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A CROSS-COUNTRY STUDY OF EQUIVALENCE SCALES AND EXPENDITURE INEQUALITY ON UNIT RECORD HOUSEHOLD BUDGET DATA

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Inequality comparisons require equivalence scales to account for differences in household size and composition. The multiplicity of equivalence scale models makes the sensitivity of the inequality calculations to the scale used a significant policy issue. Such an investigation based on unit records of two adult households from Italy, Australia, South Africa, Thailand, Peru, Philippines, India and Tanzania was our principal motivation. The equivalence scale varies across countries and between different types of children. Inequality rankings of countries, though not the inequality decomposition between households of different composition, are robust to the equivalence scale used.

1. INTRODUCTION

Following the pioneering work of Kuznets (1955), there exists an extensive literature that examines the inequality levels of one country in relation to that of another.[1] Much of the earlier work involving such inequality comparisons were based on grouped data on the size distribution of income around the world prepared by Jain (1975) under the auspices of the World Bank. Recently, Buhmann, *et al.* (1988) have used household income micro data to compare inequality levels across 10 developed countries. This study is significant because it is the first to base itself on unit record data. Unit records on household expenditure are widely acknowledged to provide superior quality data and constitute a rich source of information on household behaviour and welfare since they do not suffer from biases inherent in the use of aggregate data. However, in moving from the individual to the household as the unit of analysis, one should take account of differences

Note: We have benefited from comments on the earlier versions that were presented at the 26th Annual Conference of Economists in Hobart, Australia, September 1997, at the International Conference on Income and Wealth in New Delhi, India in November 1998 and in seminars in Cornell University, University of Illinois, Illinois State University, and the World Bank. We, also, thank Professor D. S. Prasada Rao and two anonymous referees for helpful remarks. The disclaimer applies. Financial support provided by the Australian Research Council is, also, gratefully acknowledged.

[1]See Fields (1980), Lecaillon *et al.* (1984) for detailed references on the earlier literature.

in household size and composition. This follows from the fact that the requirements differ not only between adults and children, but also between boys and girls, and between children across different age groups. Consequently, an adjustment of household income/expenditure is required to take account of differences in household "need."

The use of the equivalence scale is meant to perform this task. It seeks to answer questions such as: how much expenditure does a household with two adults and one child need, in relation to a childless couple, to enjoy the same level of "welfare" as the latter? Given differences in the theoretical bases of the alternative equivalence scale models, and the consequent lack of consensus on the scale value, the issue of the sensitivity of inequality calculations to the equivalence scale used is thus of considerable policy significance. The Buhmann *et al.* (1988) study provides useful empirical evidence on this issue. Coulter *et al.* (1992) provide further evidence on the scale sensitivity of inequality in the single country context of U.K., and report a U-shaped relation between income inequality and elasticity of the equivalence scale with respect to family size. As Banks and Johnson (1994) point out, however, the results obtained in the study by Coulter *et al.* (1992) are unlikely to be robust once household composition is taken into account.

Recent developments show that there is a growing awareness among public policy researchers, particularly those who focus on international comparisons, of the importance of the choice of equivalence scales in welfare comparisons across households. Our study strongly suggests that it is unwise to use the same scale value for different countries in the inequality comparisons. It provides new evidence on the existence of a systematic link between equivalence scale "generosity" and the extent of inequality. Furthermore, it extends the literature to cover inequality comparisons across developing countries as well.

The present study uses household expenditure data from unit records to analyse and compare inequality in 8 countries that are widely dispersed across the spectrum of economic development. It has the following features that distinguish it from most previous studies.

(i) Following McGregor and Barooah (1992), Slesnick (1994), Johnson and Shipp (1997), we study expenditure rather than income inequality. Sabelhaus and Ulrike (1995) observe that using consumption instead of income yields different results about economic welfare. As a referee pointed out, recent work on inequality analysis by researchers at the World Bank use expenditures almost exclusively—see, also, the studies by Phipps and Garner (1994), Garner, *et al.* (1995) and Garner (1998). Also, given the reality of income concealment to escape taxation, income data is notoriously unreliable for use in welfare based distributional comparisons. There are, however, problems associated with the use of expenditures as well—for example, those arising from differences in the method of measurement of expenditures. Moreover, as a referee pointed out, in an international framework in which the average savings rate varies sharply across countries, the use of expenditure could give rise to a misleading picture. In considering expenditure rather than income inequality in this study, we are not necessarily claiming that consumption expenditures always provide a better measure of economic well-being than income. They should be viewed as complementary indicators

of welfare. There is, therefore, a strong case for extending this study in future work to the case of income inequality comparisons across countries.

(ii) This study extends Buhmann *et al.* (1988) in using a more general equivalence scale specification that not only allows differences in household size but also in household composition between boys and girls, and between children in different age groups. This feature is particularly significant in the present context since households in developing countries tend to have more children than those in developed countries.

(iii) The equivalence scales used in the inequality comparisons are neither ad hoc nor imposed a priori but have been econometrically estimated for each country from the expenditure information contained in its unit records. We compare the scale estimates from the Engel model based on the estimation of Food demand equation with those based on the demographically extended rank two and rank three "complete" demand systems. As we report later, estimates of the equivalence scale not only differ between models but, quite sharply, between countries.[2] In cross-country studies on inequality, it may therefore be unwise to use the same scale value for all countries.

(iv) This study analyses the nature of expenditure inequality by decomposing the overall inequality into its within and between population subgroup components and compares the picture across the 8 countries. To do so, we use the "Generalised Entropy" family of inequality indices derived in Shorrocks (1980) and used in the U.K. context by Mookherjee and Shorrocks (1982). These indices are strictly decomposable and are analogous to the Atkinson (1970) family of indices in reflecting different "perceptions of inequality."[3]

This study attempts to answer the following questions of significant policy concern:

(a) Are there differences in the nature and extent of expenditure inequality across countries at vastly different levels of affluence and economic development?

(b) How sensitive are the expenditure inequality rankings of countries to the equivalence scales obtained using different models and methods?

(c) Is the U-shaped relationship between inequality and the elasticity of equivalence scale with respect to family size obtained in recent studies robust to a more sophisticated treatment of demographics that considers not only family size but also the age and sex distribution of children?

(d) For a given measure of inequality, is the inequality ranking of countries, based on all households, similar to those for the various household types? If, as Ray (1985) observed for the U.K., there are significant demographic differences in inequality, the aggregative picture based on a single expenditure distribution may hide useful information.

(e) The Engel scales, based on Food demand, are generally believed to be upward biased in relation to those based on "complete demand systems." Is this true for all the countries considered here? In recent years, there has been a move

[2]See Pollak and Wales (1979), Blundell and Lewbel (1991), Blackorby and Donaldson (1994) for arguments against the conventional interpretation of equivalence scale, calculated from budget data, as the "cost of a child".

[3]See Sen (1997), especially the annex, for a comprehensive discussion of the alternative measures of inequality.

towards rank 3 demand equations which, unlike rank two demand, allow a non-monotonic relation between budget share and aggregate expenditure. Does this result in sharply different magnitudes of the equivalence scale and in the inequality ranking of the countries?

(f) Does the "need" of a child, in relation to the adult couple, vary with age and sex of the child? There is considerable evidence on the former, i.e. on the age effects of children but not much on the latter, especially in the context of developing countries.[4] Estimates of separate equivalence scales for boys and girls could prove useful in investigating the issue of sex bias that has recently attracted considerable attention in the context of developing countries [see, for example, Sen and Sengupta (1983), Sen (1988)].

(g) Are the inequality rankings of countries sensitive to the inclusion or exclusion of age effects of children, and of their sex differences?

The plan of this paper is as follows. The theoretical framework of this study, including a discussion of the equivalence scale models and of the inequality measures, is presented in Section 2. The data is described and the means of the key variables are compared across countries in Section 3. The demand parameter estimates are presented and the equivalence scales are compared between models and across countries in Section 4. The results on expenditure inequality are analysed in Section 5. We end on the concluding note of Section 6.

2. Framework

2.1. *Review of Alternative Equivalence Scale Models*

Engel's (1895) model is based on the premise that the welfare of the household is inversely related to the share of the household budget spent on Food. This leads to the hypothesis that households with different numbers of children enjoy the same welfare if the budget share of Food is identical in these households. The Engel equivalence scale, then, follows as the ratio of total expenditures of the demographically varying households with an identical budget share of Food. The idea behind the Engel model of linking household welfare with the budget share of Food is simple and intuitively appealing, and this explains its popularity even to this day. However, in basing itself exclusively on Food demand, the Engel model ignores the possibility of substitution between Food and Non-Food items due to the birth of a child and, more generally, overlooks the demographic impact on parental preferences of various items.

The Engel scales, reported later, are based on the following rank 2 Food demand equation estimated in budget share form, w_F:

$$w_F = \alpha_F + \beta_F \log x + \sum_{d=1}^{D} \gamma_{Fd} n_d + u_F \tag{1}$$

where w_F is household budget share of Food, x is aggregate household expenditure, n_d is the number of children in age/sex group d, and u_F is the stochastic

[4]See, for example, Pollak and Wales (1981), Ray (1983), Nelson (1992). See, also, Browning (1992) for a recent review of the literature. A referee noted that countries in East and Central Europe, also, introduce differences in needs between individuals by their age and work effort.

error term. Note that, in this study, we have only considered two adult households so that their composition differs from one another only with respect to the age/sex distribution of children. The Engel scale, which is normalised at unity for the childless couple ($n_d = 0$) is, hence, given by:

$$m_{oh} = \exp\left\{ -\left[\sum_{d=1}^{D} \gamma_{Fd} n_{dh} \right] \Big/ \beta_F \right\} \tag{2}$$

where h denotes the household.

