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ABSTRACT

In this paper we describe a simple method to estimate household cost functions and family equivalence scales. It is an alternative to standard methods as it does not assume strong postulates about utility maximization nor any functionally specified model equations. The data requirements are extremely modest. We assume interpersonal ordinal comparability in the sense of Sen (1976). Empirical evidence for eight European countries and the U.S.A. shows the feasibility of the method and the stability of its results.

1. Introduction

In the preface to <u>Choice, Welfare and Measurement</u> Sen (1982, p. 9) makes a
rather intriguing statement about empirical economic methodology. It reads as
follows:

"One reason for the tendency in economics to concentrate only on "revealed
preference" relation is a methodolocial suspicion regarding introspective
concepts. Choice is seen as solid information, whereas introspection is not
open to observation ... Even as behaviourism this is peculiarly limited
since <u>verbal</u> behaviour (or <u>writing</u> behaviour, including response to
questionnaires) should not lie outside the scope of the behaviourist
approach."

In this article we want to show that Sen is right in his opinion that
responses to questionnaires may contain quite interesting information for
economists and that this type of data may be a cheap and viable alternative to
the observation of "revealed preferences". Our economic subject will be the
estimation of household cost functions, that is, the amount of money c(u)
needed by a household to reach a specific welfare level u. Estimation of cost
functions is mainly done on the basis of observed purchase behavior, as
described in household budget surveys. In this paper we shall estimate cost
functions on the basis of responses to attitude questions.

In most western countries increasing attention is devoted to what is
frequently called <u>income policy</u>. The fundamental problems center around two
issues.
First, what income levels or <u>household cost</u> levels correspond to a state of
"poverty", to "get along", to "be reasonably well-off"? Since in most
countries a certain responsibility is assumed for the poor, the predominant
question is clearly "what <u>is</u> the poverty line?" In a similar way, although
less pressing, policy makers try to set income amounts for other levels of
well-being. In a cardinal utility[*] (or welfare) context, where utility u is
measured numerically, this amounts to the quest for a <u>household cost function</u>
(h.c.f.) c(u;p), that assigns money amounts c to specific welfare levels u for

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[*] We shall use the terms utility and welfare indiscriminately.

a given price structure p. In an ordinal context we have to assume
interpersonal comparability (see Sen (1976)) in order to determine the
specific household cost level corresponding to the poverty line, say
c(poverty), while the same applies for c(getting along) or c(reasonably well-
off).

Second, what is the effect of variations in _family size_ (fs) on household
costs. We assume that $c = c(u;fs,p)$ and we are looking for a family
equivalence scale defined by

(1) $c(u;p,fs)/c(u;p,fs_0) = m(u;p,fs)$

where fs_0 is the size of a reference family. We call m a _family equivalence
scale_ (f.e.s.). If m depends on u, it is called _utility-specific._ If not, it
is called a _general_ family equivalence scale [cf. Ray (1983)].

In this paper the objective will be to develop a new operational method to
derive household cost functions and family equivalence scales.

The new method compares favorably with some more traditional approaches on the
following points:

   1. it is intuitively easy to understand
   2. is is not based on any model assumptions of an arbitrary and/or ·
      paternalistic nature, while it remains an ordinal method
   3. the data collection is relatively cheap and easy.

The structure of this paper will be as follows. In Section 2 we describe the
method. In Section 3 we describe a large sample of households in eight
European countries and a small North-American sample, that we use for our
empirical illustration. In Section 4 the empirical results are presented. A
discussion of the new method and a comparison with more traditional approaches
to the problem in the literature is postponed until Section 5, after the new
method has been explained. Section 6 concludes. In the Appendix we present
empirical evidence on the ordinal comparability of our data.

As we have a cross-section at our disposal, there is no price-variation observed. Therefore we ignore the dependency of household costs on prices in this paper. If we would have price variation, the method outlined in this paper may be used as well to construct price-indices.

2. The method

In order to explain the method we need a little experiment of thought. Let us assume for a moment that utility would be cardinal, such that a utility level, numerically specified by u, had an identical emotional meaning to all individuals. Then we could ask people to estimate the household cost amount c(u) needed by them to reach utility level u. More specifically the question would be formulated as:

"What household income would you consider, in your circumstances, to be needed to reach utility level u?"

If there are N households asked to answer on such a question, they would answer $c_n(u)$ (n = 1,...,N). If we assume a measurement error ε with the usual properties, we would have $c_n(u) = c(u) + \varepsilon_n$ and a sensible estimate of c(u) would be the average answer $\bar{c}(u)$. If the question would be asked for various u-values, we would be able to estimate c(u) over a range on the u-axis. In a similar way, if we would assume a dependency on the household's family size fs it would be possible to estimate c(u;fs) from the answers $c_n(u;fs)$. In such a way we would have found the h.c.f. and f.e.s. as well.

The obvious problem with this approach is that we do not know whether two respondents attach the same feeling of well-being to a specific u-level. We rarely or never hear someone saying that he evaluates the welfare of his family by a 8 or 4 for example, although olympic scoring on a (0,10)-scale seems to have made some inroads on common language usage in the U.S.A. and some other countries. Nevertheless, we cannot assume that different respondents assign the same emotional meaning to such an evaluation degree. However, things change if we realize that people do evaluate their household welfare level fairly often in terms of "I have a good income", "My income is sufficient", "We are poor". One of the basic presumptions in a language community is that words and verbal expressions have approximately the same emotional meaning and connotation to all members of the language community. Obviously this is not perfectly true; there are many misunderstandings in verbal communications, but it is true to a reasonable extent, witness the use of language as a means of communication in business, court trials and love affairs. It follows that we can have much more faith in the comparability of

answers to the above question if we describe the utility level by <u>words</u> than if we describe it by a real number u. Indifference curves would then be labeled by words instead of by numbers. Then the question might run like this:

"What household income would you consider, in your circumstances, to be a <u>good</u> income?"

