend to be poorer in developing countries has influenced research and policy. The scope for size economies in consumption cautions against this view. We find that the correlation between poverty and size vanishes in Pakistan when the size elasticity of the cost of living is about 0·6. This turns out to be the elasticity implied by a modified version of the food share method of setting scales. By contrast, some measures of child nutritional status indicate an elasticity of unity. Consideration of the weight attached to child versus adult welfare may help resolve the non-robustness of demographic profiles of poverty.

There is considerable evidence of a strong negative correlation between household size and consumption (or income) per person in developing countries.[1] It is often concluded that people living in larger and (generally) younger households are typically poorer. There has been much debate on which is the 'cause' and which is the 'effect' in this correlation. The position one takes in that debate can have implications for policy, including the role of population policy in development, and the scope for fighting poverty using demographically contingent transfers.

The existence of size economies in household consumption cautions against concluding that larger families tend to be poorer.[2] The poor tend to devote a high share of their budget to rival goods such as food. But certain goods (water taps, cooking utensils, firewood, clothing, and housing) do allow possibilities for sharing or bulk purchase such that the cost per person of a given standard of living is lower when individuals live together than apart.

Despite extensive work on welfare measurement in economics, there is still no preferred method for making inter-personal comparisons across households of different size and/or composition. Household data on demands and supplies are often used to estimate how demographic variables influence the cost of a given utility level (on the theory see Deaton and Muellbauer, 1980). It is now

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[1] This pattern has been found in innumerable household surveys spanning Asia, Africa and Latin America; for surveys see Visaria (1980, section 4), Sundrum (1990, chapter 2), and Lipton and Ravallion (1994, section 4.2).

[2] This is not the only reason. Larger households in developing countries tend also to have more children, who (it is often argued) can achieve a given level of welfare at lower expenditures. This is often built into demographic equivalence scales (which convert any demographic composition for a household into an equivalent number of adults); for a survey see Browning (1992). Later we shall argue that, by at least one common method of setting scales, these demographic compositional effects are more plausibly attributed to economies of size. There are other reasons why a greater household size may make at least some members better off; for example, it may make for a more secure and easily supervised labour force for own-production activities, or it may offer greater security in old age; in both cases the benefits are presumably appropriated largely by the household decision maker(s). (Some demographers have stressed such arguments; see, for example, Caldwell (1976).) Of course, these arguments do not imply that a typical member of a large household will be better off; the children may be worse off.

recognised that the empirical implementation of such utility-based methods of welfare measurement ultimately rests on untestable identifying assumptions.[3] In general there will exist more than one possible set of utility functions for household members which can account for their observable demands and supplies. For example, the interpretation of demographic differences in household demand behaviour as welfare-relevant differences in needs is problematic; the same demand data may equally well be explained by intra-household inequalities (Ravallion, 1994). The need to distinguish adult from child welfare – and the possibility of a tension between the two – has also motivated concern about empirical welfare measures used in both research and policy (Nelson, 1993). And, even without utility-identification problems, there are grounds for dispute about whether 'utility' is the appropriate concept for anchoring scales, or making interpersonal comparisons generally (Sen, 1985).

The choice of a welfare measure, including an equivalence scale, is ultimately based on value judgements about which differences of opinion must be expected. This alone should make one cautious about the statements one often hears concerning the relationship between poverty and household size. However, the way in which the choice of scale alters poverty comparisons has received very little attention.[4] For many purposes for which a demographic profile of poverty is required (such as designing a family allowance scheme, or some other form of 'demographic targeting' such as subsidised family planning services), it is how the measurement issue affects the poverty ordering of demographic groups that matters most.[5]

This paper tests the robustness of statements about the relationship between poverty and household size. We begin by showing that, for a broad class of poverty measures and sufficient dispersion in household sizes, the problem can be reduced to that of whether or not the value of a size parameter exceeds a unique critical value (Section I). The key question is then whether or not one believes that the true value of that parameter is above or below this critical value. We then estimate that critical value for Pakistan (Section II), and compare its value to a range of estimates that may be deemed defensible for Pakistan (Section III). As in other developing countries, past practices for Pakistan have typically assumed that the cost of a given level of welfare is

[3] See Nicholson (1976), Pollak and Wales (1979), Deaton and Muellbauer (1986), Blundell and Lewbel (1991) and Browning (1992).

[4] It is known that the cardinal value of a poverty measure can be sensitive to the choice of equivalence scale (Coulter *et al.* 1992). Our concern here is with the effect on the poverty ranking. The question we pose here is quite similar to Atkinson (1992), though both our method, and the empirical setting, are quite different. Atkinson asks how far one can go in ranking households (defined in terms of their demographic composition) in terms of poverty without specifying the precise form of the underlying welfare function; only a few (seemingly mild) assumptions are made. Our approach puts more structure on the parametric form of the scale. (Atkinson (1992) comments on the existence of this approach, but does not explore it further.) Some discussions of the poverty impact of family allowance schemes have recognised that the answer may depend critically on the properties of the equivalence scale used (see, for example, Jarvis and Micklewright, 1994).

[5] This has been a theme in recent poverty research; see Ravallion's (1994) survey. It should not be presumed that the issue is of only second-order importance to policy; for example, in another important policy application of poverty data, regional poverty profiles have been found to be highly sensitive to measurement assumptions; see Ravallion and Bidani (1994).

directly proportional to household size and (hence) that a *per capita* normalisation of total expenditures is appropriate. Taking a deliberately eclectic approach, we test that assumption using various methods. Our conclusions can be found in Section IV.

I. THE CRITICAL SIZE ELASTICITY FOR RANK REVERSAL

We consider the class of equivalence scales whereby the money metric of a consumer's welfare has an elasticity θ with respect to household size (which we term the 'size elasticity'). The welfare of a typical member of any household is then measured in monetary terms by x/n^{θ} ($0 \leqslant \theta \leqslant 1$) where x denotes total household consumption expenditure, and n denotes household size; n^{θ} can be interpreted as the equivalent number of single-persons.[6] In the empirical work we shall allow for other differences in household circumstances (such as in demographic composition, and the prices faced), but for the exposition in this section we shall assume that the households being compared are homogeneous in other respects. (For example, one is comparing large and small households amongst those of a given demographic composition or living in a given region.) However, as we shall show for our data, by at least one common method of setting scales the compositional effects are insignificant, and so the single parameter scale is also defensible empirically.

Consider two possible household sizes, n_S ('small') and n_L ('large') with $n_L > n_S$. (Two groups is unrestrictive, as we shall only need to make binary comparisons amongst the numerous demographic groups.) A poverty line is given for small households (say single adults), and this is denoted z_S. The equivalent poverty line for large households is then $z_L(\theta) = z_S(n_L/n_S)^{\theta}$. The distribution functions of household consumption for the two groups are F_S and F_L, with corresponding density functions f_S and f_L.