In contrast to Engel, the "complete demand systems" based equivalence scale models, pioneered by Barten (1964) and extended by Gorman (1976), allow for substitution between Food and Non-Food items though, admittedly, in a very special way. Estimation of this type of scales commences with the specification of preferences, usually through cost or indirect utility functions. The demand functions are then estimated using household budget data sets followed by the computation of the scales using the estimated parameters. One specific procedure for estimating scales in this context is the Price Scaling (PS) technique introduced in Ray (1983). It replaces the original cost function c_R of the reference household R (a childless adult couple) by:

$$x \equiv c(u, P, \eta) = m_0(P, \eta) c_R(u, p_1, \ldots, p_n) \tag{3}$$

where x is aggregate household expenditure, P is the price vector, η is the vector containing the age/sex distribution of children in the household, u is the utility variable, and m_0 (.) is the general equivalence scale. In specifying m_0 directly in terms of prices and household composition, PS does not require the complex estimation of the commodity specific $m_i s$ which characterises the Barten model.

Applying the Price Scaling demographic technique requires the prior specification of the cost function, c^R, of the reference household. We choose the following functional form introduced by Banks, Blundell and Lewbel (1992).

$$\log c^R(u, P) = a(P) + \frac{ub(P)}{1 - uc(P)} \tag{4}$$

where $a(.)$ is homogeneous of degree one, and $b(.)$, $c(.)$ are homogeneous of degree zero in prices, P. Choice of appropriate functional forms for $a(.)$, $b(.)$, $c(.)$ yields, in budget share form w_i, the following rank three Price Scaled demographic demand system:[5]

$$w_i = \alpha_i + \beta_i [\log x^R] + \lambda_i \prod_{k=1}^{n} p_k^{\lambda_k R - \beta_k} [\log x^R]^2 + \sum_{j=1}^{n} \beta_{ij} \log p_j, \qquad i = 1, \ldots, n \tag{5}$$

where x^R is the "per equivalent" real expenditure of the household, i.e. its real expenditure deflated by the equivalence scale, $m_0(\eta) = 1 + \sum_{d=1}^{D} \theta_d n_d$, where θ_d is the scale parameter corresponding to a child in age/sex group d. Since prices are fixed in a single cross-section, we can without loss of generality choose $p_i = 1$. The estimating form for equation (5) becomes

$$w_i = \alpha_i + \beta_i [\log (x/m_0)] + \lambda_i [\log (x/m_0)]^2, \qquad i = 1, \ldots, n \tag{6}$$

[5]See Lancaster and Ray (1998) for more details on derivation.

where

$$\sum \beta_i = \sum \lambda_i = 0, \quad \sum \alpha_i = 1$$

Note that equation (6), which is a rank 3 demand system, specialises to the rank 2 form of Working-Leser if $\lambda_i = 0$. Note, further, that the general equivalence scale m_0 can be directly calculated on budget data from the demographic parameter estimates (θ_d) of equation (5).

As a referee noted, a restrictive feature of equation (6) is that households with the same equivalent expenditure have the same expenditure shares for all components of expenditure. This is, however, not inevitable in the "complete demand systems" approach to equivalence scales. As Ray (1983) and Lancaster and Ray (1998) have shown, this restrictive feature can be easily relaxed on pooled time series of cross-section survey data by allowing the equivalence scale (m_0) to vary with prices and household characteristics. Equation (6) can, then, be extended as follows:

$$\text{(6a)} \quad w_i = \alpha_i + \sum_{k=1}^{n} \delta_{ik} \eta_k + \beta_i [\log (x/m_0)] + \lambda_i [\log (x/m_0)]^2, \qquad i = 1, \ldots, n$$

$$\sum \beta_i = \sum \lambda_i = \sum_{i=1}^{n} \delta_{ik} = 0, \qquad \sum \alpha_i = 1$$

where η_k are household characteristics. δ_{ik} measures the interaction between the equivalence scale, the price of item i (p_i), and the household characteristic k (η_k). The restrictions $\delta_{ik} = 0$ for all i, k, assumed by equation (6), lead to a considerable simplification in the estimation. Though Lancaster and Ray (1998) test and reject these restrictions on price varying Australian budget data, the equivalence scale estimate of 1.12 for a couple with a child obtained in that study, without enforcing these restrictions, is reasonably close to the comparable estimate of 1.17 obtained here (see Table 4A). In response to the referee's suggestion that the results could be very different for other countries, we estimated equation (6a) and formally tested on cross-section data, for each country, the statistical significance of the difference in the estimated m_0 between equations (6) and (6a). We found no evidence to suggest that the restrictions $\delta_{ik} = 0$ had any statistically significant impact on the estimated m_0. In addition, it turns out that the simplifying restrictions $\delta_{ik} = 0$ for all i, k carry little practical significance for this study. This was confirmed by the almost identical inequality estimates that we found between those based on the equivalence scales estimated from equation (6) and those based on the scale estimates from equation (6a).

2.2. *The Inequality Measures*

For reasons explained below, we use both the Gini and the "decomposable" inequality measures to calculate inequality. The Gini coefficient is a popular measure of the level of inequality in a population and is one of the inequality measures used in this study. For a discrete population of n households labelled in increasing order of expenditures $x_1 \leq x_2 \leq \ldots x_n$, an estimate of the Gini coefficient can be

obtained using the following computationally convenient formula:

$$G = \sum_{j=1}^{n-1} \eta_{j+1}\Pi_j - \sum_{j=1}^{n-1} \eta_j \Pi_{j+1} \tag{7}$$

where Π_j and η_j refer to the cumulated population and expenditure share, respectively, of the j-th household. Equation (7) is the computational basis of the Gini coefficient estimates obtained in this study. Lerman and Yitzhaki (1989) propose an alternative method for deriving the Gini coefficient from individual records.

The Gini coefficient satisfies the three basic properties of inequality measures: it is mean or scale independent, population-size independent and satisfies the Pigou–Dalton condition. It is also sensitive to transfers at all expenditure levels although it attaches more weight to transfers near the mode of the distribution than at the tails—see Sen (1997) for a useful discussion. The Gini coefficient is inadequate in one important respect: it is not strictly decomposable by population subgroups. This property is desirable for this study as it provides deeper insight into the cross-country aspect of the analysis.

To overcome this shortcoming on the part of the Gini, we turn to the Generalised Entropy (GE) family of inequality indices given by:

$$\left.\begin{aligned} I_c &= \frac{1}{n}\frac{1}{c(c-1)}\sum_i\left[\left(\frac{x_i}{\mu}\right)^c - 1\right], \qquad c \neq 0, 1 \\ I_0 &= \frac{1}{n}\sum_i \log\left(\frac{\mu}{x_i}\right) \\ I_1 &= \frac{1}{n}\sum_i \frac{x_i}{\mu}\log\left(\frac{x_i}{\mu}\right) \end{aligned}\right\} i = 1, \ldots, n \tag{8}$$

where n is the total number of expenditure units, μ is the mean of the expenditures x_i and the parameter c reflects the different "perceptions of inequality" with lower values indicating a higher degree of "inequality aversion". This class of inequality measures includes the Theil index (I_1), the mean logarithmic deviation (I_0) and half the square of the coefficient of variation (I_2). In the calculations reported below, we divided the population into k subgroups of households and exploited the property that all members of the GE family are additively decomposable by population subgroups [see Shorrocks (1984)] as follows:

$$I_C = I_W + I_B \tag{9}$$

where $I_W = \sum_k \tilde{p}_k(\mu_k/\mu)^c I_k$ refers to the inequality arising within subgroups; I_B refers to the inequality arising between subgroups; $\tilde{p}_k$ is the population share of the subgroup of type k; and, I_k is the value of the inequality index for subgroup k.

3. Data Description

Table 1 contains a list of the 8 countries that provided the data base for this study. The per capita GNP figures show that the chosen countries span a wide

TABLE 1
RELEVANT DETAILS OF UNIT RECORDS USED

Country	Title/Source of Unit Record	Year of Survey	Total Sample Size (no. of h'holds)	Two-Adult households	
				Number	%
India	National Sample Survey of Western India	1983	5,312	2,360	44
Philippines	Family Income and Expenditure Survey, NSO (Phil)	1988/1989	18,500	5,708	31
Thailand	Socio Economic Survey, NSO (Thld)	1988/1989	11,500	5,468	48
Italy	Annual Expenditure Survey, ISTAT	1993	35,000	16,384	47
Australia	Household Expenditure Survey, ABS	1993/1994	8,389	4,841	58
Tanzania	Living Standards Measurement Study, WB	1993/1994	5,184	2,433	47
Peru	Living Standards Measurement Study, WB	1994	3,624	1,572	43
South Africa	Living Standards Measurement Study, WB	1994	8,848	2,762	31

Note: NSO–National Statistics Office; ABS–Australian Bureau of Statistics; ISTAT–Instituto Centrale di Statistica; WB–World Bank.

range in the spectrum of economic development. Hence, unlike many other studies [Buhmann *et al.* (1989), Garner (1998)] which mostly use data from OECD or European countries, the present results are based on an analysis of data from countries in other parts of the world and at various stages of economic development. The choice of countries was dictated largely by their diversity (in economic and social terms) and the availability of comparable data sets (in terms of survey construction and consistency in the definition of variables). The data sets for Tanzania, South Africa and Peru were drawn from the Living Standards Measurement Study (LSMS) of the World Bank.[6] The Indian data was taken from the 38th round (1983) of the National Sample Survey (NSS) of rural households in Maharashtra state in Western India. The Philippine and Thai data sets were drawn from the Family Income and Expenditure Survey (FIES) of the Philippines and the Socio Economic Survey (SES) of Thailand, respectively, and both cover the period February, 1988 to January 1989.[7] The Australian data came from the 1993/94 Household Expenditure Surveys (HES) published by the Australian Bureau of Statistics (ABS). The Italian data came from the 1993 annual survey of Italian households carried out by Instituto Centrale di Statistica (ISTAT).[8] With the exception of India, the survey periods in these countries either overlap or are close enough to one another. In India, inequality was fairly static over 1983–93, and began to change only from 1994 onwards, i.e. after our reference period ended. To simplify calculations, and to focus attention on the impact of the equivalence scale on the inequality estimates, we consider only two adult households which, therefore, differ from each other in their composition only with respect to the age and sex distribution of children. In view of this, we advise caution against generalising the inequality results of this study to the entire population.

[6]See Grosh and Glewwe (1995) for details on the LSMS data sets.
[7]See Valenzuela (1997) for more details on the Philippine and Thai data sets.
[8]See ISTAT (1996) for more details on the Italian data set.