Let the answer by respondent n be $c(good;fs_n)$. Obviously we can not specify c now as a nice function of u, for u is only defined on a verbal domain, a set of verbal expressions. We can, however, study the behavior of $c(good;fs)$ as a function of fs. Applying equation (1) we would get a utility-specific family · equivalence scale $m(good;fs)$. In a similar way we might analyze the responses to a question, where u is set equal to "sufficient", "bad" etc.

There are two problems with this approach.
First, although the argument on the use of a language as an instrument of communication seems convincing, we would like some additional statistical evidence that words like "good" have a similar connotation for different members in a language community. In Section 4 and the Appendix we shall present empirical evidence on this point, from which we shall conclude that (ordinal) comparability may be assumed. At this stage we shall take it for granted.

The second problem may be that the answers of respondents do not only depend on objective factors like family size, but that they also depend on their current income y_n. To give an example, if one's income is $ 10,000 a year, there is a good chance that he will estimate a <u>good</u> income at $ 20,000, but if one's income happens to be $ 50,000 he may estimate a <u>good</u> income at $ 70,000. It looks as if there is not <u>one</u> income level (for given fs) which can be called a good income, but that to each specific level of current income y_n there corresponds a specific $c(good;fs_n,y_n)$. Although this finding is very interesting from a psychological point of view, it does not give an immediate answer to the question what is <u>the</u> level of household cost $\hat{c}(good;fs)$ for a family of size fs, such that <u>that</u> household will qualify its <u>own</u> income as representing a utility level "good". However, it may be derived in a straightforward manner.

If we know the function c(good;fs,y) we may solve the equation

(2) $\qquad \hat{c}$(good; fs) = c[good; fs, $\hat{c}$(good; fs)]

for $\hat{c}$. The solution $\hat{c}$(good; fs) gives us a family-size differentiated <u>true</u> household cost in the sense that families with income $\hat{c}$(good; fs) qualify their <u>own</u> welfare level as "good". We shall call the function c(.; ., .) a <u>virtual</u> household cost function and $\hat{c}$(.; .) the corresponding <u>true</u> h.c.f.

In a similar way we may derive $\hat{c}$(sufficient; fs) or $\hat{c}$ for any other description of a utility level. The money amounts $\hat{c}$ may be interpreted as a <u>money-metric</u> [see Samuelson (1974), Deaton and Muellbauer (1980)]. The family-equivalence index for any utility level follows automatically from (1), applied on $\hat{c}$.

3. Data

The question described in the previous section has been posed already in a lot of surveys. Since the thirties the Gallup organization asked a question running like:

"What is the smallest amount of money a family of four (husband, wife and two children) needs each week to get along in this community?"

(see Kilpatrick (1973)).

In Goedhart et al. (1977) a related but different question is described, which is sometimes posed in Europe. It runs as follows:

"We would like to know which net family income would, in your circumstances, be the absolute minimum for your household. That is to say, that you would not be able to make both ends meet if you earned less. In my (our) circumstances I consider the following net family income the absolute minimum:

.... per week/per month/per year (encircle the period)".

The latter question was also included in some recent North-American questionnaires. The difference clearly is that the latter question urges the respondent to take his own family as a frame of reference, while the former question by referring to an average family causes confusion, as every respondent will have a different "average" in mind without that the varying frame of reference is explicitized to the researcher.

In Goedhart et al. (1977) the latter question has been analyzed for Dutch data. In Colasanto et al. (1984) and Danziger et al. (1984) similar analyses have been performed on American data.

The first author of this paper introduced in 1971 the so-called Income Evaluation Question (IEQ) which is a composite question[*] running as follows:

"Please try to indicate what you consider to be an appropriate amount for each of the following cases? Under my (our) conditions I would call a net household income per week/month/year of:

about .... very bad
about .... bad
about .... insufficient
about .... sufficient
about .... good
about .... very good

Please enter an answer on each line, and underline the period you refer to".

The respondent is asked to specify the period, in order that every respondent chooses his own period of reference. The latter question has been posed in a score of large-scale surveys all over Europe, the size of which varied between 1,000 and 3,000 respondents per country.

The procedure of collecting the information was mainly dictated by strict financial conditions. In most cases the respondents have been asked at the end of a general oral interview whether they would like to fill out a trailer-questionnaire to be returned by mail. At some occasions the question has been asked in an oral interview. The IEQ has also been posed in surveys in the U.S.A. [see Colasanto et al. (1984) and Van Praag et al. (1985)].

In this paper we shall use a European data set which was collected in 1979 by means of a trailer-questionnaire, except for Ireland and Italy where an oral interview was used. [see also Van Praag et al. (1982a, b) and Hagenaars, Van Praag (1985)].
The sample used here consists of about 13,500 households and it covers the countries of the European Community at that time except the Grand Duchy of

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[*] Actually the wording and the number of levels changed a little bit over the years.