We shall allow a broad class of poverty measures. In particular, we follow Atkinson (1987) in considering additive measures of the form (for group i):

$$P_i(z) = \int_0^{z_i} p(x, z_i) f_i(x)\, dx \quad (i = S, L) \tag{1}$$

for which $p_x(x,z) \leqslant 0$, $p_z(x,z) \geqslant 0$ and $p(z,z) \geqslant 0$, with at least one of the latter two conditions holding with strict inequality (implying that $P_i'(z) > 0$).[7] Values of x and z are associated with a measure of poverty $p(x,z)$, and this function is non-increasing in x and non-decreasing in z. There are many examples of this class of measures. The widely used head-count index (H) is the proportion of the population for whom the welfare metric is less than the poverty line;

[6] This class of scales has been widely used over many years (Prais and Houthakker, 1955; Singh, 1972; Buhmann *et al.* 1988; Coulter *et al.* 1992), though it is clearly quite special. There are other possibilities, such as normalising consumptions by $1+\theta(n-1)$ (also considered by Coulter *et al.*, following O'Higgins *et al.* (1989)). Our main results in this section can be shown to hold for that specification, and (indeed) a more general class of scales, though we will confine ourselves to the simple iso-elastic scale here.

[7] Additive measures satisfy sub-group consistency, as defined by Foster and Shorrocks (1991). This requires that when poverty increases in any sub-group of the population without a decrease in poverty elsewhere, then aggregate poverty must also increase.

$H_i = F_i(z)$, obtained by setting $p(x, z_i) = 1$ in equation (1). The poverty gap index is obtained by setting $p(x, z_i) = 1 - x/z_i$ (so the measure is strictly decreasing and weakly convex in x). The squared poverty gap index has $p(x, z_i) = (1 - x/z_i)^2$, and this is distribution-sensitive (strictly convex).[8]

Which are poorer, small households or large ones? First we consider the case in which larger households have higher total consumption, in that $F_S(x) > F_L(x)$ for any given value of x.[9] Define $D(\theta) \equiv P_L - P_S$. Clearly large households will be less poor if household consumption is a pure public good; on noting that $z_L(0) = z_S$, it is readily verified that:[10]

$$D(0) = \int_0^{z_S} p(x, z_S)\,[f_L(x) - f_S(x)]\,dx < 0. \tag{2}$$

Consider instead the poverty comparison when $\theta = 1$. The answer will depend on how large the larger household is relative to the smaller one. Let n_L^* be the size of the larger household which equates its poverty with that of the smaller household, i.e.

$$P_L(z_S n_L^*/n_S) = \int_0^{z_S n_L^*/n_S} p(x, z_S n_L^*/n_S) f_L(x)\,dx = P_S. \tag{3}$$

It is clear that $D(1) \geqslant 0$ for all $n_L > n_L^*$. Thus, provided that the larger households are large enough (in this precise sense), the poverty comparison is clear at the two extremes of the size elasticity, and there must be at least one 'switch point'. But we can go further and rule out multiple switch points by noting that $D'(\theta) > 0$ for all θ. So, for all $n_L > n_L^*$, continuity of $D(\theta)$ implies that there must exist a unique $\theta = \theta^*$ such that $D(\theta) > 0$ for all $\theta > \theta^*$, while $D(\theta) < 0$ for all $\theta < \theta^*$, as depicted by the bold line in Fig. 1. Large families will be poorer if and only if the actual value of the size elasticity exceeds θ^*. However, if large households are not large enough (specifically $n_L < n_L^*$) for the given distributions, then $D(\theta) < 0$ for all θ, as indicated by the dotted line in Fig. 1; small families will then be unambiguously poorer.

Consider next the case in which large families have smaller total consumptions, and (in particular) there is first-order dominance, with $F_S(x) < F_L(x)$ for any given value of x. In this case it is plain that $D(\theta) > 0$ for all θ and all $n_L > n_S$ (since $D(0) > 0$ and $D'(\theta) > 0$ for all θ). Large families will be unambiguously poorer. However, the ranking is ambiguous if there is not first-order dominance in terms of total household consumptions; there will be some poverty measures and poverty lines which will rank differently to others at any given combination of θ and n_L/n_S. Under certain conditions, the results from the application of stochastic dominance theory to poverty comparisons

[8] On this measure see Foster, Greer and Thorbecke (1984) (hereinafter FGT). The general class of FGT measures is obtained when $p(x, z_i) = (1 - x/z_i)^\alpha$ $(\alpha \geqslant 0)$. Other distribution-sensitive measures include $p(x, z) = \log(z/x)$, as proposed by Watts (1968), and the Clark *et al.* (1981) measure $p(x, z) = [1 - (x/z)^\beta]/\beta$ $(\beta \leqslant 1)$.

[9] Empirically one typically finds that total consumption tends to be higher for larger households, even though consumption per person is lower; see, for example, Visaria (1980) and Sundrum (1990, chapter 2).

[10] This step uses a result proved in Atkinson (1987).

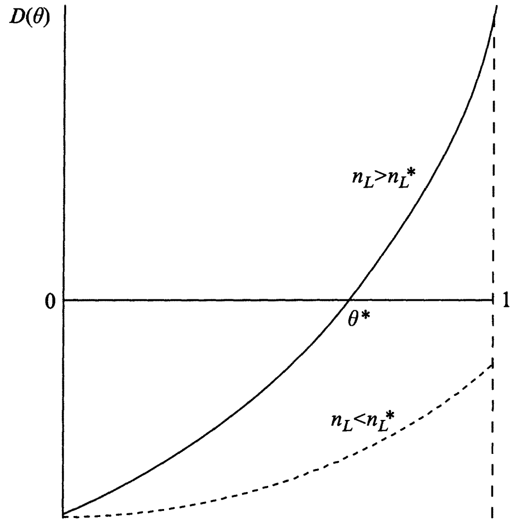

Fig. 1. Critical size elasticity for rank reversal in poverty.

can help resolve the issue. Suppose that, while $F_L(x) < F_S(x)$ at low x, the reverse is true at higher values, and that

$$\int_0^z [F_S(x) - F_L(x)]\, dx > 0 \tag{4}$$

for all z. Then (using a result from Atkinson, 1987) it can be shown that there exists a unique θ^* such that $D(\theta) > 0$ for all $\theta > \theta^*$, while $D(\theta) < 0$ for all $\theta < \theta^*$, provided one restricts attention to weakly convex poverty measures (such as all FGT poverty measures for $\alpha \geqslant 1$).

In this framework, the question of whether large households are poorer is thus seen to depend critically on the extent of dispersion in family sizes and the size elasticity of the equivalence scale. As we have shown, under certain conditions one can readily establish existence of a single critical value of the size elasticity for which the poverty ranking of household-size groups switches. We now investigate these issues empirically.

