KYKLOS, Vol. 36 – 1983 – Fasc. 2, 249–269

Tackling Hard Questions by Means of Soft Methods: The Use of Individual Welfare Functions in Socio-Economic Policy

TOM WANSBEEK and ARIE KAPTEYN*

I. INTRODUCTION

Utility seems to be to economists what the Lord is to theologians. Economists talk about utility all the time, but do not seem to have hope of ever observing it this side of heaven. In micro-economic theory, almost any model is built on utility functions of some kind. In empirical work little attempt is made to measure this all-pervasive concept. The concept is considered to be so esoteric as to defy direct measurement by mortals. Still, in a different role, viz. of non-economists, the same mortals are the sole possessors of utility functions and they are able to do incredible things with it.

For example: Individuals knowing in advance what the price of sirloin steak will be on August 12, 1991 use their utility function to weigh the attractiveness of this steak against alternatives, taking into account how their choice affects dinner possibilities at other dates. Not only that; since the amount of time spent on dinner affects the amount of time available for the accumulation of human capital, they also take into account how their choices affect their chances in the labor market ten years later, say. Those same individuals are not able, however, to say whether a change from one to two bottles of beer yields a bigger increase in utility than a move from two bottles to three. This possibility is ruled out, because it would imply cardinality which is considered blasphemous in most economic denominations.

As a result, there is a giant gap between theory and empirical work.

* Netherlands Central Bureau of Statistics, Voorburg and Tilburg University, Netherlands, respectively. The views expressed in this paper are those of the authors and do not necessarily reflect the policies of the Netherlands Central Bureau of Statistics. The authors thank WOUTER KELLER for his incisive comments.

By declaring it virtually impossible to measure utility (except in an indirect way, again like theologians who are able to quote various pieces of indirect evidence for the existence of God), economists have made it very hard to test many of the assumptions made in theoretical models regarding the rationality of economic agents. As a result, theories have developed largely unchecked by empirical tests, to a point where non-economists would probably consider them utterly unrealistic. The defense that the theories at least approximate reality in some sense is hard to test, once again due to the self imposed restraint on the measurement of utility.

On the other side of the coin, welfare economists have developed a sophisticated theoretical framework, which can be used as a foundation on which to build a rational socio-economic policy. The theoretical framework, however, relies heavily on utility functions. If these were deemed to be observable, welfare economics would probably be of enormous practical value to policy. As things stand economists' agnostic attitude towards utility leads to tenuous relations between theory and applied work, which clouds the practical politician's view on the theoretical framework involved.

In this paper we advocate the use of direct utility measures in socio-economic policy. We do this by quoting a number of examples. Using directly measured individual welfare functions we show how a number of theoretical notions in welfare economics can be operationalized straight-forwardly.

The first example concerns measurement of the cost of living. Obviously an important practical issue, with an exact definition in economic theory. Today's operationalizations are all approximations to the exact definition. The use of directly measured welfare functions will be seen to lead to substantial simplifications and to be less vulnerable to model mis-specification.

The second example deals with the evaluation of public goods. Quoting research by DAGENAIS [1977], we show how monetary measures of the value of public goods can be obtained by means of survey questions.

The third example deals with judgements about income distribution if some standard (and unrealistic) assumptions regarding utility functions are relaxed. In this context we also pay attention to the definition of a poverty line.

We end with some concluding remarks.

II. COST OF LIVING INDICES

The economic theory of cost of living indices can be paraphrased as follows. Consider a household described by a vector of characteristics h. The vector h tells us what the age-composition of the household is, its place of residence, maybe the education of the household members, etc. The household has a utility function u describing its preferences regarding various commodities. The utility function depends on the characteristics vector h. The consumption behavior of the household is assumed to follow from the maximization of its utility function, subject to a budget constraint. That is, it consumes a vector q of commodities such that the utility function $u(q; h)$ is maximized subject to $p'q = y$, where p is a vector of prices and y is income[1].

The solution of the maximization problem leads to a set of demand functions of the form:

$$q = q(p, y, h) \tag{2.1}$$

Under certain conditions, the parameters of the utility function u can be derived from the estimated parameters of the demand equations. Dual to the utility function is the cost-function $c(u, p, h)$, which gives us the amount of money needed to reach utility level u, given prices p and household characteristics h.