Luxembourg. Moreover we use a small sample from the Boston area, drawn in the spring of 1983, which has been made available to us by courtesy of Steven Dubnoff [see also Van Praag et al. (1985)]. The last sample is added just for illustration and to demonstrate that results on American data do not differ that much from those derived from European data, but it is not representative for the U.S.A. It has been created by Dubnoff with support of the National Science Foundation for methodological research only. As it is non-representative and much smaller than the other samples the American figures should be taken with some more caution than the others. The samples are modestly ridden by some sample selectivity. About 20% of those who returned the mail-back questionnaire did not completely respond to the six questions in the IEQ. Given the fact that response was not stimulated by oral reminders, gifts etc., we believe that this non-response level is quite acceptable. Only in Belgium it was much higher, while in Ireland and Italy, where the IEQ was in the oral interview, non-response was lower. As some background variables of the non-respondents are known it is possible by a probit-analysis to trace an income-dependency in the sense that people at the bottom and at the top of the income distribution are less inclined to respond than people in the middle quantiles. In order to account for this all observations have been reweighted by the calculated response chance such that the sample income distribution becomes representative and underrepresented classes carry more weight. The weighted sample covariance matrix is a consistent estimator of the population analogue and so are the regression coefficients. The standard deviations are assessed conservatively, that is they are probably too large. The method used is exactly described in Wesselman and Van Praag (1984), obtainable from the authors. We also attempted Heckman's method (1979), but it did not yield plausible answers, probably due to non-normality of the data (cf. Goldberger (1981)).

4. Empirical results

Let the six income levels answered by respondent n be denoted by $\{c_{in}\}_{i=1}^{6}$ then we shall estimate the following six regression equations

$$(3) \qquad \ln c_{in} = \beta_{oi} + \beta_{1i} \ln fs_n + \beta_{2i} \ln y_n + \varepsilon_{in} \qquad (i = 1,\ldots,6)$$

where we assume the error terms ε_{in} to be i.i.d. and distributed $N(0,\sigma^2)$.[*]

We anticipate the coefficients β_{1i} to be positive, as a rise in family size will increase needs as explicited by c_{in}. The coefficient β_{2i} should be positive as we expect that people with a low current income will express smaller income needs than people with a high income. The log-linear expression as such is strongly suggested by earlier work, to which we shall refer in the next section. There is no theoretical justification for the choice of the double-log relation, but only the strong empirical evidence that it fits rather well.

In Table 1 we present the (weighted) regression and correlation coefficients for the six levels for the nine countries separately. At first let us consider the statistical quality. It is seen that almost all coefficients are highly significant. The multiple correlation coefficients, being in the order of 0.5 or more, are high for large cross-sections of micro-data. So it appears that (3) provides a structural explanation of the answers to the IEQ. Indirectly, as an argument a contrario, this also supports our hypothesis that qualifications like "good" or "bad", used in the IEQ, convey approximately the same emotional connotation to all respondents. For, if all people would assign a randomly varying, haphazard connotation to the same wording the resulting responses c_{in} could not be structurally explained by two intuitively plausible factors to such an extent as Table 1 exhibits. More quantitative empirical evidence on the comparability issue is given in the Appendix.

Table 1 is very interesting as well from an economic (and psychological) point of view. At first consider β_{11} to β_{16}. It is a non-increasing sequence for

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[*] This may also be seen as a case of "seemingly unrelated regressions" [Zellner (1962)].

most countries (except for Ireland and Belgium). β_{1i} stands for the family size influence on the household cost level needed in order to reach a welfare level i. We see that at the bottom welfare level, where only bare necessities are bought, a family size effect is found, that is frequently twice as strong as at the top welfare level, that is associated with sheer luxury. The interpretation is obvious: at the bottom we have to think on first priorities like food and clothing, and those expenditure categories are strongly related with family size. At the top this relationship is much weaker, as we bother then on buying a luxurious house or a yacht, the size and cost of which does hardly depend on family size[*].

Second, it appears that there is a strong own-income-dependency at all levels and in all countries. In Van Praag (1971) this phenomenon was called preference drift. The preference drift increases in most countries with an increasing welfare level. The existence of preference drift is actually a specific instance of a general phenomenon, studied in psychophysical adaptation theory [e.g. Helson (1964)]. Adaptation theory states that people relate their judgments on the brightness of light, the loudness of sounds, etc., to an "anchor point", a level to which they are accustomed. In this case where income levels are judged the prominent anchor point is own current income. More generally, it shows that income evaluation is a relative affair and is becoming even more relative if one goes from the materially low level of "very bad" to the situation of "very good" where the pertinent choices are mainly of the type of choosing between a Jaguar or a Porsche. The intercepts $\beta_{01}, \ldots, \beta_{06}$ as such cannot be readily interpreted. Equation (3) is a local approximation and it looses all its reality when log-income tends to zero.

Applying (2) on (3) we may now derive the true household cost levels

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[*] For Ireland all coefficients β_{1i} are non-significant and mostly negative. This is probably due to two causes. First, in the Irish countryside farmer's families frequently include three generations. It is the "extended" family concept that was common in rural Europe as a whole. It follows that the sheer size of the family is a very ambiguous characteristic for Ireland. Second, in extended families of farmers, shopkeepers etc. the children and other adult family members frequently represent cheap labour. So an increase of the household is not only a cost-increasing but also a cost-reducing factor. Negativity of β_1 would indicate that the cost-reducing effect is the stronger one.

$$(4) \qquad \hat{c}(i; \text{ fs}) = \exp \left[(\beta_{0i} + \beta_{1i} \ln \text{fs})/(1 - \beta_{2i}) \right]$$

In Table 2 true household cost levels are presented for the six levels in the nine countries for a reference family of four persons. All amounts are after-tax incomes expressed in Dutch guilders (equalling about 0.5 U.S. dollar), referring to the Fall of 1979. For the U.S.A. the figures refer to after-tax incomes in 1983. The American figures ranging from 2,835 up to 146,811 strongly differ from the European figures. This has to do with a complex of reasons including European inflation rates, the exchange rate of the dollar, the difference in family allowance regimes and the non-representativeness of the Boston sample.

