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THE POVERTY LINE: CONCEPT AND MEASUREMENT*

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ABSTRACT

In this paper, a new approach to defining the poverty line is proposed in which family heads are asked what they consider a minimal income level for their own family. It was found that the respondents appeared to specify higher amounts, the greater their actual income and family size, and that the relationship was loglinear. For each family size there is an income level at which a respondent's stated minimum income is equal to his actual income. This level is taken as a definition of the poverty line. The poverty line thus defined varies with family size.

I. INTRODUCTION

The primary aim of this paper is to propose a new way of defining the poverty line. As an illustration of our approach, quantitative estimates are developed for a particular case—The Netherlands, January 1975. Our method starts with a subjective approach: We ask a representative sample of people what they consider to be the minimum income at which they still could make ends meet. The respondents' answers are positively related to their own income and to the size of their family. For each family size, there is an income level at which the typi-

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cal respondent's stated minimum is equal to his actual income. This level is taken as a definition of the poverty line. The poverty line thus defined varies with family size.

In the following two sections, we review the principal current scientific approaches to defining the poverty line. In order to determine what subjective feelings the respondents attach to various income levels, the concept of the individual welfare function of income is employed, and this concept is explained in Section IV. In Section V we describe the sample and present some empirical results with respect to the individual welfare function of income and the minimum income stated by the respondents. In Section VI the poverty line is defined in the way described above. Estimates of the poverty line for The Netherlands are presented in Section VII. In the eighth section we briefly discuss an alternative method, and we present some conclusions in Section IX.

The quantitative outcomes can be refined by complicating the model presented in Sections V and VI and by drawing larger samples. Therefore, we ask the reader to look upon the empirical results primarily as an *illustration* of the proposed methodology.

II. THE ECONOMIC DEFINITION OF POVERTY

In this paper, we are adopting the so-called *economic definition of poverty* as presented in Watts [28]. He considers poverty to be "a property of the individual's situation, rather than a characteristic of the individual or of his pattern of behavior" (p. 321). This viewpoint leads to a definition of poverty as a situation in which the consumption set of the individual is severely constricted, while affluence is defined as a situation in which there is little constriction of the consumption set. In simpler language, we may say that welfare is defined in terms of command over real goods and services—command over resources, for short. The less command one has over resources, the less welfare one enjoys; that is, the poorer one is. Poverty is then defined as a situation where command over resources falls below a certain level, *the poverty line*.

The economic definition of poverty does not attach welfare levels to a specific commodity bundle. Because of different tastes, different individuals will choose different commodity bundles from a certain consumption set. Thus, this definition does not impose any kind of standard behavior on individuals. For example, an individual A who prefers a situation with a low income and much leisure is not poorer than individual B who has a high income and not much leisure whenever the income-leisure combination of individual B is attainable for individual A. Still, the economic definition of poverty involves an element of interpersonal welfare comparison since it is assumed that when these two individuals, A and B, are able to attain the same income-leisure combination, they will be equally well off.

The operationalization of the concept “command over resources” causes a number of problems. The commonly used proxy, annual income, is a very crude measure. At a minimum, one would like to consider after-tax rather than before-tax income. In addition, the researcher has to take into account the size of a family that has to share a given income (compare, for example, Jackson [10], Seneca and Taussig [26], Fiegehen and Lansley [6], Nicholson [16]). Moreover, a family’s income is also a reflection of the taste for leisure versus income (Garfinkel and Haveman [7]). Another problem is that both the human and nonhuman capital of a family should be taken into account, which necessitates the introduction of life-time aspects (see, for example, Weisbrod and Hansen [29] and Habib, Kohn, and Lerman [8]). Taussig [27] and Plotnick [18] provide a fuller discussion of these and related problems.

In the present paper, we will not consider all the problems mentioned so far; rather, we will restrict ourselves to a definition of poverty in terms of current after-tax disposable family income. However, with respect to the problem of properly accounting for family-size differences, our solution will emerge from the analysis presented in the following sections.

III. DIFFERENT APPROACHES TO THE ASSESSMENT OF THE POVERTY LINE

Assume that for any two individuals in a given society, we are able to identify which individual’s command over resources is the larger. Thus, we can rank all individuals in society as to the degree of their “poorness.” Do we then also know who is poor and who is not poor? Evidently the answer is negative. We still have to define the level of the poverty line, that is, the level of command over resources below which an individual is poor.

The assessment of a poverty line involves some kind of political decision, for, from the perspective of social policy, the poverty line represents a criterion by which it can be decided which citizens need special benefits from the government to supplement their own incomes. Hence, we have to analyze under what conditions and under what premises society is willing to devote special attention to some of its poor citizens.