A cost of living index is a relative concept. It compares different situations. Consider a family with utility u_1, facing prices p_1 and having characteristics h_1. We call this the *standard family*. Then the *true constant utility-cost of living index* of a second family, with characteristics h_2 and facing prices p_2, relative to the standard family is defined as

$$\frac{c(u_1, p_2, h_2)}{c(u_1, p_1, h_1)} \tag{2.2}$$

That is, the true cost of living index represents the amount of money the second family needs in order to be as well off as the standard family.

In the way the problem is presented here, interpersonal utility comparisons are involved. If the second family were actually the standard family, but at a different date facing different prices, then no interpersonal comparisons are involved.

1. Whenever we speak of 'income' in this paper, we mean 'after tax family income'.

The index (2.2) can serve to compare differences in cost of living associated with price differences, *i.e.* for the construction of a *price index,* but also with differences in the elements of h. In so far as the standard family and the second family face the same prices and are also otherwise identical except for family composition, (2.2) represents a *family income equivalence scale.*

The empirical implementation of (2.2) involves a number of well-known problems. For price indices the common procedure is to approximate the cost function, resulting in PAASCHE, LASPEYRES, DIVISIA indices, etc. The application of these indices requires the assumption that utility functions are constant over time. For family equivalence scales approximations have been based on nutritional needs, food income ratios and expert judgements. In recent years, attempts have been made to implement (2.2) as fully as possible [see *e.g.* MUELLBAUER 1980]. The typical procedure is as follows.

A convenient functional specification is chosen for the utility function and demand functions are derived. The demand functions are next estimated on the basis of cross-sectional data on household consumption. Since the unknown parameters of the utility function also appear in the demand system, the parameters of the utility function are estimated *via* the demand system[2]. In other words, by this procedure utility functions are measured *indirectly*. Once the utility function has been estimated, the cost function is known and (2.2) can be used to calculate a family equivalence scale.

It is worthwhile to have a closer look at some aspects of this procedure. There is not much theoretical guidance as to the specification of the utility function and convenience is an important consideration. The derivation of the demand functions is based on the assumption of utility maximization. This is a strong assumption for which there exists very little empirical evidence. The data requirements are massive, because for each household in the sample one needs a complete picture of their consumption during a certain period. The whole analysis takes place within a static framework, ignoring habit formation aspects. Furthermore, utility functions are assumed independent in that one household's preferences are not allowed to be influenced by another household's consumption.

2. It is, generally, not possible to estimate all utility function parameters this way, because an identification problem arises [see, *e.g.*, MUELLBAUER 1975].

Some of these assumptions are obviously unrealistic, each of them possibly causing a serious specification error. It is, moreover, hard to test the assumptions because they are so entangled. For instance, if one tests for SLUTSKY symmetry, a rejection may indicate that households do not maximize utility, but it may also mean that the utility function was misspecified or that habit formation was wrongly neglected. Since, furthermore, the massive data requirements introduce various possibilities of measurement error and in addition there is an identification problem, the results of the indirect approach should be viewed with sound suspicion.

Still, the modern approach to family equivalence scales is probably the area of applied welfare economics where the connection between theory and empirical work is closest. The practical complications are mostly due to the insistence on indirect utility measurement. With direct utility measures, models become a lot simpler, as we shall see presently:

We restrict the discussion of the employment of direct utility measures in the construction of equivalence scales mainly to individual welfare functions of income (WFI's), although most of the features also apply to other measures. We assume the WFI concept to be known [see, *e.g.*, VAN PRAAG and KAPTEYN 1973].

How then can WFI's be used to construct equivalence scales? It has been found by VAN PRAAG (1971), VAN PRAAG and KAPTEYN (1973), VAN HERWAARDEN, KAPTEYN and VAN PRAAG (1977) that the WFI-parameter μ varies systematically over respondents according to their income and the size of their family. The following regression equation represents this relationship (for convenience of notation, indices referring to the unit of observation are suppressed):

$$\mu = \beta_0 + \beta_1 \ln fs + \beta_2 \ln y + v \tag{2.3}$$

where fs is the size of the family, measured (for the time being) by the number of family members: y is after tax family income; v is a random disturbance term with zero expectation, distributed identically for each family; and β_0, β_1, β_2 are parameters. The R^2-values for (2.3) typically are about 0.50. It has also been found that σ does not correlate significantly with lnfs and lny, hence σ is treated as exogenous.