II. ESTIMATING THE CRITICAL SIZE ELASTICITY FOR PAKISTAN

II.1. *Data*

Our data are from the Pakistan Integrated Household Survey (PIHS) covering 4,794 households residing in 300 urban and rural communities between 1 January 1991 and 31 December 1991. The survey was conducted by the Pakistan Federal Bureau of Statistics (FBS) in close collaboration with the World Bank. The format of the survey followed the Living Standard Measurement Surveys (LSMS), though it also drew on previous FBS surveys. A stratified sample was taken, based on the 1980 Census sampling frame for Pakistan as a whole, and household weights were obtained from that sampling

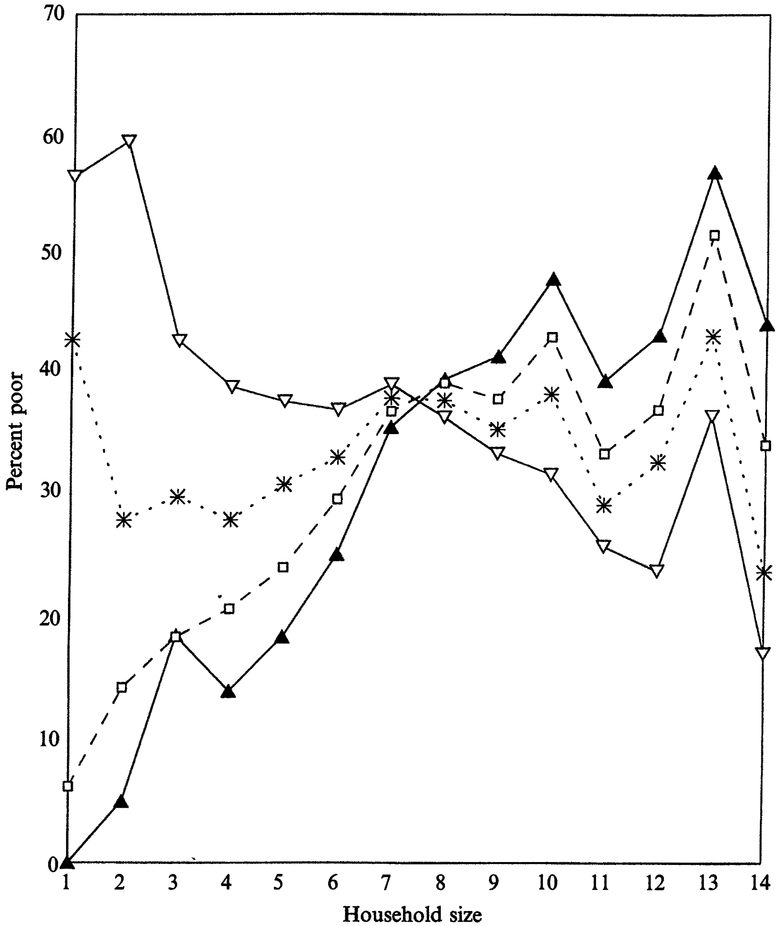

Fig. 2. Poverty and household size (head-count index). Size elasticity: ▽, 0·4; ✳, 0·6; □, 0·8; ▲, 1.

frame. A household-level questionnaire was completed for each household as well as separate questionnaires for adult females and males within each household. A community questionnaire collected prices. We use the data on expenditures and household demographics for 4,763 households (some sample points were dropped because the information was incomplete or not internally consistent). Expenditures were adjusted to reflect both geographic and urban/rural cost-of-living differences (Lanjouw, 1994).

II.2. *The Fragile Correlation Between Poverty and Household Size*

At what size elasticity is consumption per equivalent person orthogonal to household size? For these data the least squares regression coefficient of log total household expenditure on log household size is 0·50 (t-ratio = 32). At values of θ above (below) this figure larger households tend to have lower (higher) consumption per equivalent person. If one controls for differences in

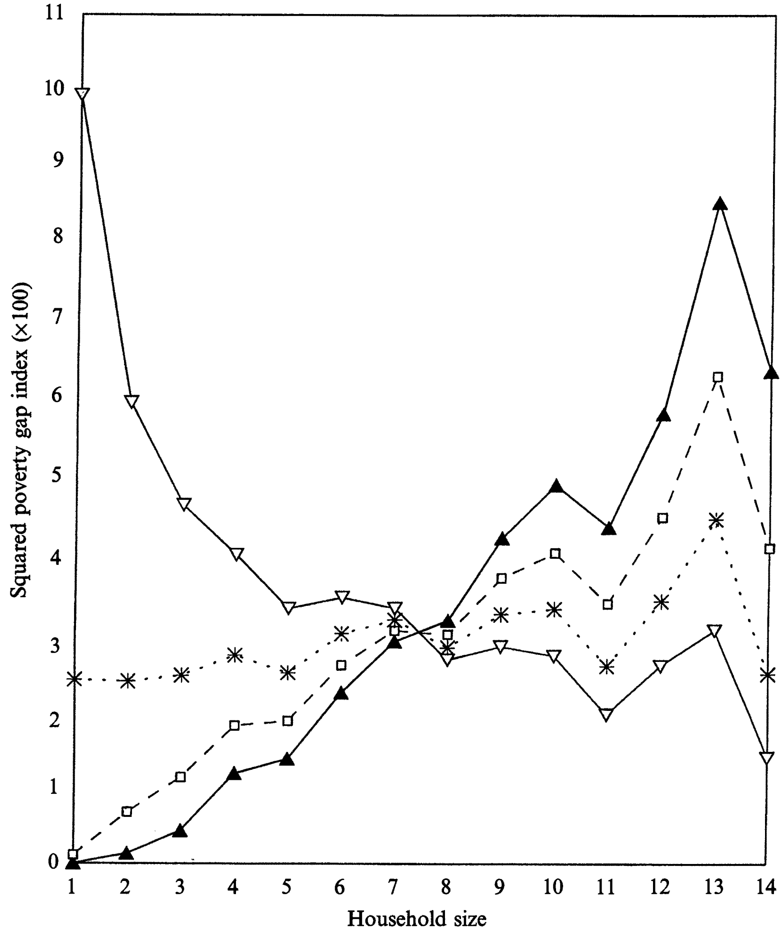

Fig. 3. Poverty and household size (squared poverty gap index). Symbols as in Fig. 2.

household demographic composition and food prices then the estimate rises to 0·62 (t = 37);[11] the higher value largely reflects the correlation between size and demographic composition.

However, consumption per equivalent person is not a measure of poverty as such. Figure 2 gives instead the head-count index of poverty at various values of θ for each household size found in the data.[12] The poverty line used is described in Lanjouw (1994) and was calculated on a *per capita* basis; we make the normalising assumption that the poverty line pertains to a household of average size (7·4 persons) (so a household of average size has the same poverty index for all values of θ). We find that the percent poor generally increases with household size when $\theta = 1·0$. However, the correlation vanishes at a size

[11] Specifically, the regression includes the proportions of persons in various demographic groups (adults under 60, children, infants) and a price index for food given by the food component of the poverty line used below.

[12] The smallest sample size is for single-person households ($n = 59$), and all other sample sizes are 100 or higher. The '14' persons category includes all households over 14.

elasticity of about 0·6, and becomes negative below this figure; at an elasticity of 0·4 there is marked tendency for the poverty rate to decrease as household size increases.