We shall look briefly at four different procedures for the assessment of a poverty line. For each, we point out some of the measurement problems involved, and we indicate to what extent there must be reliance on some kind of interpersonal welfare comparison.

The first approach is to leave the establishment of a poverty line entirely to politicians. For example, according to Atkinson’s definition [1], people are poor when they are eligible for supplementary benefits from the government. This approach seems to involve no measurement problems whatever. The amount of interpersonal welfare comparison is almost maximal. Politicians

simply decide, intuitively or on the basis of pressure from constituents, when an individual's circumstances become unbearable.

The second approach is to inquire what a "representative citizen" considers to be the minimum level of command over resources. Here the analyses by Kilpatrick [12] and Rainwater [23] are of interest. They analyze a number of Gallup polls in which respondents were asked "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?" The average of the answers to this question can be viewed as the respondents' perception of what the level of the poverty line should be. The measurement problems here are of the usual type: possible misunderstanding by the respondent of the proper income concept, interaction between interviewer and respondent, etc. The amount of interpersonal welfare comparison involved is considerable, as the respondents have to judge what a certain income means for others.

The third approach aims at an "objective" definition of the poverty line. We may call this the "subsistence-level" definition. The underlying idea is that a human being has certain basic needs which have to be satisfied—food, clothing, housing, etc. Accordingly, the problem is conveyed to experts who have to measure these basic needs. The pioneering study using this approach is by Rowntree [24], but perhaps the best-known recent study based on the subsistence-level definition is the one by Orshansky [17]. It appears that a number of arbitrary steps must be taken in measuring basic needs, and it may be said that the whole procedure rests to a large extent on interpersonal welfare comparisons by the experts who have to define the needs. Detailed criticisms of this procedure may be found in Rein [25] and Atkinson [2].

A fourth approach consists of asking people what they consider a minimal level of income for themselves. The measurement problems are similar to those of the second approach, and, in addition, one has to assume that people do not deliberately misrepresent their preferences. On the other hand, there is less need for interpersonal welfare comparisons. We will not go into detail here since this fourth approach will be elaborated in Sections V and VI.

Each of the approaches discussed so far involves interpersonal welfare comparisons. In all of them, poverty is defined by a low value of a particular welfare measure, the main difference being the type of welfare measure used to compare the situation of different individuals. In the next section we discuss more explicitly the welfare comparisons inherent in the definition of the poverty line.

IV. THE INDIVIDUAL WELFARE FUNCTION OF INCOME

As a welfare measure, we use the so-called *individual welfare function of income*, introduced and elaborated upon by van Praag [20, 21] and van Praag and

Kapteyn [22].¹ This function describes the welfare evaluation of income levels by an individual and is measured by asking him the following question:

In answering the following question it is advisable to start with the underlined words. Try at any rate to fill in all amounts asked for to the best of your judgment.

Taking into account my (our) present living circumstances, I would regard a net weekly/monthly/yearly (encircle the period) family income as:

excellent	if it were above	_____	
<u>good</u>	if it were between	_____	and _____
amply sufficient	if it were between	_____	and _____
sufficient	if it were between	_____	and _____
<u>barely sufficient</u>	if it were between	_____	and _____
insufficient	if it were between	_____	and _____
very insufficient	if it were between	_____	and _____
<u>bad</u>	if it were between	_____	and _____
very bad	if it were below	_____	

We call this the *income-evaluation question*.

The verbal evaluations (good, sufficient, bad, etc.) are transformed into numbers on a zero-one scale by identifying these evaluations with equal quantiles. In this way one obtains points on a graph of the individual's welfare function. According to the theory outlined in van Praag [20], the answers to the income-evaluation question will follow a definite pattern. More precisely, the evaluation of $U(z)$ (on a zero-one scale) of an income z is fairly well approximated by:

$$(1) \quad U(z) = (1/\sigma\sqrt{2\pi}) \int_0^z (1/t) \exp\{-1/2[\ln(t) - \mu]/\sigma\}^2 dt \\ \equiv \Lambda(z; \mu, \sigma) \equiv N[\ln(z); \mu, \sigma]$$

where $\Lambda(.; \mu, \sigma)$ is the lognormal distribution function with parameters μ and σ and $N(.; \mu, \sigma)$ is the normal distribution function with mean μ and variance σ^2 .² The parameters μ and σ are estimated from the income-evaluation question for each respondent separately.³

1 We shall often refer to this measure as the welfare function. When we refer to income, in all cases we mean disposable family income.