Inserting (2.3) in the formula for the lognormal distribution function, ignoring the random disturbance term v, one sees that an individual with family size fs and income y evaluates the income y by

$$U(y) = N[\ln y - \mu; 0, \sigma] = N[-\beta_0 - \beta_1 \ln fs + (1 - \beta_2) \ln y; 0, \sigma] \tag{2.4}$$

The individual's evaluation of family income thus depends on both income and family size:

$$U = U(y, fs) \tag{2.5}$$

Notice that prices play no role here, because (2.3) stems from a cross-section, which allows us to assume that all individuals face by and large the same prices.

Invoking the definition of the cost of living index and taking the WFI as a measure of utility, we see that, relative to a standard family with income level y_1 and family size fs_1, the cost of living of another family of size fs_2 is given by y_2/y_1, where y_2 is the solution of

$$U(y_1, fs_1) = U(y_2, fs_2) \tag{2.6}$$

where U is given in (2.4). Writing this out, we obtain:

$$N[-\beta_0 - \beta_1 \ln fs_2 + (1 - \beta_2) \ln y_2; 0, \sigma_2] = N[-\beta_0 - \beta_1) \ln fs_1 + \\ + (1 - \beta_2) \ln y_1; 0, \sigma_1] \tag{2.7}$$

Since σ is taken exogenous (not depending on income or family size) we may as well ignore variation in σ and fix σ at its population average (it will turn out that the resulting index is not dependent upon the particular value of σ chosen). Switching from welfare space to income space, (2.7) carries over into

$$-\beta_0 - \beta_1 \ln fs_2 + (1 - \beta_2) \ln y_2 = -\beta_0 - \beta_1 \ln fs_1 + (1 - \beta_2) \ln y_1 \tag{2.8}$$

because N is a monotonically increasing function. Hence,

$$\frac{y_2}{y_1} = \left(\frac{fs_2}{fs_1}\right)^{\beta_1/(1-\beta_2)} \tag{2.9}$$

The ratio y_2/y_1 is the equivalence scale value (the value of the cost of living index) of family 2 relative to the standard family 1.

Just as (2.2) represents the ratio of money amounts needed by families 2 and 1 to be at the same utility level, y_2/y_1 represents the ratio of income levels needed by both families to be at the same utility level, the only difference being the kind of utility measure used. Note that, although both (2.2) and (2.6) indicate a dependence of the equivalence scale on the utility level which one wants to hold constant, the special form of the utility function (2.4) leads to an equivalence scale (2.9), which is independent of the utility level. Also, the equivalence scale does not depend on σ.

From the viewpoint of economic theory one has to ask the question whether it is legitimate to use WFI's as measures of utility. No definite answer appears to be possible to this question: A utility function is essentially a primitive concept, partly defined by its mode of measurement. In economic theory, utility functions are both used as concepts that have to explain behavior and as measures of well-being in welfare economics. MUELLBAUER's analysis [MUELLBAUER 1974, 1977, 1980] provides an example of both uses in one and the same analysis. In view of its mode of measurement (through questions that ask directly for evaluations), the WFI has to be primarily viewed as a measure of well-being. It turns out, however, that the individual welfare function concept can also be used to explain behavior [KAPTEYN, WANSBEEK and BUYZE 1979], which lends it a character similar to the classical utility concept[3].

In any case, the reasoning that leads to the construction of a true cost of living index mainly rests upon the fact that a utility function is considered as a measure of well-being.

Hitherto, fs has been defined as the number of family members. Obviously this is somewhat primitive. KAPTEYN and VAN PRAAG [1976, 1980] have therefore refined the definition of fs to

$$fs \equiv \sum_{i=1}^{n} \alpha(i)\, f(a_i) \tag{2.10}$$

where n is the number of family members, $\alpha(i)$ is the *rank weight* attached to the i-th family member (the rank order is: woman, man, oldest child, oldest child but one, etc.), $f(a_i)$ is the *age function* representing the weight given to a family member of age a_i.