Given the well-known limitations of the head-count index of poverty, it is of interest to consider an alternative measure. Figure 3 gives analogous results to Fig. 2 for the 'squared poverty gap index' of Foster *et al.* (1984), discussed in the previous section. The same basic pattern is evident, and the extent of the reversal in the direction of correlation as one moves from $\theta = 1{\cdot}0$ to $\theta = 0{\cdot}4$ is actually sharper; up to a household size of 10 persons, the squared poverty gap increases monotonically as size increases when the size elasticity is unity, while it decreases monotonically at an elasticity of 0·4. The same pattern is obtained for the poverty gap index.

The rank correlation coefficients between three poverty measures and household size are plotted in Fig. 4. The rank correlation coefficient between

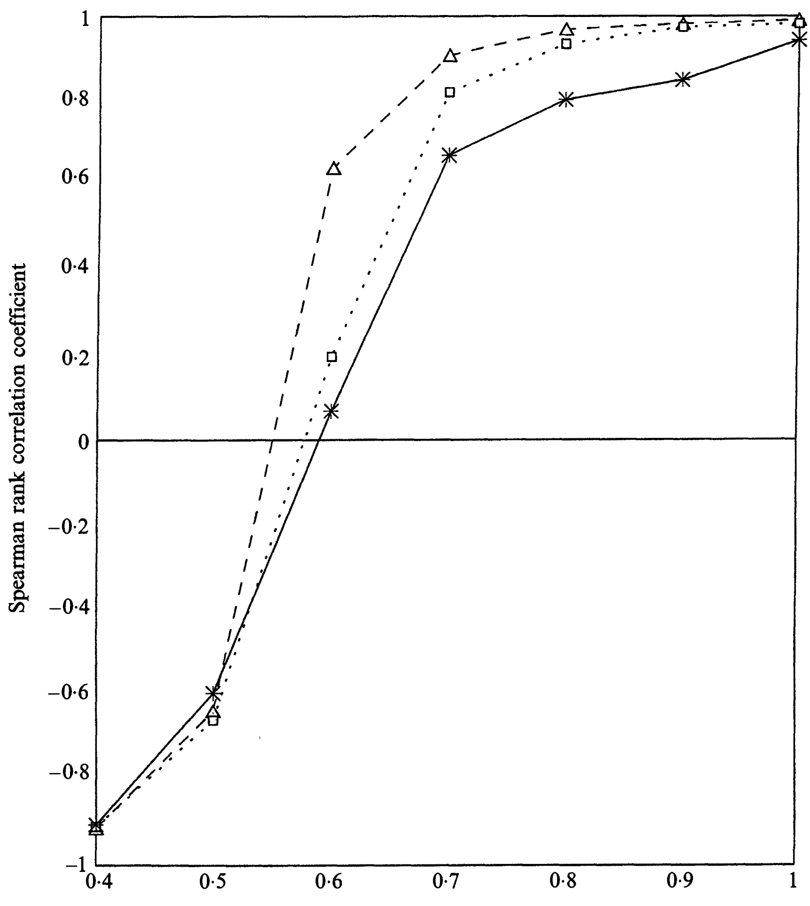

Fig. 4. Rank correlations between poverty and household size. Poverty measure: ✳, head-count index; □, poverty gap; △, squared poverty gap.

the head-count index and household size is zero (0·07) at a size elasticity of 0·6, while for the poverty gap and squared poverty gap indices the correlation reaches zero at a value of θ between 0·5 and 0·6.[13]

III. DO HOUSEHOLDS IN PAKISTAN FACE SIGNIFICANT ECONOMIES OF SIZE?

Common practice in Pakistan and other low-income countries has been to assume that the size elasticity is unity, and so household expenditures are simply divided by household size.[14] From the results of the last section it is plain then that larger households will generally be deemed poorer on average. But is that assumption defensible? Here we consider various approaches. Our aim is not to come up with a precise answer, but rather to characterise the range of values that can be supported by various approaches to setting scales when applied to the Pakistan data. An eclectic approach is warranted, given the aforementioned difficulties in identifying welfare parameters from behaviour. We start with probably the most common method of estimating equivalence scales, which we then test against some very different alternatives.

III.1. *An Engel-curve Estimate of the Size Elasticity*

Our first approach is a variation on the well-known Engel (or 'iso-prop') method of estimating equivalence scales whereby the share of spending devoted to food is taken to be an inverse welfare indicator; the higher the share of non-food spending the better off members of the household are deemed to be (see Deaton, 1981, and Deaton and Muellbauer, 1986). Later we comment on the method, after presenting the results.

We follow the common practice of estimating a Leser-Working model in which the food share is regressed on the log of expenditure per person and a set of demographic variables. However, we modify the method by adding a parameter for effects of household size independently of these variables. The basic specification thus takes the form:

$$w_i = \alpha + \beta \ln (x_i/n_i^{\theta}) + \sum_{j=1}^{J-1} \delta_j \eta_{ji} + \textit{relative prices} + \textit{residual}, \tag{5}$$

where w_i denotes the budget share devoted to food by household i, and η_{ji} is the proportion of persons in household i who belong to category J $(j = 1, \ldots, J)$. This specification allows us to obtain a direct estimate of the size elasticity, by isolating the pure compositional effects in the demographic variables (η_{ji}) from the effect of household size (n_i).[15] By adding the extra parameter for the size effect of household size, we get our estimate of the size elasticity. Amongst

[13] Of course higher values of θ are needed to reject statistically the null hypothesis that poverty and household size are independent. Against the alternative hypothesis of a positive relationship, the critical values needed at the 5% level are (rounding up to the first decimal place) 0·7, 0·7 and 0·6 for the head-count index, poverty gap index and squared poverty gap respectively.

[14] A number of studies for developing countries have incorporated differences in child costs though the scales are typically linear (or approximately so) in the number of children.

[15] It is more common not to normalise the demographic variables this way, and use instead the numbers of persons in household i who belong to category j. We discuss this specification below.

households of the same composition – or in the special case where $\delta_j = 0$ for all j – the value of x/n^θ is the appropriate money metric for ranking households when food share is the welfare indicator. Under certain assumptions, θ in (5) can also be interpreted as the size elasticity of an exact money metric of utility (Appendix). In estimating equation (5) we also added the (log) food poverty line (a cluster-specific food price index) and its squared value and regional and urban/rural dummy variables to pick up differences in relative prices.[16]

Table 1 gives our results. Column 1 is the simple regression of the food share on (log) household size. There is a tendency for larger households to have higher food shares, but the correlation is small (the correlation coefficient is 0·04). When expenditures are added (column 2) the estimated size elasticity of the money metric of welfare is 0·61. The homogeneity restriction ($\theta = 1$) is rejected ($t = 11{\cdot}4$). In column 3 we give the augmented model including both size and compositional effects, as well as the price index and regional dummy variables. We obtain a value for θ of 0·59, with a standard error of 0·044.[17] The homogeneity restriction is again rejected (t = 8·8).