2 In the sequel we use the following properties of the normal and lognormal distribution function: $N(x; \mu, \sigma) = N(x - \mu; 0, \sigma) = N[(x - \mu)/\sigma; 0, 1]$. So, if $z = \exp(x)$ (i.e., $x = \ln(z)$), we have

$$\Lambda(z; \mu, \sigma) = \Lambda[(z/e^\mu); 0, \sigma] = \Lambda[(z/e^\mu)^{1/\sigma}; 0, 1]$$

3 Denoting the amount in the left-hand column in the i th row of the income evaluation question by z_i and the corresponding evaluation by $U(z_i)$, we obtain a sequence $[z_i, U(z_i)]_{i=1}^8$. Note that the amount in the ninth row may be discarded since it will be equal to the amount in the eighth row. According to an information-maximization argument, the qualification "excellent" is identified with $U(z_1) \equiv 0.888$, the qualifi-

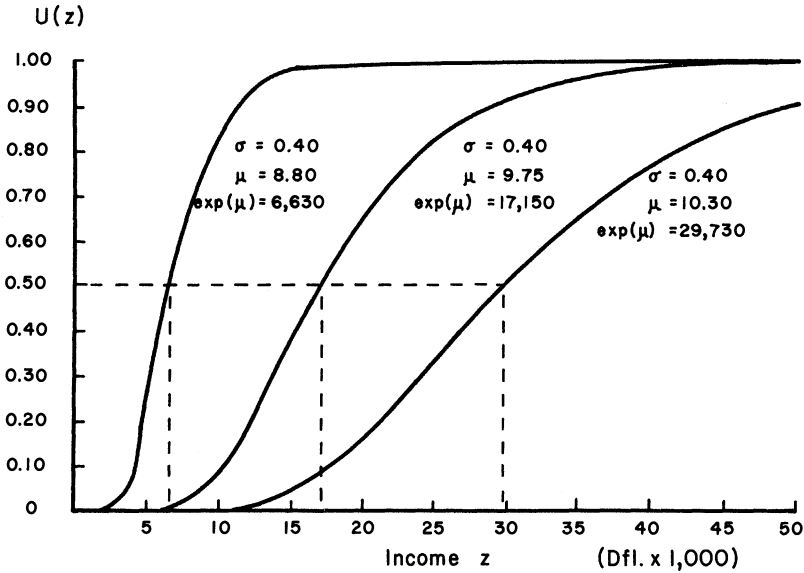


FIGURE 1
 THE INDIVIDUAL WELFARE FUNCTION OF INCOME FOR SOME VALUES OF μ
 (In the present sample the mean value of μ is equal to 9.75
 with a sample standard deviation of 0.33.)

In the present nonstochastic context, the parameters μ and σ of the log-normal distribution function have a psychological rather than a statistical meaning. These so-called *welfare parameters* differ between individuals. In the aforementioned papers, a rather extensive interpretation of μ and σ is given.

The quantity $\exp(\mu)$ is the income level which is evaluated by 0.5 (see Figure 1). It is the median value of the lognormal distribution function. If individual A has a higher μ (and consequently a higher $\exp(\mu)$) than individual B, then A needs more income to reach a certain evaluation level than does B. The quantity $\exp(\mu)$ has been called the *natural unit of income* (for a motivation of the term, see van Praag [20, p. 37]). It may be viewed as a want parameter.

The parameter σ determines the slope of the welfare function around the median value $\exp(\mu)$ (see Figure 2). The smaller an individual's σ , the steeper his welfare function will be. The parameter σ has been called the *welfare sensitivity* (van Praag [20, p. 38]).⁴

cation "good" is identified with $U(z_i) \equiv 0.777$, etc. In general, $U(z_i) = (9 - i)/9$ ($i = 1, \dots, 8$). Since $U(z_i) = N[\ln(z_i) - \mu]/\sigma; 0, 1]$, the parameters μ and σ can be estimated from the eight points $[z_i, U(z_i)]_{i=1}^8$.

4 Since σ plays only a minor role in the subsequent analysis, we abstain from a further interpretation. We refer to van Praag and Kapteyn [22] for more details.