The precise specification of $\alpha(i)$ and $f(a_i)$ need not concern us here. Given a parametric specification of both functions, their parameters can be estimated along with β_0, β_1, β_2 by matching (2.3) with cross-section data. Results obtained hitherto by KAPTEYN and VAN PRAAG [1976, 1980]

3. In fact, if one interprets the survey questions that underlie the direct measurement of μ and σ as asking for minimum amounts needed to feel 'delighted', 'pleased' etc. then a WFI would be an indirect utility function and its dual an expenditure function, measuring how much it takes to reach a certain utility level. Also KAPTEYN, WANSBEEK and BUYZE [1979, Section 2.1] argue that at least near to an individual's own income level the WFI will be a close approximation to his or her indirect utility function. It should be mentioned, though, that VAN PRAAG's derivation [VAN PRAAG 1968] is not based on an explicit utility maximization problem.

show a reasonable agreement (but also some differences) with the results obtained through various other methods.

Comparing the direct method with the indirect method, it is obvious that the data requirements for the direct method are considerably less. Rather than an extensive list of consumption items per household, one only needs the WFI of one of the household members (preferably the household head). Also the possibilities for misspecification are more limited. The lognormal form of the WFI can be tested (VAN HERWAARDEN and KAPTEYN [1981], ANTONIDES, KAPTEYN and WANSBEEK [1980]). As to habit formation and preference interdependence, which are both ignored in the indirect approach: these are obviously also ignored in (2.3). Because (2.3) is very simple to begin with, it is certainly easier to incorporate these effects in the direct approach than in the indirect approach. Moreover, there exists a preference formation theory which specifies how (2.3) has to be extended to incorporate preference interdependence and habit formation (KAPTEYN [1977, 1979], KAPTEYN and WANSBEEK [1982]). In KAPTEYN [1977, Sec. 8.2] family equivalence scales were estimated while accounting for preference interdependence. Due to severe multicollinearity it is hard to draw hard conclusions from his results, but it appears that the allowance for preference interdependence definitely affects the equivalence scales obtained.

WFI's are not the only direct utility measures that can be used to construct equivalence scales. DUBNOFF, VAUGHAN and LANCASTER [1981] use respondents' self-evaluations of their standard of living. Regressing this measure on income and family composition yields significant results. Family equivalence scales are next found by varying income with family composition in such a way that the predicted self evaluation remains constant. This yields directly measured equivalence scales. Since (2.4) also expresses utility as a function of income and family size the difference between their approach and the approach described above is basically one of functional form. In principle, the choice of functional form can be decided upon by statistical analysis.

The discussion in this section has concentrated on family equivalence scales, but a similar analysis is possible regarding other elements of the vector of characteristics h. DUBNOFF, VAUGHAN and LANCASTER [1981] also include regions in their regression. This immediately leads to cost of living indices for different regions. The same analysis could be performed with WFI's.

III. THE EVALUATION OF PUBLIC GOODS

The theory of public goods provides a prime example of an area where utility functions play a predominant role in developing the theory, but virtually no role in applied work. For instance, since SAMUELSON's elegant analysis [1954, 1955] we know that individual demand functions for public goods should be added vertically rather than horizontally. But how we can actually measure a demand function for public goods has never become clear. In this section we give two examples of how directly measured welfare functions can be used to arrive at monetary measures of the value of public goods.

The first example derives from AARON and MCGUIRE's classic article [1970]. They consider the problem of how to impute the value of public goods to households. In view of the high level of provision with public goods in developed countries, this problem is of obvious importance for a good understanding of the redistributional role played by governments. AARON and MCGUIRE note that the crucial variable in the solution of such a problem is the marginal rate of substitution between the public goods and private income. In some empirical exercises they *assume* how the marginal rate of substitution between public goods and private income varies with income. On the basis of that assumption they impute the value of public goods to income brackets.