We also tried the following alternative specification for the demographics, giving the Engel curve (ignoring relative prices and residuals):

$$w_i = \alpha^* + \beta' \ln (x_i/n_i^{\theta^*}) + \sum_{j=1}^{J} \delta_j^* n_{ji} \tag{6}$$

in which n_{ji} are the numbers (rather than proportions) of people in each demographic group.[18] These reflect differences in both demographic composition (some households are younger than others) and size (some are simply bigger). Equation (6) can be rewritten as

$$w_i = \alpha^* + \beta^* \ln (x_i/n_i^{\theta^*}) + \left(\sum_{j=1}^{J} \delta_j^* \eta_{ji}\right) n_i. \tag{7}$$

So the size elasticity is now a function of size and demographic composition:

$$\theta_i = \theta^* - \left(\sum_{j=1}^{J} \delta^* \eta_{ji}/\beta^*\right) n_i. \tag{8}$$

The results are given in column 4 of Table 1. At mean points, this specification gives an elasticity of 0·58, close to our other estimates. Homogeneity is rejected (t = 3·4).

We also found that the demographic composition effects on the Engel curve are only significant if the homogeneity restrictions ($\theta = 1$ in equation (5), or $\theta^* = 1$ in (6)) are imposed (Table 2). Once relaxed, the equivalence scale implied by the Engel curve is approximated well by n^θ with no adjustment for demographic composition. This suggests that the 'compositional effects' in the

[16] We also tested a specification in which the size elasticity is a linear function of (log) household size and (log) household consumption. A joint F-test convincingly rejected this in favour of a constant elasticity (F = 0·68).

[17] The standard error for θ is obtained from a first-order Taylor series expansion of θ around the estimated parameters.

[18] Deaton and Muellbauer (1986) use this specification, though they imposed the restriction that $\theta^* = 1$.

Table 1

Engel Curve Estimation of the Size Elasticity

Explanatory variable	1	2	Demographics as proportion of persons 3	Demographics as numbers of persons 4
1	0·494	1·656	27·148	27·204
	(59·13)	(48·39)	(4·12)	(4·13)
Log household expenditure		−0·122	−0·093	−0·092
		(34·78)	(24·03)	(24·00)
Log household size	0·013	0·074	0·055	0·062
	(3·031)	(17·66)	(11·68)	(7·10)
Demographics				
Adults			−0·004	−0·001
(15–60 years)			(0·30)	(0·84)
Children			−0·007	−0·002
(5–15 years)			(0·50)	(1·23)
Infants			0·001	0·000
(below 5 years)			(0·09)	(0·04)
Adjusted R^2	0·0017	0·207	0·298	0·298
RSS	108·04	85·86	75·80	75·78

Note: Dependent variable is the budget share devoted to food. Absolute t-ratios in parentheses. Quadratic in the log of the food poverty line and urban/rural/regional dummy variables were included to pick up differences in relative prices. Persons over 59 are excluded from the demographic composition variables to avoid singularity.

Table 2

Engel Curves with Homogeneity Imposed

Explanatory variable	Demographics as proportions of persons	Demographics as numbers of persons
1	25·372	27·181
	(3·821)	(4·121)
Log *per capita* expenditure	−0·080	−0·089
	(22·162)	(23·968)
Demographics		
Adults	−0·011	−0·005
(15–60 years)	(0·867)	(5·393)
Children	−0·041	−0·006
(5–15 years)	(3·095)	(5·219)
Infants	−0·021	−0·003
(below 5 years)	(1·296)	(1·863)
R^2	0·288	0·298
RSS	77·071	75·973

Note: Dependent variable is the budget share devoted to food. Absolute t-ratios in parentheses. Quadratic in the log of the food poverty line and urban/rural/regional dummy variables were included to pick up differences in relative prices. Persons over 59 are excluded from the demographic composition variables to avoid singularity.

past scales obtained by this method may actually be due to omitted variable bias associated with a data-inconsistent homogeneity restriction, given that size is correlated with composition (larger households tend to be younger). Our modified version of Engel's method generates a simple iso-elastic scale, as postulated in Section I.

III.2. *Limitations of Engel's Method*

Our modified version of Engel's method suggests a size elasticity of 0·6 and (recalling Section II.2) the correlation between size and poverty vanishes at about this value. However, before one accepts that conclusion, one should reflect on the assumptions which underlie it. Two problems stand out.

(i) The method is only valid under rather special assumptions about the properties of the consumer's cost function (Appendix). The appeal of these assumptions is questionable.[19] For example, the Appendix shows that if the size elasticity is not independent of utility then the true size elasticity is unidentified. A similar problem arises if prices are not independent of household size. It can be readily shown that if larger households can buy cheaper food through bulk discounts and that the price elasticity of demand for food is less than unity (both are surely plausible assumptions), then our Engel method will have underestimated the true size elasticity. Similarly, the existence of public goods within households also leads one to question the Engel method. Suppose that a household is exactly compensated for an increase in its size (holding composition and other relevant variables constant). Individuals may still want to alter their demand behaviour – for example, public goods will be cheaper per person, and so there may be a substitution in favour of such goods, away from goods such as food. If this effect is strong enough, then food share will fall as size increases, holding utility constant, and the above method will again underestimate the true size elasticity of welfare.

(ii) Intra-household inequalities are often obscure in the models of consumer behaviour used (*inter alia*) to calibrate scales (Nelson, 1993; Ravallion, 1994). Even if one agreed that food share was a valid indicator of average welfare within a household, there may be better indicators for specific sub-groups, such as adults or children, and those indicators may respond differently to household size. The fact that children consume food – a private good – more intensively than adults suggests that a money metric of child welfare may have a higher size elasticity. At one extreme, consider instead the Rothbarth method of setting scales, whereby one uses consumption of 'adult goods' as the welfare indicator. Following Deaton and Muellbauer (1986) let adult welfare be measured by total *non-food* spending. Then it can be readily verified that size elasticity implied by equation (5) is $\beta\theta/(w+\beta-1)$. The food Engel curves in

[19] The classic critique of the Engel method of identifying scales is that even when exactly compensated for an extra child, the parents will presumably still want to spend relatively more on food, which is consumed intensively by children (Nicholson, 1976; Deaton and Muellbauer, 1986). Here we focus instead on the problems in using the method to estimate the size elasticity. Chaudhuri and Ravallion (1994) examine the performance of various indicators – including food share – in predicting chronic poverty using panel data from rural India. Food share does not perform well. However, this is a different point to that raised here, since Chaudhuri and Ravallion were solely concerned with how well a static indicator predicts poverty at other dates.

Table I imply an even lower size elasticity; for example, at mean non-food spending the size elasticity implied by the first regression in Table I is 0·1! By contrast, a higher elasticity than 0·6 may be defensible when the scale is anchored to child welfare. The literature already contains some suggestive evidence. Higher child mortality rates have been found in households with lower consumption or income per person, and sibling crowding is thought to be a causative factor (see the survey in Lipton and Ravallion, 1994). And there is some evidence of discrimination against children (particularly females) in large and poor households (Drèze and Sen, 1989, Chapter 4; Nag, 1991). Such studies are suggestive, though inconclusive for the present purposes since they have not tested homogeneity in total expenditure and size (assuming instead that it is expenditure *per capita* that matters).