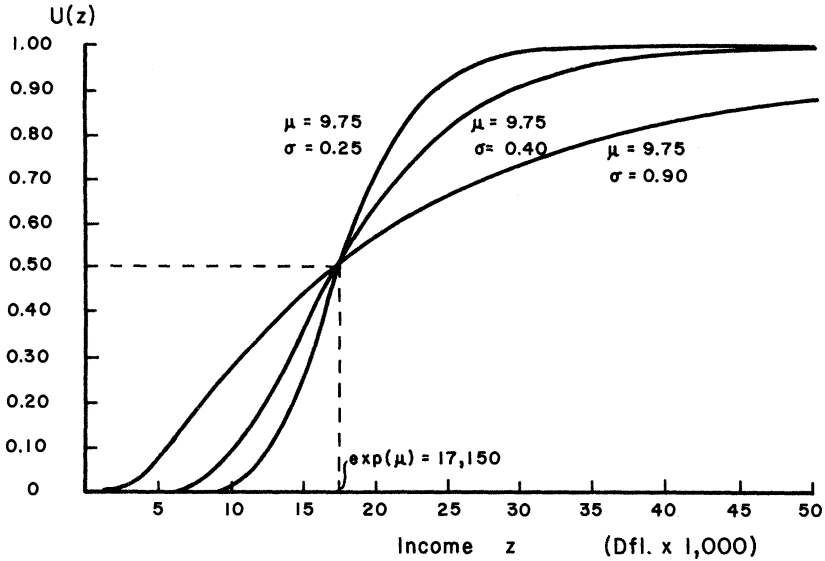


FIGURE 2
 THE INDIVIDUAL WELFARE FUNCTION OF INCOME FOR SOME VALUES OF σ
 (In the present sample the mean value of σ is equal to 0.40
 with a sample standard deviation of 0.17.)

Over a five-year period, the individual welfare functions of about 13,000 individuals were measured from written and oral questionnaires, and a number of attempts were made to explain the individual welfare parameters μ and σ from the individual's personal and social circumstances. We will discuss the results of these attempts briefly and only as far as they are relevant to the subject of this paper. In van Praag [21] and van Praag and Kapteyn [22], it was reported that the following regression equation yielded statistically significant results:

$$(2) \quad \mu = \beta_0 + \beta_1 \ln(fs) + \beta_2 \ln(y) + \epsilon$$

where fs is the size of the family, measured by the number of family members; y is net family income; ϵ is a random disturbance term with zero expectation, distributed identically for each family; and $\beta_0, \beta_1, \beta_2$ are parameters.^{5,6}

- 5 Henceforth we assume that any measured individual welfare function of income belongs to the head of the family. Therefore, when we speak of individuals or persons or people, we mean family heads, and we assume that the family head's welfare function represents the family's welfare function.
- 6 In Kapteyn and van Praag [11], the family-size concept has been complicated by weighting family members according to age and rank in the family. In Kapteyn, van Praag, and van Herwaarden [12], the additional explanation of μ by reference-group

The main factors that influence σ are an individual's "income history" and the income distribution in his social reference group. That is, the more an individual's income has varied over time or the larger the dispersion of incomes in his social reference group, the larger his σ will be. However, the proportion of variance of σ over individuals, which is explained by these factors, is rather small (about 5 percent; see Kapteyn et al. [12] and van Herwaarden et al. [9]). Since σ does not reveal a significant relationship with the variables of interest in this study, y and fs (see Sections V and VI), in the remainder of this paper we shall treat σ as an exogenous variable, fixed at the average sample value 0.40.

V. DESCRIPTION OF THE SAMPLE, MEASUREMENT OF THE INDIVIDUAL WELFARE FUNCTION OF INCOME, EXPLANATION OF μ

In January 1975 a written survey was conducted among a random sample of 2885 Dutch families. The questionnaire contained, among others, the income-evaluation question quoted in the previous section, questions with respect to the composition and size of net family income, and the following question:

We would like to know which net family income would, in *your* circumstances, be the absolute minimum for *you*. 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 answer to this question will be referred to as the *respondent's minimum income* (y_{min}).⁷

After sending reminders and ultimately visiting the families who did not respond, we obtained a total of 2489 questionnaires (86.3 percent) that were at least partially completed. Of the 2489 individuals who filled in the questionnaire, 1748 (61 percent) answered the questions on income evaluation, minimum income, and composition and size of the net family income. In the subsequent analysis we are concerned only with these 1748 respondents.⁸

effects has been considered by taking into account a number of social characteristics of the individual (such as age, job, education, etc.). As the data to be used in this paper do not allow for the estimation of the parameters that play a role in the complicated family-size concept or the reference-group model, we shall not consider these complications in the present paper, but will confine ourselves to specification (2).

7 Or "minimum income" for short. This term should not be confused with the term "statutory minimum income" which is the income level guaranteed to almost all people in The Netherlands by the Dutch Social Security system.