Obviously, the method breaks down, if $\beta_{2i} = 1$. Empirical evidence demonstrates that β_{2i} is practically always smaller than zero. Hence, we do not consider here the philosophically and psychologically interesting case of a $\beta_{2i} = 1$.

In a similar way we may now calculate the utility-specific f.e.s. m(i; fs) as

$$(5) \qquad \hat{c}(i; \text{ fs})/\hat{c}(i; 4) = \exp \left[\beta_{1i} \ln (\text{fs}/4)/(1 - \beta_{2i}) \right] = m(i, \text{ fs})$$

The values of m(i; fs) are tabulated for the six levels and the eight countries in Table 3. We see that they typically range from 0.72 to 1.21, although the variation is somewhat more at the lower end of the scale. For practical purposes it seems acceptable to use an average general index which may be taken to correspond with the third welfare level.
A peculiar problem which we shall not try to solve here, but which is certainly important if the method outlined here is refined for political applications, is caused by the existence of family allowances in most countries. We observe, that they are mainly not included in the monthly payment by the employer. Also they are frequently paid quarterly instead of monthly or weekly. It follows that the responses to the IEQ are probably given in terms of regular payment, that is after-tax household income net of family allowances, but that the answers are nevertheless tacitly conditioned by the prevailing family allowance (see also Kapteyn, Kooreman and Willemse (1986)). It implies that the household cost estimates are in terms of net income (where family allowances are ignored), but given the fact that the state pays a family allowance in addition to it. If family allowances, mostly proportional

to family size, are added to the reported household cost estimates, it follows that the then resulting household cost amounts are somewhat higher and that the f.e.s. becomes somewhat more pronounced at lower levels of welfare.

TABLE 1. Equation (3) estimated for 9 countries at 6 levels[*]

Belgium (N ≈ 1600)

Level	β_0	β_1	β_2	R^2
1	5.482 (0.338)	0.274 (0.034)	0.221 (0.044)	0.289
2	5.622 (0.295)	0.288 (0.029)	0.228 (0.038)	0.355
3	5.173 (0.309)	0.248 (0.029)	0.310 (0.040)	0.404
4	5.909 (0.431)	0.253 (0.031)	0.254 (0.054)	0.353
5	5.832 (0.446)	0.265 (0.037)	0.281 (0.057)	0.407
6	5.698 (0.518)	0.264 (0.042)	0.330 (0.066)	0.407

Denmark (N ≈ 2300)

Level	β_0	β_1	β_2	R^2
1	4.513 (0.401)	0.202 (0.027)	0.540 (0.037)	0.543
2	4.389 (0.393)	0.198 (0.025)	0.565 (0.037)	0.635
3	4.307 (0.404)	0.197 (0.025)	0.583 (0.038)	0.648
4	4.544 (0.377)	0.199 (0.024)	0.579 (0.035)	0.645
5	4.784 (0.370)	0.186 (0.023)	0.575 (0.034)	0.652
6	5.029 (0.374)	0.174 (0.024)	0.572 (0.035)	0.575

France (N ≈ 2700)

Level	β_0	β_1	β_2	R^2
1	4.520 (0.103)	0.157 (0.015)	0.381 (0.013)	0.357
2	4.707 (0.233)	0.152 (0.018)	0.387 (0.029)	0.391
3	4.720 (0.095)	0.149 (0.013)	0.410 (0.012)	0.418
4	5.003 (0.097)	0.137 (0.014)	0.410 (0.012)	0.401
5	5.252 (0.101)	0.115 (0.014)	0.409 (0.012)	0.369
6	5.463 (0.271)	0.079 (0.021)	0.416 (0.033)	0.298

W-Germany (N ≈ 2220)

Level	β_0	β_1	β_2	R^2
1	6.299 (0.343)	0.262 (0.023)	0.277 (0.035)	0.280
2	6.541 (0.329)	0.260 (0.023)	0.274 (0.034)	0.330
3	6.885 (0.361)	0.281 (0.023)	0.252 (0.037)	0.316
4	6.830 (0.324)	0.260 (0.021)	0.284 (0.034)	0.384
5	7.266 (0.338)	0.238 (0.022)	0.264 (0.035)	0.327
6	7.569 (0.341)	0.219 (0.023)	0.261 (0.035)	0.280

* Level 1 stands for "very bad". The figures in parentheses are (weighted) standard deviations. As each level equation was estimated for the responses for that level, the response numbers vary per level. The N presented is the approximate average of all response numbers in that country.