The following 5 item disaggregation of consumer expenditure was used in estimating the demand systems to calculate the equivalence scale: Food, Medical, Clothing, Fuel and Power, and Others. The choice of these items was dictated largely by consistency in their definition and data availability across the various countries. A minor exception is Italy where Medical is replaced by Transport as the second item. Total household expenditures in Italy, Australia, the Philippines and India were pre-defined in their data sets, while in case of the remaining countries, they were constructed from the fine level expenditure records. This process involved merging food expenditures (recorded either weekly or fortnightly) and other expenditures (generally recorded monthly). For all countries, except Italy and Australia, the values of home produced goods for own consumption were converted into expenditures using regional price data. In-kind benefits and remittances were also included for all countries except Italy and Australia. The absence of information on these variables for Italy and Australia is unlikely to pose a serious problem since they are considerably smaller in magnitude in the developed countries. Health expenditures were defined as the sum of expenditures on medical supplies and services.

Three age groups for children were considered, namely, 0–4 years, 5–14 years, and 15–17 years. Exceptions occur for Italy where the third child age group is 15–18 years, and for the Philippines which reports only two age groups for children, namely, 1–6 years, and 7–14 years. In our sample of eight countries,

TABLE 2
SAMPLE MEANS OF KEY VARIABLES IN TWO ADULT HOUSEHOLDS

Variable/Country	Italy	Australia	South Africa	Thailand	Peru	Philippines	India	Tanzania
Total Population (000s)[a]	57,000	17,800	40,500	58,000	23,200	67,000	913,600	29,000
Per Capita GNP (1994 $)[a,b]	19,300	18,000	3,040	2,410	2,110	950	320	140
Per Capita GNP at PPP (1994 $)[a]	18,460	18,120	5,130	6,970	3,610	2,740	1,280	620
Budget Share of:								
Food	0.3	0.24	0.42	0.42	0.54	0.59	0.61	0.68
Medical Items[c]	0.11	0.06	0.03	0.03	0.06	0.01	0.03	0.02
Clothing	0.07	0.05	0.04	0.06	0.06	0.02	0.09	0.05
Fuel & Power	0.06	0.04	0.09	0.05	0.05	0.06	0.09	0.12
Others	0.47	0.61	0.42	0.44	0.29	0.31	0.18	0.13
No. of Children								
(0–4 yrs)	0.28	0.3	0.51	0.41	0.79	1.35	0.66	1.02
(5–14 yrs)	0.41	0.55	0.99	1	1.47	1.12	1.46	1.48
(15–17 yrs)	0.18	0.11	0.2	0.19	0.27	NA	0.23	0.24
No. of Boys in Age Group								
(0–4 yrs)	NA	NA	0.262	0.202	0.4	NA	0.325	0.519
(5–14 yrs)			0.504	0.505	0.723		0.758	0.736
(15–17 yrs)			0.102	0.092	0.136		0.136	0.109
No. of Girls in Age Group								
(0–4 yrs)	NA	NA	0.251	0.207	0.388	NA	0.333	0.503
(5–14 yrs)			0.484	0.497	0.744		0.704	0.74
(15–17 yrs)			0.099	0.098	0.136		0.098	0.129

[a]*Source*: World Development Report, 1996.
[b]See World Development Report, 1996 (p224/225) for a description of the PPP rate used.
[c]Medical is replaced by Transport for Italy since Medical did not appear as a separate item in the data set of this country

five (namely, Thailand, India, South Africa, Tanzania and Peru) contained information on the number and age distribution of boys and girls in each household.

Table 2 contains the sample means of the key variables of interest for the eight countries ordered in decreasing level of per capita GNP. These summary statistics were calculated in an unweighted form from the sample of two adult households in the data. In all the surveys considered, the survey designers endeavoured to create samples that were representative of the whole population. Households in affluent countries (Australia, Italy) spend a lower proportion of their budget on Food items than the poorer countries—an observation consistent with Engel's law. Australia and Italy also have, on average, less children in the household than the poorer countries. Though the reliance on per capita GNP as a measure of development is problematic, especially as it takes no account of distribution, Table 2 shows that the ranking of the chosen countries, in general, is invariant between the per capita GNP figures converted in official exchange rates and in purchasing power parities.

TABLE 3
DEMAND PARAMETER ESTIMATES

Parameter	Italy	Australia	South Africa	Thailand
a_1	1.619[a]	0.502[a]	0.755[a]	0.040
	(0.300)	(0.061)	(0.018)	(0.106)
a_2	−0.416	−0.015	0.019[a]	0.048[a]
	(0.307)	(0.037)	(0.005)	(0.013)
a_3	−1.999[a]	−0.1[a]	0.002	0.032
	(0.223)	(0.043)	(0.006)	(0.023)
a_4	0.302	0.437[a]	0.201[a]	0.014
	(0.194)	(0.019)	(0.009)	(0.015)
a_5	1.495[a]	0.178	0.023	0.867[a]
	(0.404)	(0.094)	(0.018)	(0.132)
β_1	−0.125[a]	−0.015	−0.058[a]	−0.141[a]
	(0.054)	(0.028)	(0.012)	(0.010)
β_2	0.031	0.049[a]	0.001	0.011
	(0.055)	(0.017)	(0.003)	(0.007)
β_3	0.338[a]	0.047[a]	0.027[a]	−0.028[a]
	(0.040)	(0.020)	(0.004)	(0.012)
β_4	−0.031	−0.146[a]	−0.063[a]	−0.016[a]
	(0.035)	(0.008)	(0.006)	(0.004)
β_5	−0.214[a]	0.066	0.093[a]	0.174[a]
	(0.072)	(0.041)	(0.011)	(0.006)
λ_1	0.001	−0.009[a]	−0.016[a]	−0.001
	(0.002)	(0.003)	(0.002)	(0.002)
λ_2	0.001	−0.007[a]	0.001[a]	0.002
	(0.002)	(0.002)	(0.000)	(0.001)
λ_3	−0.014[a]	−0.003[a]	−0.004[a]	−0.007[a]
	(0.002)	(0.002)	(0.001)	(0.001)
λ_4	0.001	0.013[a]	0.008[a]	−0.001
	(0.002)	(0.001)	(0.001)	(0.001)
λ_5	0.011[a]	0.007	0.011[a]	0.007[a]
	(0.003)	(0.004)	(0.002)	(0.002)
θ_1	0.088[a]	0.116[a]	0.146[a]	0.270[a]
	(0.012)	(0.016)	(0.028)	(0.025)
θ_2	0.144[a]	0.190[a]	0.179[a]	0.121[a]
	(0.010)	(0.013)	(0.017)	(0.012)
θ_3	0.169[a]	0.224[a]	0.130[a]	0.179[a]
	(0.016)	(0.032)	(0.041)	(0.030)

TABLE 3 (Continued)

Parameter	Peru	Philippines	India	Tanzania
α_1	0.810[a]	1.016[a]	−0.011	−0.096
	(0.106)	(0.074)	(0.109)	(0.167)
α_2	−0.103[a]	−0.060[a]	0.006	−0.073[a]
	(0.051)	(0.023)	(0.034)	(0.032)
α_3	0.018	0.146[a]	0.041	0.010
	(0.045)	(0.014)	(0.047)	(0.052)
α_4	−0.141[a]	0.232[a]	0.159[a]	0.068
	(0.033)	(0.025)	(0.045)	(0.087)
α_5	0.416[a]	−0.335[a]	0.805[a]	1.092[a]
	(0.097)	(0.071)	(0.104)	(0.135)
β_1	0.046	−0.006	0.381[a]	0.371[a]
	(0.042)	(0.022)	(0.049)	(0.061)
β_2	0.037	0.018[a]	−0.001	0.026[a]
	(0.020)	(0.007)	(0.015)	(0.012)
β_3	0.019	−0.039[a]	0.036	0.008
	(0.018)	(0.004)	(0.021)	(0.019)
β_4	0.075[a]	−0.041[a]	0.009	0.043
	(0.013)	(0.007)	(0.020)	(0.032)
β_5	−0.177[a]	0.069[a]	−0.425[a]	−0.449[a]
	(0.039)	(0.021)	(0.047)	(0.048)
λ_1	−0.020[a]	−0.009[a]	−0.054[a]	−0.042[a]
	(0.004)	(0.002)	(0.005)	(0.005)
λ_2	−0.001	−0.001[a]	0.001	−0.002
	(0.002)	(0.001)	(0.002)	(0.001)
λ_3	−0.002	0.003[a]	−0.006[a]	0.000
	(0.002)	(0.000)	(0.002)	(0.002)
λ_4	−0.007[a]	0.002[a]	−0.006[a]	−0.006[a]
	(0.001)	(0.001)	(0.002)	(0.003)
λ_5	0.030[a]	0.005[a]	0.064[a]	0.050[a]
	(0.004)	(0.002)	(0.005)	(0.004)
θ_1	0.426[a]	0.286[a]	0.030	0.134[a]
	(0.078)	(0.019)	(0.020)	(0.028)
θ_2	0.299[a]	0.255[a]	0.219[a]	0.158[a]
	(0.047)	(0.017)	(0.019)	(0.021)
θ_3	0.249[a]	—	0.279[a]	0.255[a]
	(0.076)		(0.045)	(0.063)

Note: Standard errors are in brackets. The items are: Food, Medical (Transport in the case of Italy), Clothing, Fuel and Power, and Others. The child age groups are: 0–4 years, 5–14 years, and 15–17 years

[a]Indicates statistical significance at 5% level.

4. Demand Parameter Estimates and Equivalence Scale Comparisons

Table 3 reports the parameter estimates of the demographically extended rank 3 demand system [equation (5)] for the 8 countries considered in this study. The method of estimation is non-linear FIML, and we used the SHAZAM computer package. The parameter estimates, especially of the demographic parameters, are generally well determined reflecting the large variation in the unit record data. The parameters of particular interest are the λ_i's which represent the rank 3 generalisation over rank 2. There is, generally, evidence in favour of rank 3 demand, though there are significant exceptions and cross-country differences in expenditure pattern. Medical Expenditure has, for most countries, rank 2

demand. Clothing is a rank 2 item in Tanzania, Peru and Australia, unlike in others. Food has quadratic Engel curves in all countries, except Italy and Thailand. On a likelihood ratio based joint test, the rank 2 restrictions, $\lambda_i = 0$ for all i, are conclusively rejected in all countries. The β_1 estimates suggest that, in nearly all the countries, the addition of a child leads, ceteris paribus, to an increase in that household's budget share of Food.