8 In fact, the sample of 2885 was obtained from respondents to an oral interview with whom the questionnaire was left behind. Hence some social characteristics, such as education and income, of the respondents in the sample of 2885 are known. A compar-

TABLE I
STATISTICS CONCERNING THE MEASUREMENT OF THE INDIVIDUAL
WELFARE FUNCTIONS AND THE RESPONDENTS' MINIMUM INCOMES^a

		Standard Deviation
Average $\exp(\mu)$	Dfl. 18,081	(6,238)
Average value of y_{min}	Dfl. 16,257	(6,412)
Average income	Dfl. 20,815	(9,225)
Average evaluation of own current income, $\bar{\Lambda}(y; \mu, \sigma)$	0.58	(0.22)
Average σ	0.40	(0.17)
Number of observations	1748	

a All statistics are averages over all individual estimates. At the time of the survey, a Dutch guilder was equivalent to 0.407 U.S. dollars.

In Table 1 we present some statistics on the measurement of the parameters of the individual welfare functions and the respondents' minimum incomes.⁹

According to equation (2), the regression yields:

$$(3) \quad \mu = 4.41 + 0.13 \ln(fs) + 0.53 \ln(y) \quad \bar{R}^2 = 0.60 \quad N = 1748$$

(0.13) (0.01) (0.01)

The numbers in parentheses are the estimated standard errors of the regression coefficients.¹⁰

VI. THE DEFINITION OF THE POVERTY LINE

It was argued in Section III that any definition of poverty rests on the notion that an individual is poor when he experiences a low level of welfare.¹¹ In terms

ison between the distribution of social characteristics in the sample of 2885 and the sample of 1748 does not reveal significant differences between the samples.

9 There appeared to be some problems with the definition of the income concept in the questionnaire. In an appendix we describe the problems and present the solution we adopted. This appendix is available from the authors on request: Economic Institute, Groenhovenstraat 5, Leyden, The Netherlands.

10 The estimates are similar to earlier outcomes. For example, the corresponding regression on the sample used by van Praag and Kapteyn [22] yields
 $\mu = 3.53 + 0.14 \ln(fs) + 0.60 \ln(y) \quad R^2 = 0.63 \quad N = 2952$
 (0.10) (0.01) (0.01)

Van Herwaarden, Kapteyn, and van Praag [9] provide a discussion of the differences between this result and (3).

11 This idea is also advanced by others. For example, Leveson [14] defines poverty as "the existence of a low level of utility."

of the individual welfare function of income, a low level of welfare means that $U(y) = \Lambda(y; \mu, \sigma)$ falls below some prescribed minimum value Λ^0 . In other words,

$$(4) \quad [\ln(y) - \mu] / \sigma < \gamma_1$$

where γ_1 follows from

$$(5) \quad \Lambda[\exp(\gamma_1); 0, 1] = \Lambda^0$$

The reader will note that according to (4) individuals may not only become poor if their incomes decrease, but also if there is a change in their welfare parameters μ and σ . Since σ is treated as exogenous, we abstract from differences in σ among individuals. In the following analysis we assign to all individuals identical σ equal to the average σ in the sample ($\bar{\sigma} = 0.40$).

Taking the value of σ for granted, equation (4) suggests that the respondent's minimum income (y_{min}), stated in the questionnaire, would follow from

$$(6) \quad \ln(y_{min}) - \mu = \gamma_0$$

In other words, we conjecture that $\ln(y_{min})$ will be equal to the respondent's μ plus a constant γ_0 .¹²

A combining of (6) with (2) suggests that hypothesis (6) might be tested to see whether α_1 and α_2 in regression equation

$$(7) \quad \ln(y_{min}) = \alpha_0 + \alpha_1 \ln(fs) + \alpha_2 \ln(y) + \eta$$

are equal to β_1 and β_2 in (2).¹³

Least-squares estimation of the parameters of α_0 , α_1 , and α_2 in (7) yields

$$(8) \quad \ln(y_{min}) = 3.60 + 0.12 \ln(fs) + 0.60 \ln(y) \quad \bar{R}^2 = 0.57 \quad N = 1748$$

$$(0.15) \quad (0.01) \quad (0.02)$$

where the estimated standard errors of the parameters have been added in parentheses.¹⁴ We see that β_1 (see equation (3)) and α_1 are only one standard deviation apart. But since β_2 and α_2 are significantly different, we have to reject (6). That is, the welfare level associated with a respondent's minimum income is not independent of his actual income.

Subtracting (3) from (8) we obtain¹⁵

$$(9) \quad \ln(y_{min}) - \mu = -0.81 + 0.071 \ln(y)$$

12 If poverty is represented by a welfare level under 0.5, γ_0 is negative.

13 The variable η in (7) represents a random disturbance term, with expectation equal to zero.

14 In order to test whether specification (8) is correct, we have also estimated specifications where higher order terms in $\ln(y)$ were added to the right-hand side of (8). However, the fit did not improve and the regression coefficients of the added terms were insignificant.