Ireland (N ≈ 2300)

Level	β_0	β_1	β_2	R^2
1	2.772 (0.407)	−0.036 (0.100)	0.595 (0.063)	0.400
2	2.643 (0.454)	−0.080 (0.120)	0.642 (0.073)	0.398
3	4.297 (1.032)	0.131 (0.122)	0.419 (0.141)	0.384
4	3.487 (0.362)	−0.062 (0.108)	0.585 (0.059)	0.394
5	4.128 (0.625)	−0.042 (0.126)	0.535 (0.092)	0.370
6	3.968 (0.538)	−0.082 (0.115)	0.589 (0.081)	0.346

Italy (N ≈ 2520)

Level	β_0	β_1	β_2	R^2
1	6.747 (0.387)	0.216 (0.023)	0.292 (0.036)	0.231
2	7.156 (0.569)	0.193 (0.020)	0.283 (0.052)	0.289
3	7.148 (0.390)	0.199 (0.018)	0.299 (0.036)	0.307
4	7.137 (0.357)	0.176 (0.017)	0.333 (0.033)	0.361
5	7.269 (0.271)	0.146 (0.016)	0.352 (0.025)	0.400
6	7.461 (0.429)	0.135 (0.021)	0.364 (0.040)	0.321

Netherlands (N ≈ 2160)

Level	β_0	β_1	β_2	R^2
1	5.135 (0.325)	0.175 (0.016)	0.417 (0.033)	0.423
2	5.143 (0.546)	0.160 (0.020)	0.434 (0.055)	0.503
3	4.840 (0.587)	0.148 (0.020)	0.479 (0.060)	0.542
4	4.893 (0.791)	0.140 (0.026)	0.497 (0.080)	0.548
5	5.276 (1.157)	0.136 (0.036)	0.478 (0.118)	0.506
6	3.943 (0.431)	0.090 (0.018)	0.634 (0.044)	0.520

United Kingdom (N ≈ 1950)

Level	β_0	β_1	β_2	R^2
1	5.578 (0.218)	0.247 (0.028)	0.218 (0.027)	0.186
2	5.566 (0.218)	0.237 (0.026)	0.247 (0.027)	0.234
3	5.388 (0.233)	0.213 (0.022)	0.293 (0.029)	0.263
4	5.662 (0.237)	0.186 (0.021)	0.300 (0.030)	0.292
5	5.915 (0.275)	0.173 (0.022)	0.294 (0.034)	0.260
6	5.406 (0.248)	0.121 (0.027)	0.389 (0.031)	0.238

U.S.A. Boston Area (N ≈ 480)

Level	β_0	β_1	β_2	R^2
1	2.534 (0.352)	0.140 (0.040)	0.657 (0.037)	0.565
2	2.875 (0.317)	0.132 (0.032)	0.649 (0.033)	0.660
3	3.138 (0.247)	0.142 (0.024)	0.650 (0.026)	0.763
4	3.110 (0.261)	0.100 (0.024)	0.684 (0.027)	0.763
5	3.482 (0.330)	0.104 (0.030)	0.671 (0.034)	0.674
6	3.765 (0.455)	0.094 (0.038)	0.672 (0.047)	0.500

TABLE 2. True Annual Household Cost Levels (1979) in D.Fl.*
(for a 4-persons household)

Levels	Countries Belgium	Denmark	France	W-Germany	Ireland	Italy	Netherlands	United Kingdom	Boston Area
1	12,701	12,726	9,984	11,123	3,427	5,034	10,097	8,270	7,655
2	16,713	17,114	14,390	14,935	4,860	7,513	13,169	10,665	16,340
3	20,401	22,415	20,058	18,687	9,231	9,561	16,171	13,153	36,944
4	30,322	35,506	31,641	25,523	15,144	15,463	24,515	19,093	78,308
5	38,379	54,066	44,537	33,625	26,393	24,498	34,973	26,017	164,230
6	54,893	85,099	65,442	46,947	48,735	40,353	67,703	38,757	396,390

* All amounts are after-tax incomes in Dutch guilders (1979), net of family allowances.
In October 1979 the American dollar was about two Dutch guilders, in Spring 1983 the American dollar was about Dfl. 2,70 and probably overvalued for the comparison of living costs.

TABLE 3. Family equivalence scales (base fs=4)[*]

Belgium

Level	fs=2	fs=3	fs=5	fs=6
1	0.78	0.90	1.08	1.15
2	0.77	0.90	1.09	1.16
3	0.78	0.90	1.08	1.16
4	0.79	0.91	1.08	1.15
5	0.77	0.90	1.09	1.16
6	0.76	0.89	1.09	1.17

Denmark

Level	fs=2	fs=3	fs=5	fs=6
1	0.74	0.88	1.10	1.19
2	0.73	0.88	1.11	1.20
3	0.72	0.87	1.11	1.21
4	0.72	0.87	1.11	1.21
5	0.74	0.88	1.10	1.19
6	0.75	0.89	1.09	1.18

France

Level	fs=2	fs=3	fs=5	fs=6
1	0.84	0.93	1.06	1.11
2	0.84	0.93	1.06	1.11
3	0.84	0.93	1.06	1.11
4	0.85	0.94	1.05	1.10
5	0.87	0.95	1.04	1.08
6	0.91	0.96	1.03	1.06

W-Germany

Level	fs=2	fs=3	fs=5	fs=6
1	0.78	0.90	1.08	1.16
2	0.78	0.90	1.08	1.16
3	0.77	0.90	1.09	1.16
4	0.78	0.90	1.08	1.16
5	0.80	0.91	1.07	1.14
6	0.81	0.92	1.07	1.13

Ireland[*]

Level	fs=2	fs=3	fs=5	fs=6
1	1.06	1.03	0.98	0.96
2	1.17	1.07	0.95	0.91
3	0.86	0.94	1.05	1.10
4	1.11	1.04	0.97	0.94
5	1.06	1.03	0.98	0.96
6	1.15	1.06	0.96	0.92

Italy

Level	fs=2	fs=3	fs=5	fs=6
1	0.81	0.92	1.07	1.13
2	0.83	0.93	1.06	1.12
3	0.82	0.92	1.07	1.12
4	0.83	0.93	1.06	1.11
5	0.86	0.94	1.05	1.10
6	0.86	0.94	1.05	1.09

* See previous footnote on Irish family size effects.