In view of these problems, we shall now test our Engel curve estimate against two rather different welfare measures.

III.3. *Public versus Private Goods within Households*

Under the assumptions discussed above (and in the Appendix), one can use x/n^{θ} as a money metric of utility and identify θ empirically. But there is another approach which leads to the same conclusion. Suppose that individual utility is a Cobb-Douglas function of (i) the household's *per capita* expenditure on private (rivalrous) goods, and (ii) the household's total expenditure on local public goods within the household. Letting e denote expenditure on private goods, utility is directly proportional to $(e/n)^{\beta}(x-e)$ for a parameter β. After maximising with respect to e, (indirect) utility is then directly proportional to $(x/n^{\theta})^{1+\beta}$ where $\theta = \beta/(1+\beta)$ which is also the utility maximising share of expenditure devoted to private goods. Under these conditions, the correct size elasticity for the welfare metric is simply the budget share devoted to private goods.

Is a size elasticity much below unity believable for a country in which the bulk of expenditures goes on food items, which are widely perceived to represent private goods? The consumption by one person of a certain quantity of food precludes the consumption by another of that quantity, and to maintain living standards the quantity available for such goods must rise concomitantly with increasing household size.[20] While private goods do not permit economies in consumption, the degree to which such economies exist, and their impact on welfare, will be a function not only of the proportion of private good consumption but also of household size, for this is what determines the cost saving to individuals from collective consumption.

Suppose that ρ is the proportion of household expenditure x which consists of purely private goods (such as food), with $1-\rho$ being allocated to pure public goods (such as a water tap).[21] Then the monetary measure of average welfare is:

$$x/n^{\theta} = \rho x/n + (1-\rho)\,x. \tag{9}$$

[20] Large households can, however, be better placed than small households to take advantage of bulk purchase discounts – particularly with respect to perishable food items, see Nelson (1988).

[21] We are grateful to Jean Drèze for help on how to illustrate the following point.

This collapses to x/n when there is only one person in the household or only private goods are consumed. As n increases or ρ declines, *per capita* expenditure becomes a less accurate welfare measure. On solving equation (9) for θ one obtains:

$$\theta = \frac{-\ln(1-\rho+\rho/n)}{\ln n}. \tag{10}$$

Average household size in Pakistan in 7·44 persons. By inverting equation (10) numerically one finds that a size elasticity of 0·59 (the lowest estimate obtained in the last sub-section) is implied by a budget share on private goods of 0·80; a size elasticity of 0·61 (our highest estimate) is implied by a share of 0·82.

Thus our Engel curve estimates of the size elasticity are consistent with what one would expect at the average household size if about 80% of spending is on private goods within households, and the rest is public goods. The average food share is 51%, though clearly many non-food goods (such as clothing) also have rival consumption. Even so, we would conjecture that a budget share devoted to public goods of 20% is high for poor households in a country such as Pakistan. Without better data on the actual private–public split of spending, this approach to the issue must remain somewhat inconclusive.

III.4. *Child Welfare and Household Size*

Is our Engel curve-based estimate of the size elasticity also a good basis for predicting how child nutritional status varies with household size? We can offer a simple test. We regress anthropometric indicators of child nutritional status on $\ln(x/n^{\theta})$ – using the estimate of $\theta = 0{\cdot}59$ from Section III.1 – *and* the log of household size, as well as a number of other variables typically deemed to be important determinants of child nutritional status (including female literacy and food prices). If size is significant independently of $\ln(x/n^{0\cdot 59})$ then the latter is not the right money metric of economic welfare for predicting child nutritional status. Thus the test equation takes the form (ignoring the error term and other determinants of child nutrition for expositional purposes):

$$\begin{aligned} \textit{nutritional status}_i &= \gamma \ln(x_i/n_i^{\theta}) + \delta \ln n_i \\ &= \gamma \ln(x_i/n_i^{\theta*}), \end{aligned} \tag{11}$$

where $\theta^* = \theta - \delta/\gamma$ is the size elasticity appropriate to a money metric of child nutritional status. We add to this regression a number of other variables for child i or its household.

We consider two widely used indicators, namely *stunting* (as indicated by child height-for-age, relative to international standards), and *wasting* (as indicated by weight-for-height). The former is generally interpreted as an indicator of 'long-term' nutritional status, while the latter better reflects current status. Following convention, a z-score of -2 or lower is taken to indicate 'undernutrition' (though we consider a lower cut-off point later). The z-score is calculated as the difference between each child's height and the median height of that child's reference age group, expressed as a proportion of the standard deviation of the reference group.

Table 3
Test of the Engel Size Elasticity in a Model of Child Stunting

Explanatory variable*	1	2	3
1	−0·371	2·906	90·319
	(3·844)	(7·811)	(1·243)
Log household size	0·104	0·167	0·056
	(2·393)	(3·784)	(1·113)
Consumption per equivalent adult†		−0·367	−0·281
		(9·097)	(5·635)
Age of child			−0·010
			(7·846)
Gender of child (1 = male)			0·095
			(2·304)
Mother's literacy			−0·385
			(5·772)
Father's literacy			−0·058
			(1·305)
Proportion of adults in household			−0·132
			(0·587)
Proportion of children in household			−0·212
			(1·057)
Proportion of infants in household			−0·650
			(2·563)
Log likelihood	−2,666·215	−2,623·931	−2,533·721

Note: Absolute t-statistics in parentheses. Dependent variable is a binary variable taking a value of 1 for stunting and 0 for no stunting. A z-score for a child's height for age of −2 or lower indicates stunting. The z-score is calculated as the difference between each child's height and the median height of that child's reference age group, expressed as a proportion of the standard deviation of the reference group. Quadratic in the log of the food poverty line and urban/rural/regional dummy variables were included to pick up differences in relative prices.
* 1,720 observations = 1 and 2,168 observations = 0.
† Engel curve size elasticity of 0·59.

The probit estimates are given in Tables 3 and 4 for stunting and wasting respectively. In each case we first give the 'unconditional' probit of the probability of undernutrition regressed on household size, followed by various augmented models.

We find that the incidence of stunting tends to be higher in larger households (column 1 of Table 3), while wasting tends to be lower (column 1 of Table 4), though in the latter case the effect is not statistically significant. When we add consumption per equivalent person (using our Engel curve estimate of the size elasticity) we find that household size is still significant in explaining stunting, indicating a higher size elasticity for this welfare indicator than implied by the Engel curve method; indeed, the size elasticity for a money metric of stunting is not significantly different from 1·0. When we add the rest of the variables to the stunting model, household size becomes insignificant, controlling for our Engel curve based estimate of consumption per equivalent person; the size effect on stunting is attributable to other household characteristics correlated with size. Size is insignificant in all the models of wasting (Table 4).