15 We have ignored the small insignificant difference between the values of α_1 and β_1 . When regressing $[\ln(y_{min}) - \mu]$ directly on $\ln(y)$ we obtain

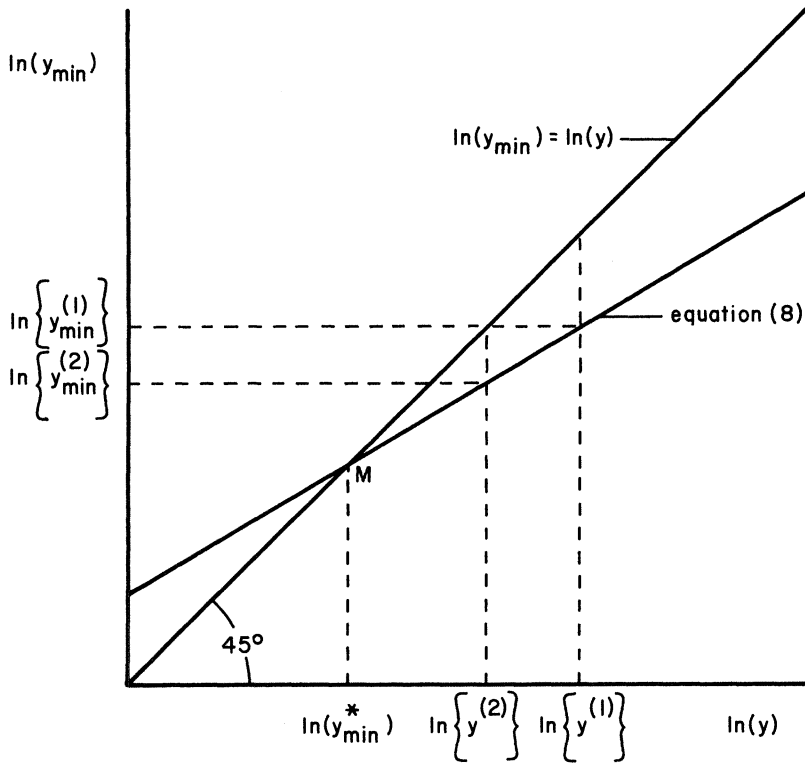


FIGURE 3
THE RELATIONSHIP BETWEEN LOG-MINIMUM INCOME
AND LOG-INCOME FOR A GIVEN FAMILY SIZE

In other words, equations (8) and (9) imply that when the individual's actual income rises, his minimum income rises as well. The latter quantity increases at a faster rate than the natural unit, $\exp(\mu)$.

The welfare evaluation of the minimum income is obtained by inserting (9) in the individual welfare function (1). We obtain

$$(10) \quad N[\ln(y_{min}) - \mu; 0, \sigma] = N[-0.81 + 0.07\ln(y); 0, \sigma]$$

The average value of (10) in the sample is equal to 0.39 (with sample standard deviation 0.19). From the positive coefficient of $\ln(y)$ on the right-hand side of (10), it follows that the welfare evaluation of the minimum income rises with income, that is, richer people are more demanding with respect to their mini-

$$[\ln(y_{min}) - \mu] = -0.77 + 0.07\ln(y) \qquad \bar{R}^2 = 0.02$$

(0.12) (0.01)

The addition of a number of socioeconomic characteristics as dummy variables on the right-hand side of this equation does not yield a significant increase in \bar{R}^2 .

imum income than are poor people, not only in money terms but also in welfare terms.¹⁶

Let us now turn to the problem of how to define a poverty line for the society as a whole. Relation (8) shows that individuals' minimum income levels vary with current income and family size. Can we extract from this diversity of individual minimum incomes one poverty line for the entire society? To answer this question we look at Figure 3 where relation (8) is depicted for a certain family size.

Consider an individual with income $y^{(1)}$. His minimum income will be $y_{min}^{(1)}$ (see Figure 3). Suppose he evaluates $y^{(1)}$ by 0.8 and $y_{min}^{(1)}$ by 0.45. Now let his income fall from $y^{(1)}$ to $y_{min}^{(1)}$. Immediately his new income $y_{min}^{(1)}$ will be considered to be absolutely minimal. However, as time passes he will become accustomed to the new situation and he will realize that he is actually in situation $y^{(2)}$, which is quite tolerable. He then will evaluate $y^{(2)}$ by 0.6, for instance, and according to (8) he will begin to consider $y_{min}^{(2)}$ to be the absolute minimum for him. If his income should fall from $y^{(2)}$ to $y_{min}^{(2)}$, an adaptation process would start, similar to the adaptation process that took place when his income fell from $y^{(1)}$ to $y_{min}^{(1)}$, etc. The process stops when $y = y_{min}^*$.