Table 4 reports the Engel equivalence scales based on Food demand and those based on the complete demand systems for these groups of countries. There is wide variation in the scales across countries. The following conclusions can be drawn from these estimates.

(i) As discussed earlier, the Engel methodology overlooks the substitution possibilities between Food and Non-Food items and, consequently, the Engel scales differ, quite substantially in many cases, from those based on "complete demand systems". The evidence on the nature of difference between the two sets of estimates is, however, quite mixed. The Engel scales exceed the systems based scales in the case of Tanzania, India, Australia and Italy—the reverse occurs for the other countries.

(ii) The "cost of a child" increases with age but, once again, it is unwise to generalise since Philippines, Thailand and Peru prove to be significant exceptions. In Thailand and Peru, for example, a child in the age group, 15–17 years, 'costs' less than a younger child aged 0–4 years. This may reflect cultural factors, differences in sex composition between boys and girls, and the way they are viewed in the different countries.

(iii) Philippines and Peru register, among our chosen group of eight countries, some of the highest equivalence scales based on complete demand systems. The picture changes somewhat with the Engel scales based on Food.

(iv) In contrast to the sharp difference in magnitudes between the Engel scales and those based on complete demand systems, the latter seem much less sensitive to the rank of the estimated demand system.

To illustrate the statistical significance of the differences in the scale estimates between methods and between countries, Table 4A reports the standard errors of the estimated scales, ignoring the age and sex differences between children. Tables 4B, 4C draw attention to the main implication of these numbers by reporting, respectively, for each country (method) the difference (and its standard error) between the scale estimates from the various methods (countries). The following features emerge.

(i) The Engel scales are mostly out of step with those from utility based methods with the difference proving statistically significant in 5 out of the 8 countries considered. In contrast, as the last column of Table 4B confirms, the rank of the demand system used has little impact on the estimated scale.

(ii) The results confirm the earlier discussion in denying the conventional wisdom that the Engel scales always exceed the utility based scales, since the reverse occurs for Peru and the Philippines, with the difference turning out to be highly significant.

(iii) The developed countries in the sample, namely, Italy and Australia have near identical Engel scales consistent with the evidence for U.S. and Canada reported in Phipps and Garner (1994). This observation does not, however, extend to the utility based scales for Italy and Australia. Moreover, as Table 4C confirms, the scales vary widely across the developing countries with the pairwise differences being statistically significant in several cases.

(iv) In general, the ranking of countries in order of magnitude of their equivalence scale differs quite sharply between the Engel and utility based methods.

TABLE 4
ESTIMATES OF HOUSEHOLD EQUIVALENCE SCALES

	Engel Scales		
Country	0–4 Years	5–14 Years	15–17 Years
1. Italy	0.213	0.229	0.231
	(0.014)	(0.012)	(0.018)
2. Australia	0.120	0.249	0.359
	(0.024)	(0.018)	(0.049)
3. South Africa	0.179	0.135	0.074
	(0.028)	(0.017)	(0.039)
4. Thailand	0.232	0.103	0.129
	(0.025)	(0.012)	(0.030)
5. Peru	0.246	0.123	0.133
	(0.040)	(0.021)	(0.051)
6. Philippines	0.232	0.197	NA
	(0.012)	(0.010)	
7. India	0.059	0.292	0.292
	(0.028)	(0.022)	(0.059)
8. Tanzania	0.149	0.183	0.275
	(0.044)	(0.030)	(0.082)

	Scales Based on Demand Systems					
	0–4 Years		5–14 Years		15–17 Years	
Country	Rank 2	Rank 3	Rank 2	Rank 3	Rank 2	Rank 3
1. Italy	0.083	0.088	0.141	0.144	0.173	0.169
	(0.013)	(0.012)	(0.011)	(0.010)	(0.017)	(0.016)
2. Australia	0.109	0.116	0.184	0.190	0.239	0.224
	(0.017)	(0.016)	(0.014)	(0.013)	(0.034)	(0.032)
3. South Africa	0.162	0.146	0.185	0.179	0.130	0.130
	(0.028)	(0.028)	(0.019)	(0.017)	(0.044)	(0.041)
4. Thailand	0.278	0.270	0.127	0.121	0.187	0.179
	(0.028)	(0.025)	(0.015)	(0.012)	(0.032)	(0.030)
5. Peru	0.431	0.426	0.291	0.299	0.288	0.249
	(0.082)	(0.078)	(0.054)	(0.047)	(0.092)	(0.076)
6. Philippines	0.303	0.286	0.270	0.255	NA	NA
	(0.019)	(0.019)	(0.019)	(0.017)		
7. India	0.041	0.030	0.226	0.219	0.259	0.279
	(0.022)	(0.020)	(0.020)	(0.019)	(0.047)	(0.045)
8. Tanzania	0.091	0.134	0.147	0.158	0.217	0.255
	(0.036)	(0.028)	(0.028)	(0.021)	(0.070)	(0.063)

Note: An adult couple = 1.0. Standard Errors in brackets.

Table 5 presents the equivalence scales for boys and girls in the case of the 5 countries in our sample that provide information on the sex composition of

TABLE 4A

VARIATION OF EQUIVALENCE SCALES WITH COUNTRIES AND BETWEEN METHODS

Country	Engel	Utility Based Scales	
		Rank 2	Rank 3
1. Italy	1.220	1.132	1.134
	(0.010)	(0.008)	(0.008)
2. Australia	1.225	1.167	1.171
	(0.013)	(0.010)	(0.010)
3. South Africa	1.138	1.173	1.165
	(0.012)	(0.016)	(0.015)
4. Thailand	1.125	1.157	1.151
	(0.011)	(0.013)	(0.013)
5. Peru	1.149	1.318	1.314
	(0.017)	(0.049)	(0.042)
6. Philippines	1.212	1.285	1.269
	(0.008)	(0.013)	(0.014)
7. India	1.260	1.180	1.175
	(0.020)	(0.017)	(0.017)
8. Tanzania	1.186	1.141	1.162
	(0.023)	(0.024)	(0.021)

Note: An adult couple = 1.0. Standard errors are in brackets.

TABLE 4B

TESTING FOR DIFFERENCES IN EQUIVALENCE SCALES BETWEEN ALTERNATIVE METHODS

Country	Engel–Rank 2	Engel–Rank 3	Rank 2–Rank 3
1. Italy	0.088[a]	0.086[a]	–0.002
	(0.013)	(0.013)	(0.012)
2. Australia	0.057[a]	0.053[a]	–0.004
	(0.017)	(0.016)	(0.014)
3. South Africa	–0.035	–0.027	0.008
	(0.020)	(0.019)	(0.022)
4. Thailand	–0.032	–0.025	0.007
	(0.017)	(0.017)	(0.019)
5. Peru	–0.169[a]	–0.164[a]	0.005
	(0.052)	(0.046)	(0.065)
6. Philippines	–0.073[a]	–0.057[a]	0.016
	(0.016)	(0.016)	(0.020)
7. India	0.080[a]	0.085[a]	0.005
	(0.027)	(0.026)	(0.024)
8. Tanzania	0.046	0.024	–0.021
	(0.033)	(0.031)	(0.032)

Note: Standard errors in brackets.
[a]Statistically significant at 5% level of significance.

children in the household. Once again, the scale estimates vary widely across countries, and between the Engel scales and the complete demand systems based scales. There is no consensus or any general pattern in these estimates. In India, for example, in the age group 5 to 14 years, girls cost less than boys, but the situation is sharply reversed for the older children. Peruvian infants aged between 0 to 4 years, especially Peruvian boys in this age group, turn out to be the most expensive, consistent with our earlier evidence.

TABLE 4C

TESTING FOR DIFFERENCES IN EQUIVALENCE SCALES BETWEEN COUNTRIES

Engel

	Italy (1)	Australia (2)	S. Africa (3)	Thailand (4)	Peru (5)	Philippines (6)	India (7)	Tanzania (8)
1.	0.0	−0.005	0.082[a]	0.095[a]	0.071[a]	0.008	−0.040	0.034
	(—)	(0.016)	(0.016)	(0.015)	(0.019)	(0.013)	(0.022)	(0.025)
2.	0.005	0.000	0.087[a]	0.100[a]	0.076[a]	0.013	−0.035	0.039
	(0.016)	(—)	(0.018)	(0.017)	(0.021)	(0.015)	(0.024)	(0.026)
3.	−0.082[a]	−0.087[a]	0.000	0.013	−0.011	−0.074[a]	−0.122[a]	−0.048
	(0.016)	(0.018)	(—)	(0.016)	(0.021)	(0.014)	(0.023)	(0.026)
4.	−0.095[a]	−0.100[a]	−0.013	0.000	−0.024	−0.087[a]	−0.135[a]	−0.061[a]
	(0.015)	(0.017)	(0.016)	(—)	(0.020)	(0.013)	(0.023)	(0.025)
5.	−0.071[a]	−0.076[a]	0.011	0.024	0.000	−0.063[a]	−0.111[a]	−0.037
	(0.019)	(0.021)	(0.021)	(0.026)	(—)	(0.019)	(0.026)	(0.028)
6.	−0.008	−0.013	0.074[a]	0.087[a]	0.063[a]	0.000	−0.048	0.026
	(0.013)	(0.015)	(0.014)	(0.013)	(0.019)	(—)	(0.022)	(0.024)
7.	0.040	0.035	0.122[a]	0.135[a]	0.111[a]	0.048[a]	0.000	0.074[a]
	(0.022)	(0.024)	(0.023)	(0.023)	(0.026)	(0.022)	(—)	(0.03)
8.	−0.034	−0.039	0.048	0.061[a]	0.037	−0.026	−0.074[a]	0.000
	(0.025)	(0.026)	(0.026)	(0.025)	(0.028)	(0.024)	(0.030)	(—)

Utility Based (Rank Three)