Later authors have tried to circumvent the problem of measurement of the demand for public goods by devising intricate mechanisms for the revelation of preferences for public goods (*e.g.*, CLARKE [1971], GROVES and LEDYARD [1977, 1980], GREEN and LAFFONT [1977]), so that economic agents are induced to show behavior which brings about an efficient equilibrium. Although it is nice to see that such mechanisms exist, they appear to be too complicated to be of practical value.

Employing WFI's, one can think of simpler methods. A good example is the study by DAGENAIS [1977]. The public good considered is air quality. She asks a sample of about 80 people to rate combinations of income and air quality. The air quality is measured by an index ranging from zero to one hundred. For each of ten different verbal labels, from 'excellent' to 'very bad', respondents are asked to specify combinations of air quality and income corresponding to those labels. The labels are taken to represent points on a [0, 1]-welfare scale in exactly the same way as verbal labels are used to measure WFI's. The income, air quality combinations represent points of indifference curves corresponding to the points on the welfare scale. Grouping the sample in three subsamples according to income, she estimates a bivariate welfare function of income and air quality for each of the three groups. Three functional forms are considered: the bivariate normal, the bivariate lognormal and a quadratic function. After some experimenting she chooses the bivariate lognormal.

Given the estimates, the marginal rate of substitution between income and the public good air quality is known for each of the three income groups. So, for example, if the government might decide to start a pollution abatement project to be financed by a tax increase, then the distributional effects are known; on the tax side, because tax rates are of course known, and on the benefit side, because one can calculate the dollar value of a certain improvement in air quality for each of the groups.

Obviously, DAGENAIS' procedure may be refined, but that is not the main point. Her procedure appears to be simple and workable. The procedure can also be applied to other public goods, like public transportation or crime prevention.

A common objection to direct questioning methods is the possibility of free rider behavior. If respondents to DAGENAIS' questionnaire realize that their answers may be used to tax them to finance a pollution abatement project, they may understate the true value of air quality to them. How serious such a problem is remains to be seen. At the very least, effective free ridership requires a high level of sophistication on the part of the respondents and the availability of a substantial amount of information on the preferences of others. To avoid the free rider problem one can conceive of slightly less direct methods using WFI's. Let there be a public good whose provision varies regionally (as may well be the case in the U.S. for instance). By measuring WFI's in the different regions and controlling for factors like family composition, income, regional price differences etc., a systematic comparison of WFI's across regions provides 'equivalence scales' for public goods exactly analogous to the construction of equivalence scales for differences in family composition considered in the previous section.

A second example is cost-benefit analysis. The argument is again due to DAGENAIS [1977]. Let there be a social welfare function (SWF) of the form:

$$W = W(U_1, \ldots, U_N) \tag{3.1}$$

where U_n ($n = 1, \ldots, N$) is the utility function of the n-th individual (or family):

$$U_n = U_n(x_n, z_n),\ n = 1, \ldots, N \tag{3.2}$$

with x_n and z_n amounts of private goods x and z consumed by individual n. A project is considered which will affect the relative prices of x and z. For a small change in relative prices, the project will improve social welfare if

$$dW = \sum_{n=1}^{N} \frac{\partial W}{\partial U_n} \left(\frac{\partial U_n}{\partial x_n} \cdot dx_n + \frac{\partial U_n}{\partial z_n} \cdot dz_n \right) > 0 \tag{3.3}$$

Equation (3.3) can be rewritten as

$$dW = \sum_{n=1}^{N} \frac{\partial W}{\partial U_n} \cdot \frac{\partial U_n}{\partial x_n} \left[dx_n + \frac{\partial U_n}{\partial z_n} \Big/ \frac{\partial U_n}{\partial x_n} \cdot dz_n \right] > 0 \tag{3.4}$$

where $(\partial U_n/\partial z_n)/(\partial U_n/\partial x_n)$ is the marginal rate of substitution between commodities z and x for individual n. If all individuals maximize utility, then

$$\frac{1}{p_x} \frac{\partial U_n}{\partial x_n} = \lambda_n$$

with λ_n being the marginal utility of money for individual n, and p_x the price of x. Under utility maximization we also have that

$$\frac{\partial U_n}{\partial z_n} \Big/ \frac{\partial U_n}{\partial x_n} = p_z/p_x$$

with p_z being the price of z. So criterion (3.4) is equivalent to

$$\sum_{n=1}^{N} \frac{\partial W}{\partial U_n} \cdot \lambda_n [p_x dx_n + p_z dz_n] > 0 \tag{3.5}$$

The term in square brackets is the monetary gain (or loss) of the n-th individual due to the project.