Netherlands					United Kingdom				
Level	fs=2	fs=3	fs=5	fs=6	Level	fs=2	fs=3	fs=5	fs=6
1	0.81	0.92	1.07	1.13	1	0.80	0.91	1.07	1.14
2	0.82	0.92	1.07	1.12	2	0.80	0.91	1.07	1.14
3	0.82	0.92	1.07	1.12	3	0.81	0.92	1.07	1.13
4	0.82	0.92	1.06	1.12	4	0.83	0.93	1.06	1.11
5	0.83	0.93	1.06	1.11	5	0.84	0.93	1.06	1.10
6	0.84	0.93	1.06	1.10	6	0.87	0.94	1.05	1.08

U.S.A., Boston area				
Level	fs=2	fs=3	fs=5	fs=6
1	0.75	0.89	1.10	1.18
2	0.77	0.90	1.09	1.16
3	0.75	0.89	1.09	1.18
4	0.80	0.91	1.07	1.14
5	0.80	0.91	1.07	1.14
6	0.82	0.92	1.07	1.12

5. Discussion and evaluation

As the method outlined above is rather novel it deserves a somewhat broader discussion than usual. It seems useful to split the discussion into two parts. First, we compare this method with the classical and neo-classical methods known in the literature. Second, we compare the method to earlier work by the first author, Kapteyn and others.

In the literature we find several approaches varying in degree of sophistication:

1. The first approach is what may be called the political approach. Politicians and/or experts like nutritionists and sociologists describe a level of well-being in physical terms, e.g. a state of poverty. Second, they define an income level needed to reach that level. Third, they define an equivalence scale.
   This method which is most popular when applied to the state of poverty, is followed for instance by writers like Townsend (1979), Rowntree (1901), and Orshansky (1965), on whose work the official U.S. poverty line is based.

   This method is rather aprioristic. If there is agreement on what is "poor", then the method may be excellent for counting the poor, but it does not help us to define poverty to begin with. That has already been agreed upon before the study started [see also Hagenaars, Van Praag (1985)]. Similar observations hold for the construction of equivalence scales. They are given to begin with. The approach may be honorable for political purposes, and like many intuitive methods may not be too far off from results derived by sophisticated empirical methods, but from the point of positive science they are not very relevant.

2. The second approach in this field is what may be called the Engel approach, recently stressed by Deaton and Muellbauer (1986), Muellbauer (1977). Its main idea is that the food-share w_f in a household budget, which decreases monotonically with increasing income according to Engel's Law, may be considered as a utility index. Consider then $w_f(y; fs)$ or rather its inverse $y(w_f; fs)$. It may be seen as a household cost function, where the degree of household welfare is described by the food-share. So we might

speak of a welfare level corresponding to a food-share of 1/3 as rather poor and of a level corresponding to a food-share of 1/6 as rather well-to-do. The utility-specific f.e.s. is defined by

$$m(w_f; \text{ fs}) = \frac{y(w_f; \text{ fs})}{y(w_f; 4)}.$$

In this approach there is a basic difficulty. Actually w_f is a utility measure and the question is whether we accept it as meaningful? The question boils down to the issue whether w_f unambiguously describes a situation which has the same emotional meaning of hardship to most citizens. In short is it ordinally comparable? Personally, we are willing to go along with this idea if we consider a population where the households acquire their consumption on the market or, if not, the ratio between market and non-market household consumption is about equal in all parts of the population. This excludes the method for societies where there is a considerable home production in some households and none in others. A similar proviso holds for our own method outlined above.

There are also problems with respect to the technicalities.
First, there is the question "what is food?" Does it cover only cheap bread or also expensive bread, non-alcoholic beverages or also beer, wine etc. The definition of "food", and consequently of the food-share involves a lot of arbitrary elements both for the interpretation of the h.c.f. and the resulting f.e.s. If the expenditure category is widened from "food" to include "food and clothing" or even larger, it comprises almost everything, and w_f would tend to one. Hence the problem of defining "food" is not irrelevant. If it is defined too narrowly, the results are more or less arbitrary depending on the definition, and if it is taken too widely the food-share concept does not differentiate any more and its interpretation becomes blurred. The same difficulties are met if one uses the complementary approach, based on the definition of adult goods. [cf. Nicholson (1949)]

The second technical problem is that it is based on income-demand curves which can only be meaningfully derived from a data set on individual household budgets. The collection of such data is painful as many individuals, who do not have very rational consumer habits and do have a

somewhat haphazard spending pattern, are also not inclined to participate in the rather demanding exercise of self-observation and self-registration, which a household budget survey usually stands for. In short, the risk is rather high, that the sample may be accurate but not representative for the population it aims to represent, as there is a considerable rate of systematic refusals.

The third problem with this method is rather down-to-earth. An extensive budget survey is very costly [see also Van Praag, Spit, Van de Stadt (1982), Hagenaars and Van Praag (1985)].