	Italy (1)	Australia (2)	S. Africa (3)	Thailand (4)	Peru (5)	Philippines (6)	India (7)	Tanzania (8)
1.	0.00	−0.037[a]	−0.031	−0.016	−0.179[a]	−0.135[a]	−0.041[a]	−0.028
	(—)	(0.013)	(0.017)	(0.015)	(0.043)	(0.016)	(0.018)	(0.022)
2.	0.037[a]	0.00	0.006	0.021	−0.142[a]	−0.098[a]	−0.004	0.009
	(0.013)	(—)	(0.018)	(0.016)	(0.044)	(0.017)	(0.019)	(0.023)
3.	0.031	−0.006	0.00	0.014	−0.149[a]	−0.104[a]	−0.010	0.003
	(0.017)	(0.018)	(—)	(0.020)	(0.045)	(0.021)	(0.022)	(0.026)
4.	0.016	−0.021	−0.014	0.00	−0.163[a]	−0.119[a]	−0.025	−0.011
	(0.015)	(0.016)	(0.020)	(—)	(0.044)	(0.020)	(0.021)	(0.025)
5.	0.179[a]	0.142[a]	0.149[a]	0.163[a]	0.00	0.044	0.138[a]	0.152[a]
	(0.043)	(0.044)	(0.045)	(0.044)	(—)	(0.045)	(0.046)	(0.047)
6.	0.135[a]	0.098[a]	0.104[a]	0.119[a]	−0.044	0.00	0.094[a]	0.107[a]
	(0.016)	(0.017)	(0.021)	(0.020)	(0.045)	(—)	(0.022)	(0.025)
7.	0.041[a]	0.004	0.010	0.025	−0.138[a]	−0.094[a]	0.00	0.013
	(0.018)	(0.019)	(0.022)	(0.021)	(0.046)	(0.022)	(—)	(0.027)
8.	0.028	−0.009	−0.003	0.011	−0.152[a]	−0.107[a]	−0.013	0.00
	(0.022)	(0.023)	(0.026)	(0.025)	(0.047)	(0.025)	(0.027)	(—)

Note: The (i,j)th element in the matrix shows the difference between the scale estimates of countries i, j. Standard errors in brackets

[a]Statistically significant at 5% level of significance.

5. EXPENDITURE INEQUALITY AND SENSITIVITY TO SCALES

Given the sharp differences in the estimates of equivalence scales across countries, between models, and between boys and girls of different ages, questions on sensitivity of the inequality rankings posed in the Introduction take on a special policy significance. Table 6 presents the inequality indices for the 8 countries covered in this study. These indices were calculated by deflating the total household expenditure by the equivalence scales obtained earlier. In effect, household expenditures were normalised using the two-adult zero-children household as the reference household. Thus, the indices presented in Table 6 measure the inequality in the distribution of "equivalent" expenditures of households. We chose to analyse inequality across households rather than across persons because the results

TABLE 5

EQUIVALENCE SCALE ESTIMATES FOR GIRLS AND BOYS

	Engel Scales					
	0–4 Years		5–14 Years		15–17 Years	
Country	Girl	Boy	Girl	Boy	Girl	Boy
South Africa	0.197	0.167	0.149	0.125	0.019	0.157
	(0.041)	(0.038)	(0.026)	(0.025)	(0.053)	(0.058)
Thailand	0.294	0.172	0.108	0.099	0.146	0.112
	(0.036)	(0.032)	(0.018)	(0.018)	(0.043)	(0.043)
Peru	0.247	0.246	0.122	0.125	0.099	0.171
	(0.053)	(0.052)	(0.031)	(0.030)	(0.069)	(0.076)
India	0.075	0.052	0.263	0.321	0.228	0.348
	(0.039)	(0.040)	(0.031)	(0.033)	(0.083)	(0.080)
Tanzania	0.128	0.171	0.168	0.197	0.236	0.326
	(0.056)	(0.058)	(0.043)	(0.043)	(0.110)	(0.129)

	Scales Based on Demand Systems											
	0–4 Years				5–14 Years				15–17 Years			
	Rank 2		Rank 3		Rank 2		Rank 3		Rank 2		Rank 3	
Country	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy
South Africa	0.163	0.160	0.133	0.158	0.196	0.176	0.186	0.173	0.078	0.174	0.099	0.155
	(0.041)	(0.038)	(0.040)	(0.037)	(0.029)	(0.028)	(0.030)	(0.027)	(0.064)	(0.064)	(0.064)	(0.058)
Thailand	0.331	0.224	0.323	0.217	0.121	0.133	0.115	0.127	0.200	0.173	0.187	0.170
	(0.038)	(0.036)	(0.038)	(0.034)	(0.020)	(0.020)	(0.020)	(0.017)	(0.045)	(0.046)	(0.047)	(0.038)
Peru	0.396	0.475	0.394	0.465	0.293	0.300	0.298	0.310	0.171	0.408	0.123	0.363
	(0.094)	(0.100)	(0.084)	(0.085)	(0.057)	(0.058)	(0.060)	(0.046)	(0.111)	(0.107)	(0.091)	(0.110)
India	0.037	0.053	0.034	0.033	0.203	0.249	0.195	0.242	0.284	0.245	0.349	0.240
	(0.024)	(0.030)	(0.021)	(0.025)	(0.025)	(0.026)	(0.022)	(0.026)	(0.068)	(0.059)	(0.070)	(0.053)
Tanzania	0.083	0.100	0.119	0.152	0.114	0.180	0.151	0.163	0.157	0.296	0.221	0.304
	(0.043)	(0.044)	(0.040)	(0.042)	(0.036)	(0.038)	(0.035)	(0.034)	(0.088)	(0.105)	(0.091)	(0.106)

Note: An adult couple = 1.0. Standard Errors in Brackets.

on the former are of greater significance in social policy programs. While the ultimate aim in any redistribution program is equality of welfare among individuals, in practice, these programs target a redistribution of welfare across households. The 2nd and 3rd columns of Table 6 present the estimated inequality at the two extremes: (i) when no adjustment is made to household expenditure, and (ii) when all members of the household are given equal weights i.e. uncorrected household size is used as deflator. It is clear that the magnitudes of inequality vary between the different inequality measures used and that, within one measure, the use of equivalence scales makes a significant difference to the result—the use of different scales can affect the level of inequality in a population.

The last 7 columns of Table 6 correspond to the complete systems (rank 3) based equivalence scales allowing economies of household size through the parameter ϕ as follows:

$$m_0(\eta) = \left(1 + \sum_{s=1}^{2} \sum_{d=1}^{D} \theta_{ds} n_{ds}\right)^{\phi} \tag{10}$$

where θ_{ds} is the scale parameter for a child in sex group s (= 1, 2) in age group d (= 1, 2, 3), with the scale normalised at unity for the reference household, namely, the childless couple, and n_{ds} is the number of children in the age group d and sex group s. Note that this extends the equivalence scale specification considered by Buhmann *et al.* (1988) and Coulter *et al.* (1992) to incorporate household composition between adults and children of different age/sex groups, as suggested by Banks and Johnson (1994). Moreover, we allow the scales to vary in a manner consistent with changing needs and preferences between nations. Citro and Michael (1995) use a similar model to explicitly account for the differences between adults and children, and economies of scale. South Africa and the Philippines record some of the highest expenditure inequalities, more than the less affluent countries, India and Tanzania. This finding for India is consistent with that of an earlier cross-country study (Valenzuela, 1993) covering 23 countries where India stood out as a very poor country but one with the lowest level of inequality in incomes. This is also consistent with other evidence [see Atkinson and Micklewright (1992), Garner *et al.* (1995)] suggesting that a relatively poor country can have a very low level of inequality in income. The Indian inequality estimates, reported in Table 6, are almost identical to those obtained by Maiti and Chattopadhyay (1994) where the Gini index of consumption inequality was constant over the period 1988–93.[9] Thus, even though the Indian sample considered here relates to an earlier time period, the Indian estimates obtained are comparable with those of the other countries.

Notwithstanding the sharp differences in the equivalence scale estimates, the inequality rankings are quite robust to the alternative demographic specifications, and this is true using the chosen alternative inequality measures. This is confirmed by Tables 7, 8 and 9 which report the ranks of countries according to decreasing levels of inequality and the rank correlations between the alternative inequality rankings. None of the rank correlation estimates is statistically different from

[9]We are grateful to Amita Majumder of the Indian Statistical Institute, Calcutta for drawing this study to our attention.

unity which is implied by identical rankings. The inequality rankings of the countries are quite insensitive to the economies of household size, ϕ, especially if, along with country specific equivalence scales, the number and age/sex distribution of children are taken into account in the calculations.

The relationship between the inequality estimate and the magnitude of ϕ has generated some interest in the past. Using the demographic specification of Buhmann *et al.* (1988) that ignores household composition between adults and children, Coulter *et al.* (1992) observe that, for some inequality measures, a U-shaped relation exists between the magnitude of inequality and ϕ. The diagrams in Figure 1 show this relationship for each of the countries included in our study. In contrast to some earlier results, these diagrams hardly indicate any evidence in case of the developing countries of such a U-shaped relationship, though there are sharp differences between countries, and wide disagreements between inequality measures on the nature of this relationship. Using top sensitive Generalised Entropy inequality measures, Coulter *et al.* [1992, p. 1078/79] also observe a non-U-shaped relationship, namely, a flattened *J* curve, between inequality estimate and ϕ. The presence of children and of their age/sex effects, and use of country specific equivalence scales may, also, have an impact on this relationship. Note, incidentally, from Figure 1 that the Italian and the Australian estimates are exceptions in providing some support to the idea of a U-shaped relationship between inequality and ϕ. Apart from the fact that Italy and Australia are the only developed countries in our sample, adult couples in them are similar to one another in family size and composition compared to that in the other countries (Table 2). This suggests that the non-U-shaped relationship between inequality and ϕ observed for most of the developing countries may be largely driven by the greater role played in them by the age and sex distribution of children than in the developed countries.