In customary cost-benefit analysis, net benefits are defined as the sum of all monetary gains and benefits, *i.e.* by setting $\partial W/\partial U_n = 1/\lambda_n$. In a sense, $\partial W/\partial U_n$ is the weight given to the n-th individual in the SWF.

Clearly, then, cost-benefit analysis implicitly assigns weights to individuals (or families) inversely proportional to their utility of income. Since the marginal utility of income tends to fall with rising income, cost-benefit analysis gives a higher weight to well-to-do people than to the less well-to-do.

There have been attempts to redress the situation by applying distributional weights, for instance by weighing benefits to different groups differently. Although in principle correct, without knowledge of the marginal utility of money and an explicitly specified SWF, the ad hoc introduction of weights is arbitrary. Of course, the marginal utility of money is directly measured by WFI's, so that their relevance to cost-benefit analysis is clear.

Finally, returning to the pollution abatement example discussed above, let z be the public good air quality and let x_n be individual n's income. Call individual n's marginal rate of substitution between z and x_n, m_n. Then (3.4) becomes

$$dW = \sum_{n=1}^{N} \frac{\partial W}{\partial U_n} \cdot \frac{\partial U_n}{\partial x_n} [dx_n + m_n \cdot dz_n] > 0 \tag{3.6}$$

Since for public goods there are no market prices which can be used to measure m_n, one sees that cost-benefit analysis of a project involving a public good can only be carried out if a measure of m_n can be obtained, as in DAGENAIS' procedure.

IV. SOCIAL WELFARE FUNCTIONS AND INCOME DISTRIBUTION

The example regarding the implicit social welfare weights used in cost-benefit analysis illustrates that attempts to avoid utility measurement in policy oriented research easily lead to practices that involve implicit interpersonal utility comparisons of an undesirable nature. One may, of course, be willing to explicitly specify a SWF, but insist on measuring utility indirectly. That, again, leads to complicated models and involves many entangled assumptions as in the indirect measurement of family equivalence scales.

In recent years, quite a literature has developed that uses an SWF framework to derive optimal taxation rules. As usual in theory, authors try to make as weak assumptions as possible and still arrive at policy conclusions of some practical value. Despite the attempts to make weak assumptions, some of them are unacceptable, primarily the supposition that utility functions are constant and independent of one another. This assumption is at variance with reality and has a dramatic influence on the conclusion of these studies. LAYARD [1980] shows that alternative assumptions lead to entirely different conclusions. For instance, in a simple model with an additive SWF, where utility depends on the number of hours worked and one's ranking in the income distribution, the optimal marginal tax rate turns out to be unity!

Given the fact that assumptions on utility functions have such a dramatic effect on the conclusions of theoretical studies, empirical investigations into the validity of those assumptions should be of considerable scientific interest. Research with respect to WFI's has time and again brought out that WFI's are interdependent (*i.e.* one person's WFI is influenced by other person's behavior; see, *e.g.*, KAPTEYN, VAN PRAAG and VAN HERWAARDEN [1976, 1978], KAPTEYN, WANSBEEK and BUYZE [1978, 1980]) and subject to habit formation (KAPTEYN, WANSBEEK and BUYZE [1980], KAPTEYN and WANSBEEK [1982]).

Even with the simplifying assumption of constant and independent preferences, models in optimal taxation theory tends to become fairly complicated (see, *e.g.*, MIRRLEES [1971], SHESHINSKI [1972], to mention a few classics, or the review paper by BRADFORD and ROSEN [1976]), whereas the results are not very specific. Introducing habit formation and preference interdependence undoubtedly would further complicate the models. Rather than attempting to further generalize existing models it is worthwhile to carry out specific research on the building blocks of such models. A few examples may clarify this.