Apparently a respondent's perception of the poverty line is distorted by the fact that his actual income is not equal to his minimum income level. There is only one income level, y_{min}^* , where this misperception does not obtain. Therefore, we take y_{min}^* as our definition of the poverty line.

According to this argument, it seems as if we only honor the opinion of people who can just make ends meet, and one may wonder why we included the others in the sample. It is obvious that we do not know a priori which people have an income equal to y_{min}^* . Therefore we use all observations to obtain equation (8) and consequently the value of y_{min}^* in Figure 3. When we exclude those with higher incomes from the sample, the estimation of (8), and consequently of y_{min}^* , becomes less reliable. In other words, we need all observations in order to find out which people's opinion on minimum income we should honor.

VII. RESULTS

The value of y_{min}^* for different family sizes is easily computed from the equation

$$(11) \quad \ln(y_{min}^*) = \alpha_0 + \alpha_1(\ln(fs)) + \alpha_2 \ln(y_{min}^*)$$

16 A possible explanation is that individuals with high incomes have relatively large proportions of committed expenditures. For example, they have to pay mortgages, whereas lower-income individuals pay relatively low rents (in The Netherlands).

TABLE 2
 POVERTY LINE FOR A NUMBER OF DIFFERENT FAMILY SIZES
 (Standard errors in parentheses)

Family Size	Estimated Level of the Poverty Line (guilders/year)	Evaluation of Estimated Poverty Line	Statutory Minimum Income ^a The Netherlands January 1, 1975 (guilders/year)	Evaluation of Dutch Statutory Minimum Income	U.S. Poverty Line 1974 (guilders/year) ^b
1	7,700 (310)	0.33	8,080	0.35	6,130
2	9,510 (270)	0.34	11,500	0.42	7,889
3	10,770 (290)	0.35	12,340	0.41	9,670
4	11,760 (330)	0.35	13,430	0.41	12,378
5	12,580 (390)	0.35	14,660	0.42	14,618
6	13,310 (450)	0.35	15,960	0.44	16,459
7	13,950 (510)	0.35	17,290	0.45	20,278

a These minimums are based on the provisions of the so-called Social Assistance Act (as per January 1975).

b 1 Dfl. = 0.407 U.S. dollars.

which yields

$$(12) \quad \ln(y_{min}^*) = [\alpha_0 + \alpha_1 \ln(fs)] / (1 - \alpha_2)$$

In Table 2 we present the y_{min}^* for various values of (fs) , with the standard errors in parentheses below.¹⁷ For comparison, the levels of the statutory minimum income (also called the legal minimum) in The Netherlands in January

17 Since the parameters α_0 , α_1 , and α_2 in (12) contain errors of measurement, y_{min}^* contains errors of measurement as well. Assuming that the vector of estimators of the parameters is distributed according to a multivariate normal distribution, with a variance-covariance matrix which can be estimated from the data, we simulated a sample of 3000 values of the vector $(\alpha_0, \alpha_1, \alpha_2)$. For each vector value the corresponding value of y_{min}^* was computed according to (1). The standard deviation of the sample distribution of the simulated values of y_{min}^* is taken as an estimate of the standard error of the estimate of y_{min}^* . The more traditional approach of approximating the standard error of y_{min}^* by expanding the right-hand side of (12), according to a Taylor series (see Cramer [4, p. 96]), yields almost identical results.

1975 are listed in the fourth column, and the levels of the U.S. poverty line for 1974 (converted to guilders according to the January 1975 exchange rate) in the sixth column. To both the estimated levels of the poverty line and the statutory minimums, we have added a column of numbers that represent the welfare evaluations of these amounts, according to equations (1) and (2).

It is seen from Table 2 that the Dutch legal minimums are well above the estimated values of the poverty line. The standard errors of the latter are small enough so that the differences between the Dutch legal minimums and the estimated values of the poverty line are statistically significant except for a one-person family. The U.S. 1974 poverty line appears to increase far more with family size than do the Dutch legal minimums or our estimated poverty lines.

Readers familiar with the literature on family equivalence scales may find the increase in the estimated poverty line with family size very small. Apart from the fact that the definition of family size as the number of persons in the family is rather primitive (we have improved upon this procedure in Kapteyn and van Praag [11]), we believe that the moderate increase in y_{min}^* with family size is a better approximation of a *constant welfare* family equivalence scale than the values usually obtained. Although we recognize that the life-style and preferences change drastically when a family size changes from one to two or from two to three, our small estimates of the increase in needs reflect the fact that the preferences within the family shift in such a way that material needs do not increase very much. For example, a two-person family (husband and wife) may be accustomed to a life-style which includes relatively high holiday expenditures. When the first child is born, the parents decide to spend their holidays at home, thus saving money which may be used to compensate for the additional expenditures caused by the increase in family size.