Tables 10 and 11 provide evidence on the demographic differences in inequality estimates and inequality ranking by calculating them separately for households that contain different numbers of children. The first column of numbers shows the inequality estimates and inequality rankings for all households with the rank 3 demand based equivalence scales used to deflate the household expenditures. The rankings are quite robust to households varying in size and composition, though the presence of children does have an appreciable impact on the inequality estimates. With the exception of Tanzania, the arrival of the first child tends to have a sharp equalising effect on the distribution of aggregate expenditures. This is consistent with the U.K. evidence presented in Ray (1985), and, possibly, reflects the fact that couples with children are likely to be closer to each other in their circumstances and stages in their life cycle compared to households without children. The latter, for example, could well include newly married couples on the one hand, and pensioners with no dependent children on the other.

Table 12 presents the decomposition of the inequality estimate into its "within" (I_w) and "between" households components (I_B) when the households are grouped according to the number of children.[10] Since the picture looks very similar for the decomposable measures, I_0 and I_1, we have presented the estimates

[10]See equation (9). I_w is the first term on the RHS of equation (9).

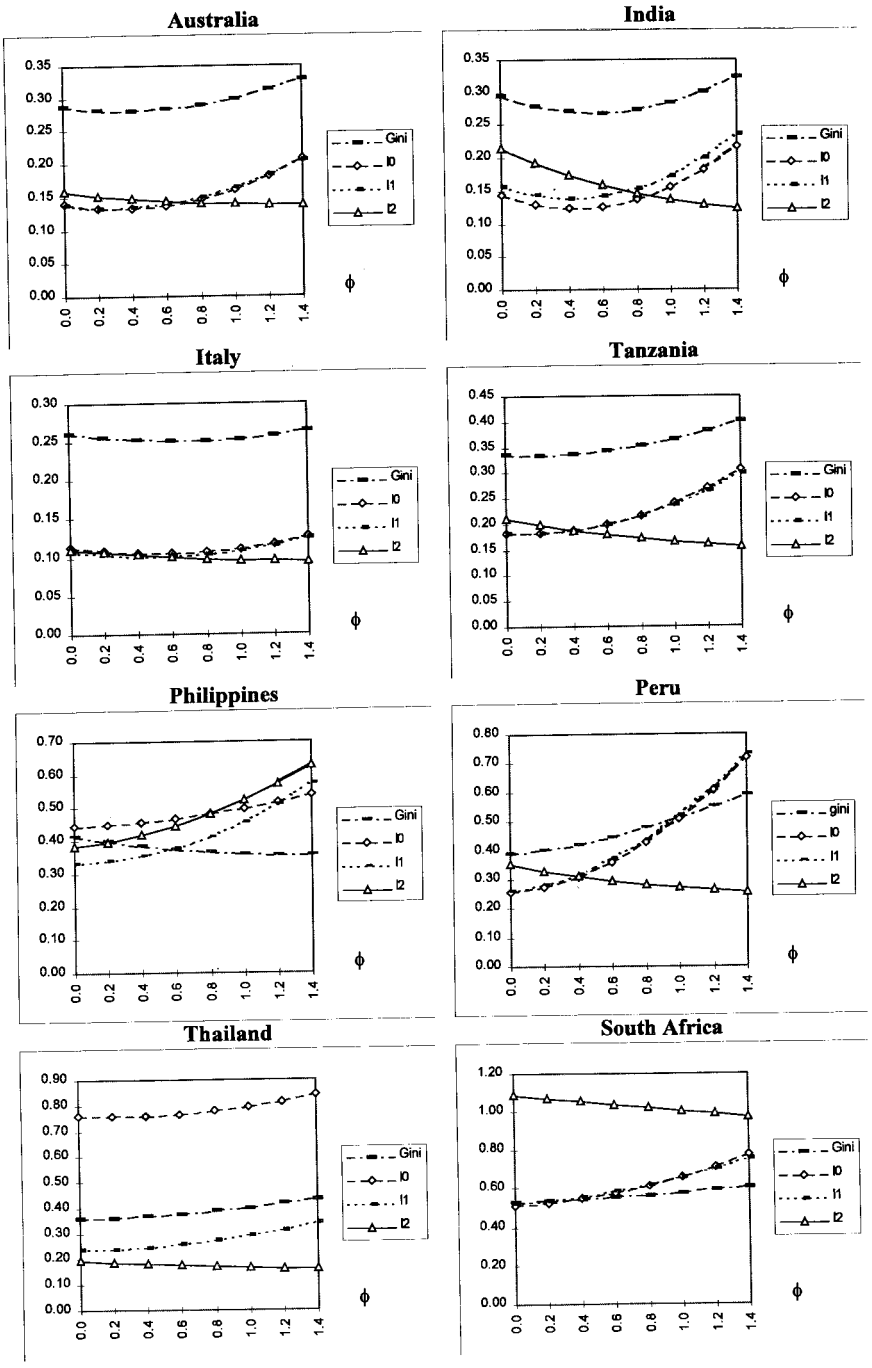

Figure 1. Inequality Indices vs. ϕ.

TABLE 6

INEQUALITY INDICES BY COUNTRY AND BY TYPE OF EQUIVALENCE SCALING USED

	No Adjustment	Per Capita	No Age/Sex Differences		With Age/Sex Differences		Rank 3 Demand System (with age/sex differences)						
			Engel	Rank 3	Engel	Rank 2	$\phi = 0.2$	$\phi = 0.4$	$\phi = 0.6$	$\phi = 0.8$	$\phi = 1.0$	$\phi = 1.2$	$\phi = 1.4$
Gini Coefficient													
Italy	0.262	0.343	0.267	0.254	0.268	0.268	0.257	0.253	0.252	0.252	0.254	0.258	0.264
Australia	0.289	0.415	0.316	0.300	0.317	0.299	0.283	0.281	0.284	0.290	0.300	0.314	0.330
South Africa	0.532	0.665	0.571	0.579	0.573	0.578	0.538	0.546	0.556	0.567	0.581	0.595	0.611
Thailand	0.361	0.504	0.385	0.393	0.430	0.400	0.363	0.368	0.377	0.388	0.402	0.417	0.434
Peru	0.388	0.553	0.440	0.499	0.454	0.514	0.401	0.421	0.447	0.478	0.513	0.550	0.588
Philippines	0.444	0.551	0.481	0.495	0.486	0.503	0.448	0.456	0.467	0.481	0.499	0.518	0.540
India	0.295	0.363	0.295	0.276	0.300	0.284	0.271	0.268	0.272	0.284	0.301	0.324	0.332
Tanzania	0.336	0.475	0.375	0.367	0.379	0.370	0.335	0.338	0.344	0.354	0.367	0.383	0.401
I_0 Index													
Italy	0.114	0.243	0.130	0.111	0.131	0.112	0.109	0.106	0.106	0.107	0.111	0.118	0.127
Australia	0.140	0.350	0.183	0.159	0.187	0.159	0.134	0.133	0.137	0.146	0.161	0.181	0.207
South Africa	0.515	0.986	0.626	0.653	0.635	0.652	0.529	0.550	0.579	0.616	0.661	0.714	0.774
Thailand	0.762	0.945	0.772	0.781	0.826	0.793	0.759	0.761	0.767	0.778	0.794	0.815	0.840
Peru	0.256	0.613	0.349	0.480	0.374	0.511	0.274	0.309	0.359	0.426	0.508	0.606	0.717
Philippines	0.334	0.600	0.412	0.446	0.423	0.466	0.340	0.355	0.379	0.412	0.456	0.509	0.571
India	0.143	0.271	0.172	0.142	0.179	0.155	0.123	0.126	0.136	0.155	0.182	0.217	0.246
Tanzania	0.184	0.448	0.257	0.238	0.263	0.247	0.183	0.188	0.199	0.216	0.238	0.270	0.306
I_1 Index													
Italy	0.108	0.237	0.128	0.108	0.130	0.109	0.104	0.102	0.102	0.104	0.109	0.116	0.124
Australia	0.138	0.336	0.186	0.163	0.188	0.163	0.134	0.134	0.140	0.150	0.164	0.183	0.207
South Africa	0.523	0.969	0.630	0.655	0.638	0.652	0.539	0.560	0.588	0.621	0.660	0.705	0.756
Thailand	0.240	0.479	0.269	0.280	0.336	0.290	0.242	0.248	0.258	0.273	0.292	0.315	0.342
Philippines	0.385	0.664	0.481	0.516	0.492	0.535	0.398	0.418	0.446	0.482	0.525	0.574	0.630
Peru	0.261	0.642	0.356	0.491	0.381	0.522	0.282	0.319	0.370	0.438	0.520	0.618	0.730
India	0.157	0.312	0.193	0.161	0.198	0.173	0.139	0.142	0.154	0.173	0.200	0.235	0.262
Tanzania	0.183	0.466	0.256	0.240	0.260	0.245	0.183	0.188	0.199	0.216	0.238	0.265	0.298

TABLE 7

INEQUALITY RANKING OF COUNTRIES

Country	No Adjustment	Per Capita	No Age/Sex Effects		Age/Sex Effects		Rank 3 Demand with Age/Sex Effects		
			Engel	Rank 3 Demand	Engel	Rank 2 Demand	$\phi = 0.2$	$\phi = 1$	$\phi = 1.4$
Inequality Measure: Gini									
Italy	8	8	8	8	7	8	8	8	8
Australia	7	6	6	6	6	6	6	7	6
South Africa	1	1	1	1	1	1	1	1	1
Thailand	4	4	4	4	4	4	4	4	4
Peru	3	2	3	2	3	2	3	2	2
Philippines	2	3	2	3	2	3	2	3	3
India	6	7	7	7	7	7	7	6	7
Tanzania	5	5	5	5	5	5	5	5	5
Inequality Measure: I_0									
Italy	8	8	8	8	8	8	8	8	8
Australia	7	6	6	6	6	6	6	7	7
South Africa	2	1	2	2	2	2	2	2	2
Thailand	1	2	1	1	1	1	1	1	1
Peru	4	3	4	3	4	3	4	3	3
Philippines	3	4	3	4	3	4	3	4	4
India	6	7	7	7	7	7	7	6	6
Tanzania	5	5	5	5	5	5	5	5	5
Inequality Measure: I_1									
Italy	8	8	8	8	8	8	8	8	8
Australia	7	6	7	6	7	7	7	7	7
South Africa	1	1	1	1	1	1	1	1	1
Thailand	4	4	4	4	4	4	4	4	4
Peru	3	3	3	3	3	3	3	3	2
Philippines	2	2	2	2	2	2	2	2	3
India	6	7	6	7	6	6	6	6	6
Tanzania	5	5	5	5	5	5	5	5	5

Note: The rankings are in decreasing order of inequality, i.e. inequality rank 1 implies highest inequality, etc.