We also examined the incidence of 'severe' stunting and wasting, by setting the cut-off point at 2·5 standard deviations below the median. The results for

Table 4
Test of the Engel Size Elasticity in a Model of Child Wasting

Explanatory variable*	1	2	3
1	−0·563	1·206	−34·789
	(5·341)	(2·986)	(0·432)
Log household size	−0·072	−0·044	0·004
	(1·512)	(0·918)	(0·063)
Consumption per equivalent adult†		−0·197	−0·116
		(4·539)	(2·160)
Age of child			−0·0016
			(1·594)
Gender of child (1 = male)			0·089
			(1·968)
Mother's literacy			−0·068
			(0·944)
Father's literacy			−0·073
			(1·501)
Proportion of adults in household			0·192
			(0·980)
Proportion of children in household			0·062
			(0·362)
Proportion of infants in household			0·126
			(0·526)
Log likelihood	−2,122·687	−2,112·305	−2,044·522

Note: Absolute t-statistics in parentheses. Dependent variable is a binary variable taking a value of 1 for wasting and 0 for no wasting. A z-score for a child's weight for height of −2·0 or lower indicates wasting. The z-score is calculated as the difference between each child's weight and the median weight of that child's reference height group, expressed as a proportion of the standard deviation of the reference group. Quadratic in the log of the food poverty line and urban/rural/regional dummy variables were included to pick up differences in relative prices.
* 917 observations = 1 and 2,971 observations = 0.
† Engel curve size elasticity of 0·59.

wasting were very similar, and so are not reported. However, there is a notable difference in the stunting equation (Table 5). For the augmented model of stunting (column 3), we can now reject the Engel curve estimate of the size elasticity in favour of an elasticity of unity ($t = 1{\cdot}41$) – all our results for the incidence of more severe stunting suggest a positive correlation with household size. This was still not true for wasting.

It thus appears that our Engel curve elasticity of about 0·6 is defensible for calibrating a money metric of child wasting. However, for child stunting, a stronger case can be made for using an elasticity of unity, particularly if one focuses on the incidence of more severe stunting.

IV. CONCLUSIONS

One of the 'stylised facts' about poverty in developing countries is that large families tend to be poorer, and some effort has gone into explaining why this might be so, and what implications it has for policy. However, the basis for this stylised fact is questionable. Widely cited evidence of a strong negative correlation between size and consumption per person is unconvincing, given that even poor households face economies of size.

Table 5

Test of the Engel Size Elasticity in a Model of Stunting ($z < -2.5$)

Explanatory variable*	1	2	3
1	0.830	2.421	121.225
	(8.291)	(6.226)	(1.637)
Log household size	0.160	0.226	0.156
	(3.564)	(4.914)	(2.985)
Consumption per equivalent adult†		−0.366	−0.289
		(8.632)	(5.566)
Age of child			0.007
			(5.379)
Gender of child (1 = male)			0.060
			(1.397)
Mother's literacy			−0.474
			(6.401)
Father's literacy			−0.069
			(1.495)
Proportion of adults in household			0.191
			(0.894)
Proportion of children in household			−0.176
			(0.929)
Proportion of infants in household			−0.180
			(0.720)
Log likelihood	−2,416.239	−2,378.094	−2,291.574

Note: Absolute t-statistics in parentheses. Dependent variable is a binary variable taking a value of 1 for stunting and 0 for no stunting. A z-score for a child's height for age of −2.5 or lower indicates stunting. The z-score is calculated as the difference between each child's height and the median height of that child's reference age group, expressed as a proportion of the standard deviation of the reference group. Quadratic in the log of the food poverty line and urban/rural/regional dummy variables were included to pick up differences in relative prices.

* 1,225 observations = 1 and 2,663 observations = 0.

† Engel curve size elasticity of 0.59.

We have characterised and estimated the critical value of the household-size elasticity of the cost of living at which the relationship between poverty and size switches sign. For Pakistan, the positive correlation between poverty incidence and household size drops rapidly at size elasticities below 0.7, and vanishes at 0.6 (between 0.5 and 0.6 for a distribution-sensitive poverty measure). Recognising the uncertainties of welfare measurement, we have made an eclectic assessment of what size elasticity might be defensible. An elasticity of 0.6 is implied by a modified version of Engel's method of setting scales. Then poverty and household size are roughly orthogonal. However, when we consider instead the allocation of expenditures between public and private goods, the budget share of jointly-consumed goods would need to be quite high (around 20%) to justify a size elasticity as low as 0.6. There may also be a tension over household size between adult and child welfare, which can only be exposed by more direct evidence on child welfare. We have shown that the incidence of child stunting is more elastic to household size than our Engel curve estimate suggests, though the latter is still a fair predictor of child wasting.

It is plain from these results that empirical statements about the relationship between poverty and household size should be interpreted with considerable caution. The empirical relationship is quite fragile, being particularly sensitive to differences in the assumed size elasticity. Furthermore, the different welfare measures examined here suggest sufficiently different elasticities to be consistent with either the conventional view that larger households tend to be poorer, *or* that household size and poverty are roughly orthogonal or even negatively correlated. The differences do appear to bear some relationship to the weight one attaches to child versus adult welfare; at the two extremes considered here, the Rothbarth method based on non-food spending as a measure of adult welfare suggests that small households tend to be poorer while the anthropometric indicator of severe child stunting implies that it is larger households who tend to be poorer. This suggests that a consideration of the purpose of poverty measurement – notably the extent to which it is used to inform policies aimed at promoting child welfare – may go some way toward resolving the issue.

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Appendix

Identifying Assumptions for our Engel Curve Estimate of the Size Elasticity

Under what conditions can the parameter we have added to the Engel curve, namely θ in equation (5), be interpreted as the size elasticity of money metric utility? Let adults maximise utility which depends on the household's consumption of composite food and non-food goods and on household size (other variables such as demographic composition can be readily introduced). Let the minimum cost to household i of utility u be

$$\ln(c_i) = a_i + \theta \ln(n_i) + \phi(p_i) + up_i^\beta, \qquad (A\ 1)$$

where p_i is a price index for food facing household i, ϕ is a function (defined below), β and θ are parameters to be estimated. (This type of cost function is a familiar one in the literature on utility-consistent demand functions; for a discussion see Deaton and Muellbauer, 1980.) Taking the derivative of (A 1) w.r.t. $\ln(p_i)$, and eliminating u by inverting the cost function at the utility maximum one obtains the demand function for food:

$$w_i = \phi'(p_i)\,p_i - \beta\phi(p_i) + \beta \ln(x_i/n_i^\theta). \qquad (A\ 2)$$

We need to postulate a form for ϕ. If we assume that

$$\phi(p_i) = \alpha_0 + \alpha_1 \ln(p_i) + \alpha_2[\ln(p_i)]^2, \qquad (A\ 3)$$

then terms in the log price and its squared value appear on the right-hand side of (5). Under these assumptions, the value of θ estimated from the Engel curve specification in equation (5) can be interpreted as the size elasticity of the cost of utility. Amongst households who face the same prices ($p_i = p$ for all i) and do not differ in other relevant respects, such as demographic composition and tastes (in particular $a_i = a$ for all i) we have:

$$w_i = \beta a + \phi'(p) + \beta p^\beta u_i \qquad (A\ 4)$$

$$\ln(x_i/n_i^\theta) = a + \phi(p) + p^\beta u_i \qquad (A\ 5)$$

i.e. under these conditions, both $\ln(x_i/n_i^\theta)$ and food share will be affine transforms of utility, and hence valid utility functions in their own right (the only difference being that $\ln(x_i/n_i^\theta)$ is a money metric of utility).