In our opinion, substitution possibilities of this kind are not fully taken into account in current literature on the family equivalence scale.

VIII. AN ALTERNATIVE METHOD

The values of the poverty line given in the second column of Table 2 follow from the application of the methodology proposed in Section VI to the data in our sample. Politicians may find the corresponding welfare evaluations in the third column of the table unacceptable. For example, they may feel that a welfare evaluation of 0.35 is too low and that it should be at least 0.40, or 0.45. Obviously, the concept of the individual welfare function in connection with relation (3) makes it easy to compute the corresponding income levels for any welfare evaluation specified.

By way of example, in Table 3 we present the income levels corresponding to the welfare evaluation levels 0.40, 0.45, and 0.50.

TABLE 3
 INCOME LEVELS (GUILDERS/YEAR)
 CORRESPONDING TO DIFFERENT WELFARE EVALUATIONS

Family Size	Welfare Evaluation Level		
	0.40	0.45	0.50
1	9,040	10,090	11,240
2	10,910	12,180	13,570
3	12,190	13,600	15,150
4	13,180	14,700	16,380
5	14,000	15,620	17,400
6	14,710	16,420	18,290
7	15,340	17,120	19,070

IX. CONCLUSIONS

We do not present our methodology as a perfect substitute for the other approaches to determining a poverty line, as described in Section III, but rather as a complement to them—a method that could be employed in conjunction with one or another of them. The results summarized in Sections VI and VII shed some light on the measurement problems in these approaches, so let us briefly respond to all three along with our own.

With respect to the first approach, we observe that the politicians who are called upon to determine the level of the poverty line usually earn incomes far above the y_{min}^* in Figure 3. Consequently, following the argument put forward in Section VI, their perception of what a poverty line really means may be severely biased. Thus, because they are not poor themselves, politicians may not be qualified to make any direct intuitive assessment of the poverty line.¹⁸ However, the analysis in the previous section yields a possible alternative for them; although their intuitive perception of a minimum income in “income space” may be biased, this need not be the case with their perception in “welfare space.” That is, politicians can stipulate a certain minimum welfare evaluation below which citizens should not fall. The computation of the corresponding income levels is then straightforward.

With respect to the second approach, which leaves the decision on the level of the poverty line to a representative citizen, the same objection can be made as with the first approach. The income of the representative citizen is not equal to y_{min}^* ; hence, his perception also would be biased. Here our analysis provides an

18 They may be able to make better assessments, however, interacting with their constituents, especially those with relatively low incomes.

alternative since, for example, we could ask citizens: "What is the minimal welfare evaluation (on a zero-one scale) below which no family in this community should fall?" Translating the average of the answers to this question into money amounts via the procedure sketched in the previous section is again simple.

The minimum-subsistence-level definition of the poverty line (the third approach) presumably suffers from the same kind of bias as the first two approaches, as the incomes of the experts are usually well above the poverty line and their judgment as to what is minimally required may well reflect their own social backgrounds. In this connection, we may mention some evidence summarized by Kilpatrick [13, pp. 331-32]. He observes that the judgments of experts on minimum subsistence rise significantly with average income in society, a finding that highlights a considerable sociocultural component in experts' judgments. Given this observation, it seems unlikely that experts could completely divorce themselves from their own circumstances.

The fourth approach is the one that underlies the definition of y_{min}^* in Section VI. The only value judgment involved seems to be that people themselves are best qualified to judge what their minimal requirements are. Once one accepts that value judgment and the analysis presented in Section VI, the level of the poverty line readily follows.

Although we want to stress the methodological advantages of the approach adopted in this paper, we do not believe that this analysis should be viewed as final. Our aim was to investigate whether it is possible to define the concept of the poverty line in a simple and operational way. A number of aspects—for instance, wealth and differences between annual and permanent income—were not considered here, but these and other factors relevant for the definition of poverty can easily be built into the model in a manner similar to the way the family-size variable was used in our example.¹⁹ Thus many other factors that influence y_{min} (and therefore y_{min}^*), such as psychological factors (social reference group effects, for example), health status, and/or environmental factors (urban or rural residence) also could be taken into account. In fact, any quantifiable factor that has a measurable effect on the individual's welfare parameter μ (and thus presumably on y_{min} as well) might be incorporated into the definition of the poverty line.

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