TABLE 8

RANK CORRELATION MATRIX OF THE GINI COEFFICIENTS

	No Adjustment (1)	Per Capita (2)	No Age/Sex Effects: Engel (3)	No Age/Sex Effects: Rank 3 (4)	With Age/Sex Effects: Engel (5)	With Age/Sex Effects: Rank 2 (6)	Rank 3 Demand With Age/Sex Effects: $\phi = 0.2$ (7)	Rank 3 Demand With Age/Sex Effects: $\phi = 1.0$ (8)	Rank 3 Demand With Age/Sex Effects: $\phi = 1.4$ (9)
(1)		0.886 (0.232)	0.949 (0.167)	0.886 (0.232)	0.914 (0.164)	0.886 (0.232)	0.943 (0.167)	0.943 (0.167)	0.886 (0.232)
(2)			0.943 (0.167)	1.000 (0.000)	0.914 (0.164)	1.000 (0.000)	0.943 (0.167)	0.943 (0.167)	1.000 (0.000)
(3)				0.943 (0.167)	0.971 (0.119)	0.943 (0.167)	1.000 (0.000)	0.886 (0.232)	0.943 (0.167)
(4)					0.914 (0.203)	1.000 (0.000)	0.943 (0.167)	0.943 (0.167)	1.000 (0.000)
(5)						0.914 (0.203)	0.971 (0.119)	0.857 (0.258)	0.914 (0.164)
(6)							0.943 (0.167)	0.943 (0.167)	1.000 (0.000)
(7)								0.886 (0.232)	0.943 (0.167)
(8)									0.943 (0.167)

Note: Standard errors in brackets.

TABLE 9

RANK CORRELATION MATRIX OF THE I_0 INDICES

	No Adjustment (1)	Per Capita (2)	No Age/Sex Effects: Engel (3)	No Age/Sex Effects: Rank 3 (4)	With Age/Sex Effects: Engel (5)	With Age/Sex Effects: Rank 2 (6)	Rank 3 Demand With Age/Sex Effects: $\phi = 0.2$ (7)	Rank 3 Demand With Age/Sex Effects: $\phi = 1.0$ (8)	Rank 3 Demand With Age/Sex Effects: $\phi = 1.4$ (9)
(1)		0.857 (0.258)	0.943 (0.167)	0.886 (0.232)	0.943 (0.167)	0.943 (0.167)	0.943 (0.167)	0.943 (0.167)	0.943 (0.167)
(2)			0.914 (0.203)	0.971 (0.119)	0.914 (0.203)	0.971 (0.119)	0.914 (0.203)	0.914 (0.203)	0.914 (0.203)
(3)				0.943 (0.167)	1.000 (0.000)	0.943 (0.167)	1.000 (0.000)	0.886 (0.232)	0.886 (0.232)
(4)					0.943 (0.167)	1.000 (0.000)	0.943 (0.167)	0.943 (0.167)	0.943 (0.167)
(5)						0.943 (0.167)	1.000 (0.000)	0.856 (0.232)	0.856 (0.232)
(6)							0.943 (0.167)	0.943 (0.167)	0.943 (0.167)
(7)								0.856 (0.232)	0.856 (0.232)
(8)									1.000 (0.000)

Note: Standard errors in brackets.

TABLE 10

HOUSEHOLD SPECIFIC INEQUALITY ESTIMATES AND INEQUALITY RANKINGS USING GINI

Country	All Households	No Children	One Child	Two Children
1. Italy	0.2542(8)	0.2829(8)	0.2293(8)	0.2205(8)
2. Australia	0.3000(7)	0.3108(7)	0.2554(7)	0.2462(7)
3. South Africa	0.5806(1)	0.5428(1)	0.5241(1)	0.5132(1)
4. Thailand	0.4015(4)	0.3889(4)	0.3662(4)	0.3570(4)
5. Peru	0.5128(2)	0.4501(3)	0.3763(3)	0.3988(2)
6. Philippines	0.4986(3)	0.4828(2)	0.4363(2)	0.3931(3)
7. India	0.3013(6)	0.3165(6)	0.2810(6)	0.2855(6)
8. Tanzania	0.3667(5)	0.3271(5)	0.3356(5)	0.3532(5)

TABLE 11

HOUSEHOLD SPECIFIC INEQUALITY ESTIMATES AND INEQUALITY RANKINGS USING I_1

Country	All Households	No Children	One Child	Two Children
1. Italy	0.1090(8)	0.1263(8)	0.0824(8)	0.0766(8)
2. Australia	0.1643(7)	0.1573(7)	0.1117(7)	0.1067(7)
3. South Africa	0.6605(1)	0.5842(1)	0.4795(1)	0.4595(1)
4. Thailand	0.2917(4)	0.2856(4)	0.2414(4)	0.2306(4)
5. Peru	0.5203(3)	0.3591(3)	0.2363(3)	0.2659(3)
6. Philippines	0.5248(2)	0.4776(2)	0.3482(2)	0.2701(2)
7. India	0.2002(6)	0.1822(5)	0.1484(6)	0.1561(6)
8. Tanzania	0.2377(5)	0.1789(6)	0.1865(5)	0.2007(5)

only for the former. Of particular interest among the numbers presented in Table 12 are the magnitudes of the ratio I_w/I. These give us an idea of the relative importance of the two components of inequality. The principal features are as follows.

(i) For all countries, the "within group" inequality dominates the "between-group" inequality across the different household types.

(ii) The use of equivalence scales to account for differences in household size and composition generally leads to a decline in the relative importance of "within group" inequality, though there are some interesting cross-country variations in this regard. There is hardly any impact of size adjustment on the ratio I_w/I in the cases of India and Tanzania, but considerably greater impact in case of the more affluent countries, Italy, Australia and South Africa.

(iii) In contrast to their relatively minor impact on the inequality estimates and the inequality rankings reported earlier, the rank 2 and rank 3 demand based equivalence scales have, in several cases, an appreciable impact on the magnitude of the ratio of "within" to "between" group inequalities. The nature of the revision differs, however, across countries with the ratio, I_w/I, increasing sharply from the rank 2 to rank 3 scales for Italy, and decreasing markedly for Tanzania.

Before concluding, we investigate the extent to which the inequality differences between countries are due to differences in the definition of expenditures or

TABLE 12

INEQUALITY DECOMPOSITION USING INEQUALITY MEASURE, I_0

	Unadjusted				Rank 2 Scales				Rank 3 Scales			
Country	I	I_w	I_B	I_w/I	I	I_w	I_B	I_w/I	I	I_w	I_B	I_w/I
1. Italy	0.1143	0.1051	0.0092	0.9193	0.1120	0.0957	0.0155	0.8606	0.1113	0.1027	0.0086	0.9225
2. Australia	0.1397	0.1336	0.0061	0.9566	0.1592	0.1297	0.0295	0.8149	0.1607	0.1294	0.0312	0.8056
3. South Africa	0.5151	0.4896	0.0256	0.9504	0.6518	0.4746	0.1772	0.7281	0.6607	0.4041	0.2566	0.6116
4. Thailand	0.7624	0.7619	0.0005	0.9993	0.7925	0.7540	0.0385	0.9514	0.7943	0.7536	0.0407	0.9487
5. Peru	0.2564	0.2509	0.0055	0.9784	0.5110	0.2335	0.2775	0.4569	0.5083	0.2325	0.2758	0.4574
6. Philippines	0.3342	0.3305	0.0037	0.9890	0.4664	0.3121	0.1543	0.6692	0.4557	0.3129	0.1429	0.6865
7. India	0.1434	0.1249	0.0185	0.8710	0.1554	0.1356	0.0198	0.8725	0.1821	0.1326	0.0495	0.7281
8. Tanzania	0.1839	0.1811	0.0028	0.9846	0.2471	0.1796	0.0675	0.7268	0.2377	0.1871	0.0506	0.7871

Note: I_W denotes inequality "within household-type" where the household types are distinguished by the number of children in the household (see Section 3, paragraph 1); I_B denotes inequality "between household-type"; $I = I_W + I_B$ denotes "total inequality"; I_W/I measures the proportion of total inequality that is due to "within household-type" inequality.

TABLE 13

IMPACT OF DELETION OF MEDICAL AND OTHERS ON INEQUALITY OF PER CAPITA EXPENDITURES

Country	Three Items[a]		Five Items[b]	
	Estimate	Ranking	Estimate	Ranking
Italy	0.331	7	0.343	8
Australia	0.370	6	0.415	6
South Africa	0.522	1	0.665	1
Thailand	0.458	2	0.504	4
Peru	0.457	3	0.553	2
Philippines	0.435	5	0.551	3
India	0.321	8	0.363	7
Tanzania	0.445	4	0.475	5

Note: Inequality measure used is Gini.

[a]Food, Clothing, Fuel and Power.

[b]Food, Medical (Transport in the case of Italy), Clothing, Fuel and Power, and Others.

consumption. To do so, we calculated the inequality of expenditures on the following three items which are comparable internationally: Food, Clothing, Fuel and Power. To ensure identical meaning, we considered Food expenditures rather than Food consumption. Table 13 presents, in the per capita case, the new inequality estimates as measured by the Gini coefficient. The corresponding estimates, reported earlier in Table 6, are also presented for ready comparison. The expenditure inequalities generally decline, with the magnitude of reduction varying between countries. The small adjustments in Italy and Australia, in relation to the others, partly reflect the fact that the distinction between Food consumption and Food expenditure is unlikely to be significant in case of the developed countries. Moreover, the distribution of expenditures on the deleted items, Medical and Others is more unequal in the developing countries than in the more affluent ones. The inequality rankings are, however, much less sensitive to the deletion of the non-comparable items from the inequality calculations. For example, notwithstanding her poverty, India continues to register one of the lowest inequalities in the chosen sample of countries.