It is obvious that the method outlined in the previous sections does not suffer from those elements of arbitrariness. With respect to the required data set it is evident, that it causes much less systematic refusal as it requires answering only a few simple questions. Moreover as the questions, as experience shows, may be posed as part of any questionaire (oral, written or even, as performed in the Netherlands twice in recent years, by means of a survey in a newspaper!) the collection of this type of data is much less costly than the creation of a detailed budget survey.

3. The third approach in this field originated by Barten (1964) employs the established ordinal theory of consumer behavior. A family-dependent utility function is maximized. A prominent development in this line is the AIDS-model of Deaton and Muellbauer. Then the demand functions and the resulting household cost function also contain family size as a parameter. With suitable functional specifications it is possible to derive equivalence scales.

The data requirements for the third approach are the same as for the second approach. In addition to it strong postulates are made on the optimizing rational behavior of consumers and on the functional specification of the household cost function and the resulting indirect utility function.

Finally, let us compare these results with earlier work, in which the authors were involved. In earlier work [Van Praag (1971), Van Praag, Kapteyn (1973), Kapteyn, Van Praag (1976)] the answers $\ln c_1, \ldots, \ln c_6$ have been used to fit a cardinal utility function. That function was specified as a lognormal

distribution function that is

$$U = N \left(\frac{\ln c - \mu}{\sigma}; \ 0,1\right)$$ where N stands for a standard-normal distribution

function. The parameter μ was estimated per individual t
as $\mu_t = 1/6 \ \Sigma_{i=1}^{6} \ \ln c_{it}$. Assuming σ to be constant and μ_t to depend on y_t and
fs_t according to the relationship

$$(6) \qquad \mu_t = \beta_0 + \beta_1 \ \ln fs_t + \beta_2 \ \ln y_t$$

it follows that the constraint $\ln y_t - \mu_t = \ln y_t - \beta_0 - \beta_1 \ln fs_t - \beta_2 \ln y_t =$ constant defines the compensation for a change in family size to keep utility of current income constant. This yields results, analogous to those in Section 4. From the results in this paper and given the evidence presented in the Appendix it actually follows that the cardinal context, which has been used in earlier work, is not needed at all in order to derive results on equivalence scales. It follows that all previous results [see also Goedhart et al. (1977), Van Praag et al. (1980, 1982a, b)] could have been derived in an ordinal context as well. Then the effects there derived have to be interpreted as "average" effects, since μ actually is the average of $\ln c_1,\ldots,\ \ln c_6$; summing up the six equations

$$(7) \qquad \ln c_{it} = \beta_{0i} + \beta_{1i} \ \ln fs_t + \beta_{2i} \ \ln y_t \qquad\qquad (i = 1, \ldots, 6)$$

and division by 6 yields

$$\mu_t = 1/6 \ \Sigma_{i=1}^{6} \ \beta_{0i} + 1/6 \ \Sigma_{1}^{6} \ \beta_{1i} \ln fs_t + 1/6 \ \Sigma_{1}^{6} \ \beta_{2i} \ \ln y_t$$

$$= \beta_0 + \beta_1 \ \ln fs_t + \beta_2 \ \ln y_t$$

This ordinal re-interpretation of equivalence scales based on μ may also be applied on the first results on μ derived for a North-American sample [Colasanto et al. (1984)], which appear to be very similar to those derived for European data sets [see also Danziger et al. (1984)].

6. <u>Conclusion</u>

Summarizing the paper, it seems that a very general, easy and not costly method has been found to derive household cost functions and family equivalence scales that involves less postulates than traditional methods, while remaining ordinal at the same time. The results are pretty stable all over Europe. In three American surveys [viz. Colasanto et al. (1984), and Danziger et al. (1984)] similar results have been found. The advantages mentioned before and all this empirically consistent evidence point in the direction of further research which will have as a necessary prerequisite the introduction of the IEQ in household surveys as a routine question [see also Danziger et al. (1984)].

In this paper we concentrate on the basic methodology. However, we may ask now whether c_{in} may depend on other factors than fs_n and y_n as well. For instance, we may think of health, housing, public services, the price level, climate, etc. This would open the possibility to construct equivalence scales for those factors as well. Another way of research is indicated by the suspicion that we may assume that virtual costs depend also on our neighbour's income $y_{n'}$. Say,

$$\ln c_{in} = \beta_{0i} + \beta_{1i}\ln fs + \beta_{2i}\ln y_n + \beta_{3i}\ln y_{n'}$$

Then the obvious idea is that $\beta_{3i} > 0$. If our neighbor becomes more well-to-do we need more as well. This phenomenon has been called reference drift (see for instance Kapteyn (1977)). However, as $y_{n'}$ is an exogenous variable for the respondent, it can be dealt with just as with fs, etc. This suggests that the IEQ may also be used to track sociological relationships between individuals and their social environment. Finally, the responses on the IEQ may be made dependent not only on current income, but also on past incomes and even on income levels anticipated in the future. First estimates of such a relationship are given by Van Praag, Van Weeren (1987).

Appendix: On the Ordinal Comparability of the Answers

In this Appendix we shall give additional evidence for our statement that verbal labels like "a good income" are ordinally comparable among respondents belonging to the same language community.