Of course, many of these assumptions are rather special, and relaxing one or more of them may make it impossible to identify the size elasticity from observed behaviour. For example, suppose we relax the implicit assumption in (A 1) that the size elasticity is independent of utility.[22] There are many ways of doing so, and some are not empirically distinguishable from equation (5). For example, suppose that, instead of (A 1), the cost-function takes the form:

$$\ln(c_i) = a + \theta \ln(n_i) + \phi(p_i) + u[\ln(n_i)]^\gamma p_i^\beta \tag{A 6}$$

(for which (A 1) is the restricted form in which $\gamma = 0$). It is readily verified that this yields exactly the same Engel curve as we have estimated, and so is empirically indistinguishable. Yet the true size elasticity becomes $\theta + \gamma[\ln(n_i)]^{\gamma-1} u p_i^\beta$ which is not estimable.

References

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

Atkinson, Anthony B. (1992). 'Measuring poverty and differences in family composition.' *Economica*, vol. 59, pp. 1–16.

Blundell, Richard and Lewbel, Arthur (1991). 'The information content of equivalence scales.' *Journal of Econometrics*, vol. 50, pp. 49–68.

Browning, Martin (1992). 'Children and household economic behavior.' *Journal of Economic Literature*, vol. 30, pp. 1434–75.

Buhmann, B., Rainwater, L., Schmaus, G. and Smeeding, T. (1988). 'Equivalence scales, well-being, inequality, and poverty: sensitivity estimates across ten countries using the Luxembourg Income Study (LIS) database.' *Review of Income and Wealth*, vol. 34, pp. 115–42.

Caldwell, John C. (1976). 'Toward a restatement of demographic transition theory.' *Population and Development Review*, vol. 2, pp. 321–66.

Chaudhuri, Shubham and Ravallion, Martin (1994). 'How well do static indicators identify the chronically poor?' *Journal of Public Economics*, vol. 53, pp. 367–94.

Clark, S., Hemming, R. and Ulph, D. (1981). 'On indices for the measurement of poverty.' ECONOMIC JOURNAL, vol. 91, pp. 515–26.

Coulter, F. A. E., Cowell, F. A. and Jenkins, S. P. (1992). 'Equivalence scale relativities and the extent of inequality and poverty.' ECONOMIC JOURNAL, vol. 102, pp. 1067–82.

Deaton, Angus (1981). 'Three essays on a Sri Lanka household survey.' LSMS Working Paper No. 11. Washington, D.C.: The World Bank.

Deaton, Angus and Muellbauer, John (1980). *Economics and Consumer Behaviour*. Cambridge: Cambridge University Press.

Deaton, Angus and Muellbauer, John (1986). 'On measuring child costs: with applications to poor countries.' *Journal of Political Economy*, vol. 94, pp. 720–44.

Dickens, Richard, Fry, Vanessa and Pashardes, Panos (1993). 'Non-linearities and equivalence scales.' ECONOMIC JOURNAL, vol. 103, pp. 359–68.

Drèze, Jean and Sen, Amartya (1989). *Hunger and Public Action*. Oxford: Oxford University Press.

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

Foster, J. and Shorrocks, A. (1991). 'Subgroup consistent poverty measures.' *Econometrica*, vol. 59, pp. 687–709.

Jarvis, Sarah J. and Micklewright, John (1994). 'The targeting of family allowance in Hungary.' In *Public Spending and the Poor: Theory and Evidence* (ed. D. van de Walle and K. Nead). Washington, D.C.: World Bank (in press).

Lanjouw, Peter (1994). 'A poverty profile for Pakistan.' Mimeo, Poverty and Human Resources Division, World Bank.

Lazear, E. and Michael, R. (1980). 'Family size and the distribution of per capita income.' *American Economic Review*, vol. 70, pp. 91–107.

Lipton, Michael and Ravallion, Martin (1994). 'Poverty and policy.' In *Handbook of Development Economics*, Vol. 3 (ed. Jere Behrman and T. N. Srinivasan). Amsterdam: North-Holland.

Nag, Moni (1991). 'Sex preference in Bangladesh, India and Pakistan, and its effect on fertility.' Working Paper 29, The Population Council, New York.

[22] This is sometimes termed the 'independence of base' condition. It is often imposed, though it has been rejected in the few times it has been tested (Blundell and Lewbel, 1991; Dickens *et al.* 1993).

Nelson, Julie A. (1988). 'Household economies of scale in consumption: theory and evidence.' *Econometrica*, vol. 56, pp. 1301–14.

Nelson, Julie A. (1993). 'Household equivalence scales: theory versus policy?' *Journal of Labor Economics*, vol. 11, pp. 471–93.

Nicholson, J. Leonard (1976). 'Appraisal of different methods of estimating equivalence scales and their results.' *Review of Income and Wealth*, vol. 22, pp. 216–21.

O'Higgins, M., Schmaus, G. and Stephenson, G. (1989). 'Income distribution and redistribution: a microdata analysis for seven countries.' *Review of Income and Wealth*, vol. 35, pp. 107–31.

Pollak, R. A. and Wales, T. J. (1979). 'Welfare comparisons and equivalence scales.' *American Economic Review*, vol. 69, 216–21.

Prais, S. J. and Houthakker, H. S. (1955). *The Analysis of Family Budgets*. Cambridge: Cambridge University Press.

Ravallion, Martin (1994). *Poverty Comparisons*. Fundamentals in Pure and Applied Economics, Vol. 56. Chur, Switzerland: Harwood Academic Press.

Ravallion, Martin and Bidani, Benu (1994). 'How robust is a poverty profile?' *World Bank Economic Review*, vol. 8(1), pp. 75–102.

Sen, Amartya (1985). *Commodities and Capabilities*. Amsterdam: North-Holland.

Singh, Balvir (1972). 'On the determinants of economies of scale in household consumption.' *International Economic Review*, vol. 13, pp. 257–70.

Sundrum, R. M. (1990). *Income Distribution in Less Developed Countries*. London: Routledge.

Visaria, Pravin (1980). 'Poverty and living standards in Asia.' Living Standards Measurement Study Working Paper No. 2. Washington, D.C.: World Bank.

Watts, H. W. (1968). 'An economic definition of poverty.' In *On Understanding Poverty* (ed. D. P. Moynihan). New York: Basic Books.