6. CONCLUSION

The very early work on inequality comparisons was conducted on the size distribution of incomes with little or no correction for differences in household size and composition. Buhmann *et al.* (1988)'s study is significant in being one of the first to examine the sensitivity of inequality ranking of countries to the equivalence scale used to correct for differences in household size. They do not, however, consider the impact of household composition on inequality.

The present study extends the previous literature on cross-country inequality comparisons in, principally, the following respects:

(i) The chosen group includes both the developing and the developed countries spanning a wide spectrum in the international expenditure distribution.

(ii) Aggregate household expenditure, based on unit records, is used in the inequality calculations.

(iii) The equivalence scales, used in deflating the household expenditures, are not imposed *a priori* but estimated separately for each country on its unit record of expenditure information. Moreover, the equivalence scales, calculated here, incorporate information not only on household size but, also, on household composition between the adults and children of different ages and sexes.

The same equivalence scale model yields quite different scale estimates for the different countries. It is, therefore, unwise to use the same scale value for all the countries in the inequality comparisons. The equivalence scale estimates differ not only between children of different ages but, also, between girls and boys. This may reflect differences in the way boys and girls are valued in the different countries. There are some interesting cross-country variations in the relative magnitudes of girl and boy costs, possibly, reflecting the cultural differences. There is very little previous evidence on the age effects of children on household costs and expenditure behaviour in developing countries. Murthi's (1994) observation on Sri Lanka data that the Engel scales are identical for young and old children is inconsistent with the present evidence to the contrary for India and Tanzania.

The equivalence scale estimates are also quite different between the Food based Engel scales, and those based on complete demand systems, though they are not very sensitive to the rank of the estimated demand system. The Engel scales do not, however, always exceed the complete demand systems based equivalence scales, possibly, reflecting the absence of price based substitution of consumer expenditure among items in our study. Notwithstanding the sharp differences in child costs between countries and between the equivalence scale models, the inequality rankings are quite insensitive to demographic specification. This is confirmed by the estimates of rank correlation which are never significantly different from unity. In contrast, use of the equivalence scales to adjust household expenditures for varying household size and composition does have a marked impact on the relative magnitude of "within" to "between" group inequalities for most countries considered in this study.

The present study can be extended to include a still wider cross-section of countries than considered in this exercise. The LSMS of the World Bank maintains a comprehensive collection of good quality, unit record, household budget data from various countries which can facilitate the conduct of such a study. In many cases, data from more than one survey is available, thus allowing the inclusion of the price variable and of price effects in the scale estimation and in the inequality calculations. The focus of such studies could, also, be extended to the issue of sensitivity of poverty based rankings to the estimated equivalence scales, and to differences in household composition between boys and girls, an issue that is of special interest to the developing countries.

References

Atkinson, A. B., On the Measurement of Inequality, *Journal of Economic Theory*, 2, 244–63, 1970.

——— and J. Micklewright, *Economic Transformation in Eastern Europe and the Distribution of Income*, Cambridge University Press, Cambridge, 1992.

Banks, J., R. Blundell, and A. Lewbel, Quadratic Engel Curves, Welfare Measurement and Consumer Demand, Discussion Paper of the Institute for Fiscal Studies, London, 1992.
——— and P. Johnson, Equivalence Scales Relativities Revisited, *The Economic Journal*, 104, 883–90, 1994.
Barten, A. P. Family Composition, Prices and Expenditure Patterns, in P. E. Hart, G. Mills, and J. K. Whitaker, (eds.), *Econometric Analysis for National Economic Planning*, Butterworths, London, 277–92, 1964.
Blackorby, C. and D. Donaldson, Measuring the Cost of Children: A Theoretical Framework, in R. Blundell, I. Preston, and I. Walker, (eds.), *The Measurement of Household Welfare*, Cambridge Unuversity Press, Cambridge, 1994.
Blundell, R. W. and A. Lewbel, The Information Content of Equivalence Scales, *Journal of Econometrics*, 50, 49–68, 1991.
Browning, M., Modelling the Effects of Children on Household Economic Behaviour, *Journal of Economic Literature*, 30, 1434–75, 1992.
Buhmann, B., L. Rainwater, G. Schmaus, and T. Smeeding, Equivalence Scales, Well-Being, Inequality and Poverty: Sensitivity Estimates Across Ten Countries Using the Luxembourg Income Study (LIS) Database, *Review of Income and Wealth*, 94, 115–42, 1988.
Citro, C. P. and R. T. Michael (eds.), *Measuring Poverty: A New Approach,* National Academy Press, Washington, DC, 1995.
Coulter, F. A. E., F. A. Cowell, and S. P. Jenkins, Equivalence Scale Relativities and the Extent of Inequality and Poverty, *Economic Journal*, 102, 1067–82, 1992.
Engel, E., Die Lebenskosten Belgischer Arbeiter-Familien Fruher und Jetzt, *Bulletin de L'Institute International de Statistique*, 9, 1–124, 1895.
Fields, G. S., *Poverty, Inequality and Development*, Cambridge University Press, London, 1980.
Garner, T. I., Changing Welfare in a Changing World? Income and Expenditure Distributions in the Czech and Slovak Republics, Chapter 13 in S. P. Jenkins, A. Kapteyn, and B. van Praag, (eds.), *The Distribution of Welfare and Household Production: International Perspectives (Aldi Hagenaars Memorial Volume),* Cambridge University Press, Cambridge, 1998.
———, M. Lubyova, and K. Terrell, Changes in Expenditure and Income Inequality in the Czech and Slovak Republics, 1989 vs. 1992 (An Examination of the Micro Data), in J. Svejnar, (ed.), *Czech Republic and Economic Transition in Eastern Europe*, Academic Press, Florida, 1995.
Gorman, W. M., Tricks with Utility Functions, in M. J. Artis and A. R. Nobay (eds.), *Essays in Economic Analysis*, Cambridge University Press, Cambridge, 1976.
Grosh, M. and P. Glewwe, A Guide to Living Standards Measurement Study Surveys and their Data Sets, LSMS Working Paper, No. 120, World Bank, Washington, DC, 1995.
ISTAT, Indagine Sui Consumi Delle Famiglie. Documentazione Tecnica e Descrizione del File Standard Gerarchico, Anni, 1987–94, Rome, 1996.
Jain, S., Size Distribution of Income: A Compilation of Data, World Bank, Washington, DC, 1975.
Johnson, D. and S. Shipp, Inequality and the Business Cycle: A Consumption Viewpoint, forthcoming in *Empirical Economics*, 1997.
Kuznets, S., Economic Growth and Income Inequality, *American Economic Review*, March, 1–28, 1955.
Lancaster, G. and R. Ray, Comparison of Alternative Models of Household Equivalence Scales: The Australian Evidence on Unit Record Data, *The Economic Record*, 74(224), 1–14, 1998.
Lecaillon, J., F. Paukert, C. Morrison, and D. Germidis, *Income Distribution and Economic Development*, ILO, Geneva, 1984.
Lerman, R. I. and S. Yitzhaki, Improving the Accuracy of Estimates of Gini Coefficients, *Journal of Econometrics*, 42, 43–47, 1989.
Maiti, P. and M. Chattopadhyay, Rural-urban Disparity in Level of Living in India, mimeographed, Economics Research Unit, Indian Statistical Institute, Calcutta, 1994.
McGregor, P. and V. K. Barooah, Is Low Spending or Low Income a Better Indicator of Whether or Not a Household is Poor: Some Results from the 1985 Family Expenditure Survey, *Journal of Social Policy*, 21(1), 53–69, 1992.
Mookherjee, D. and A. F. Shorrocks, A Decomposition Analysis of the Trend in U.K. Income Inequality, *Economic Journal*, 92, 886–902, 1982.
Murthi, M., Engel Equivalence Scales in Sri Lanka: Exactness, Specification, Measurement Error, in R. Blundell, I. Preston and I. Walker, (eds.), *The Measurement of Household Welfare*, Cambridge University Press, Cambridge, 1994.
Nelson, J., Methods of Estimating Household Equivalence Scales: An Empirical Investigation, *Review of Income and Wealth*, 38, 295–310, 1992.
Phipps, S. and T.I. Garner, Are Equivalence Scales the Same for the United States and Canada?, *Review of Income and Wealth*, 40(1), 1–17, 1994.

Pollak, R. A. and T. J. Wales, Welfare Comparisons and Equivalence Scales, *American Economic Review*, 69, 216–21, 1979.
———, Demographic Variables in Demand Analysis, *Econometrica*, 49, 1533–52, 1981.
Ray, R., Measuring the Costs of Children: An Alternative Approach, *Journal of Public Economics*, 22, 89–102, 1983.
———, Prices, Children and Inequality: Further Evidence for the U.K., 1965–82, *Economic Journal*, 95, 1069–77, 1985.
Sabelhaus, J. and S. Ulrike, Measuring the Distribution of Well Being: Why Income and Consumption Give Different Answers?, *Urban Institute*, November, 1995.
Sen, A. K., Family and Food: Sex Bias in Poverty, in P. Bardhan and T. N. Srinivasan, (eds.), *Rural Poverty in South Asia*, Columbia University Press, New York, 1988.
———, *On Economic Inequality*, Clarendon Press, Oxford, 1997.
——— and S. Sengupta, Malnutrition of Rural Children and the Sex Bias, *Economic and Political Weekly*, 18, 855–64, 1983.
Shorrocks, A.F., The Class of Additively Decomposable Inequality Measures, *Econometrica*, 48, 613–25, 1980.
———, Inequality Decomposition by Population Subgroups, *Econometrica*, 22, 1369–86, 1984.
Slesnick, D., Consumption, Needs and Inequality, *International Economic Review*, 35(3), 677–703, 1994.
Valenzuela, R., Income Inequality in Asia: 1960-1985: A Decomposition Analysis, Working Papers in Econometrics and Applied Statistics, UNE, Department of Econometrics, No. 67, April, 1993.
———, Alternative Approaches to the Estimation of Household Equivalence Scales: An Australian Application, Unpublished Doctoral Dissertation, University of New England, Australia, 1997.
World Development Report, Oxford University Press, Oxford, 1996.