We denote the vector of ordered verbal labels in the IEQ by L (= $L_1,\ldots,L_k$). The individual response is a vector of virtual cost levels c (= $c_1,\ldots,c_k$). In the samples considered k = 6. Actually, each individual n maps L into c by a mapping $c^{(n)} = \phi^{(n)}(L)$. As the responses vary, $\phi^{(n)}(.)$ varies over n as well. This may be due either to objective differences in individual variables like income, family size, or generally a vector X_n or to inter-respondent differences in how the verbal labels are interpreted. Let us write $c^{(n)} = \phi^{(n)}(L; X_n)$. Both effects can be separated by rewriting $\phi^{(n)}$ as

$$(A.1) \qquad c^{(n)} = \phi(\rho^{(n)}(L); X_n).$$

If $\rho^{(n)}(.)$ is constant over individuals n, there are no differences in interpretation of the verbal labels between individuals. One of the easiest specifications of (A.1) is

$$(A.2) \qquad \ln c_i^{(n)} = \alpha_n u_{in} + \beta_n \qquad (i = 1,\ldots,k)$$

where (α_n, β_n) depend on X_n in a way that is irrelevant for this analysis and where the dependency on the specific levels i is reflected through u_{in}. Obviously u_{in} may be replaced by $\tilde{u}_{in} = \gamma u_{in} + \delta$ without spoiling (A.2). We assume that γ and δ are chosen such that $\tilde{u}_{in}$ fulfills the requirement that it has zero mean and unit variance, i.e. $\frac{1}{K} \Sigma \tilde{u}_{in} = 0$ and $\frac{1}{K} \Sigma \tilde{u}_{in}^2 = 1$. It is obvious that for that choice $\frac{1}{K} \Sigma \ln c_i^{(n)} = \beta_n$ and $\frac{1}{K} \Sigma(\ln c_i^{(n)} - \beta_n)^2 = \alpha_n^2$ hold.

Hence α_n and β_n may be estimated per individual by $\hat{\alpha}_n$, $\hat{\beta}_n$, being the mean and variance of $\{\ln c_i^{(n)}\}_{i=1}^k$. Then we may assess u_{in} for each respondent by

$$u_{in} = \frac{\ln c_i^{(n)} - \beta_n}{\alpha_n} \qquad i = 1,\ldots,K.$$

It is evident that there are no interpretation differences, if u_{in} does not depend on n, i.e. if $u_{in} = u_i$. We calculated the average of u_{in} and its

standard deviation over the sample. They are presented for the American dataset in Table A.1.[*].

TABLE A.1. Average u-levels and N(u)-levels and their sample deviations.

u_i	$\sigma(u_i)$	$N(u_i) = \hat{u}_i$	$\sigma(\hat{u}_i)$
−1.29	0.24	0.10	0.04
−0.78	0.19	0.22	0.06
−0.26	0.24	0.40	0.09
0.26	0.24	0.60	0.09
0.76	0.19	0.77	0.06
1.31	0.24	0.90	0.04
			(N = 453)

From the empirical results we conclude that the sample deviations over individuals are such that u_{in} may be considered as a constant except for random fluctuations. It is remarkable how symmetric about zero the answers are. The u_i's may be seen as a numerical translation of the verbal labels. Actually, it is an ordinally comparable utility index, attaining values on $(-\infty, +\infty)$. Then we may also attach an unambiguous utility meaning to any interpolated value, say $\frac{1}{2}(u_i + u_{i+1})$ etc.

Obviously, if u is an ordinal utility index, any $\hat{u} = \psi(u)$ with ψ a monotonous function is a utility index as well. Especially if ψ is taken to be the standard normal distribution function, i.e. $\hat{\psi} = N(u; 0,1)$, $\hat{u}$ is a utility index as well, that varies between zero and one. The same utility index is then described by

(A.3) $U(c) = N(\ln c; \mu_n, \sigma_n)$

where $\mu_n = \beta_n$ and $\sigma_n = \alpha_n$. If u is ordinally comparable, the same holds for and for U(c). It is the latter cardinalization which yields a lognormal

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* For the analysis we used only the 453 complete responses to IEQ in the USA-sample. For the other European data sets we found similar results.

welfare function.

Finally why is this surprising result that u_i is roughly constant over individual responses plausible in some sense? Let us assume that notions on what is a "good" or "bad" income are determined as rankings in an income distribution. That is, a level i is associated with an income c_i such that a fraction p_i in the income distribution is below c_i and $(1-p_i)$ above it.*

So c_i is the solution of the equation $F(c_i) = p_i$ where $F(.)$ stands for the income distribution function. If every individual has its own perception of the income distribution function, say $F_n(.)$ and when F_n is approximately lognormal (like any income distribution) with parameters (μ_n, σ_n) we have (see Aitchison and Brown (1954))

(A.4) $\ln c_{in} = \mu_n + u_i \sigma_n$

where u_i is the solution of $N(u_i; 0, 1) = p_i$ where $N(.; 0, 1)$ is the standard normal distribution function.
Related ideas may be found in Kapteyn (1977), Layard (1980), Van Praag (1981) and more vaguely in Duesenberry (1949), Scitovsky (1976).

Finally (A.4) demonstrates how to "interpolate" between the welfare levels i = 1,...,k. We replace u_i, corresponding to a supplied verbal label, by another value say u. That may be a value known to correspond with another verbal label. However, when working with those u-values or the corresponding fractions $p = N(u; 0, 1)$ we also get feeling for what numerical u-values stand for, just as we know from experience which climatic condition a temperature of 80° F. presents.

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* A well-known poverty line is determined as the lowest 20% quantile of the income distribution making poverty a purely relative concept.

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        pages.

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        66 pages.

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8614/A **L. de Haan and S. Resnick**, "On regular variation of probability
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