KAPTEYN and VAN HERWAARDEN [1980] use a model developed in KAPTEYN, VAN PRAAG and VAN HERWAARDEN [1976, 1978], in which the interdependence of WFI's has been quantified on the basis of a 1971 sample of about 3,000 families in the Netherlands. Using a SWF which is additive in WFI's, and neglecting feed back effects from income redistribution to the level of national income, they compute the income distribution which maximizes the SWF. One of the outcomes is that the usual postulate in inequality measurement, that strict equality of incomes is optimal, does no longer hold true. Although the computation of the optimal income distribution is a non-trivial task, the model is conceptually straightforward. One simply blends theoretical insights from welfare economics with a quantitative model. Although, partly due to data limitations, the quantitative model should be viewed as preliminary, the exercise shows clearly how progress can be made by *empirical* analysis.

A second example is due to KAPTEYN [1977]. Employing a preference formation theory which has been tested fairly extensively, he analyzes the effects of economic growth and income redistribution on the distribution of welfare (*i.e.* the evaluation of incomes). In the simplest case where incomes are equal and grow at a constant rate, the growth rate turns out to be irrelevant to individual welfare, provided it is positive. In more complicated situations the results are less clear-cut, but always very specific. That is, if the relevant parameters are known (and they can be estimated if sufficient data are collected), then the results of various income policies can be compared unambiguously.

The third, and final, example of this section deals with the definition of a poverty line. The usual role of a poverty line is to provide a lower cut-off point for the income distribution. Although economists have developed various measurements to describe the extent of poverty in a society given the level of the poverty line (*e.g.*, SEN [1976], KAKWANI [1980]), they have been silent on the question of how a poverty line has to be defined. Various ad hoc approaches have been applied in practice, but none of these has any reasonable theoretical basis.

In GOEDHART et al. [1977], a new approach to the definition of a poverty line is developed which is related to the WFI-framework. In a survey of 1748 Dutchmen in 1975, they ask the 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 ends meet if you earned less.'

We call a respondent's answer to this question the respondent's *minimum income*, y_{min}. If we plot the logarithm of y_{min} against the logarithm of actual income, y, for a given family size, we get the line AB in *Figure 1.* GOEDHART et al. [1977] argue that y^*_{min}, corresponding to the intersection of the 45°-line and AB, is an estimate of the true poverty line in society. Their argument runs as follows:

Consider an individual with income $y^{(1)}$. His minimum will be $y^{(1)}_{min}$. Suppose he evaluates $y^{(1)}$ by 0.8 and $y^{(1)}_{min}$ by 0.45. Now let his income fall from $y^{(1)}$ to $y^{(1)}_{min}$. Immediately, his new income $y^{(1)}_{min}$ 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 *Figure 1* he will begin to consider $y^{(2)}_{min}$ to be the absolute minimum for him. If his income would fall from $y^{(2)}$ to $y^{(2)}_{min}$, an adaptation process would start, similar to the adaptation process that took place when his income fell from $y^{(1)}$ to $y^{(1)}_{min}$, 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, y^{*}_{min} is taken as the definition of the poverty line.

VAN PRAAG, GOEDHART and KAPTEYN [1980] have given an alternative motivation, which does not depend on the above dynamic interpretation:

Ideally, a poverty line satisfies the requirement that somebody with an income above it feels able to make ends meet, whereas somebody below it does not. According to *Figure 1*, everybody above y^{*}_{min} has an income $y > y_{min}$ and hence these people feel that they can make ends meet. Any person below y^{*}_{min} has an income $y < y_{min}$ and therefore feels that he cannot make ends meet. Thus y^{*}_{min} satisfies the requirement. It is, moreover, obvious that y^{*}_{min} is the only income level satisfying the requirement for being a poverty line.

The relation between y_{min} and y has been given for one family size. If one repeats the drawing for different family sizes, it turns out that the line AB shifts parallel upward if family size increases. In fact lines like AB are generated by the regression equation:

$$\ln y_{min} = \alpha_0 + \alpha_1 \ln fs + \alpha_2 \ln y + w \tag{4.1}$$

where fs is again the family size. The intersection point for a given family size fs_0 is found by equating y_{min} to y (ignoring w):

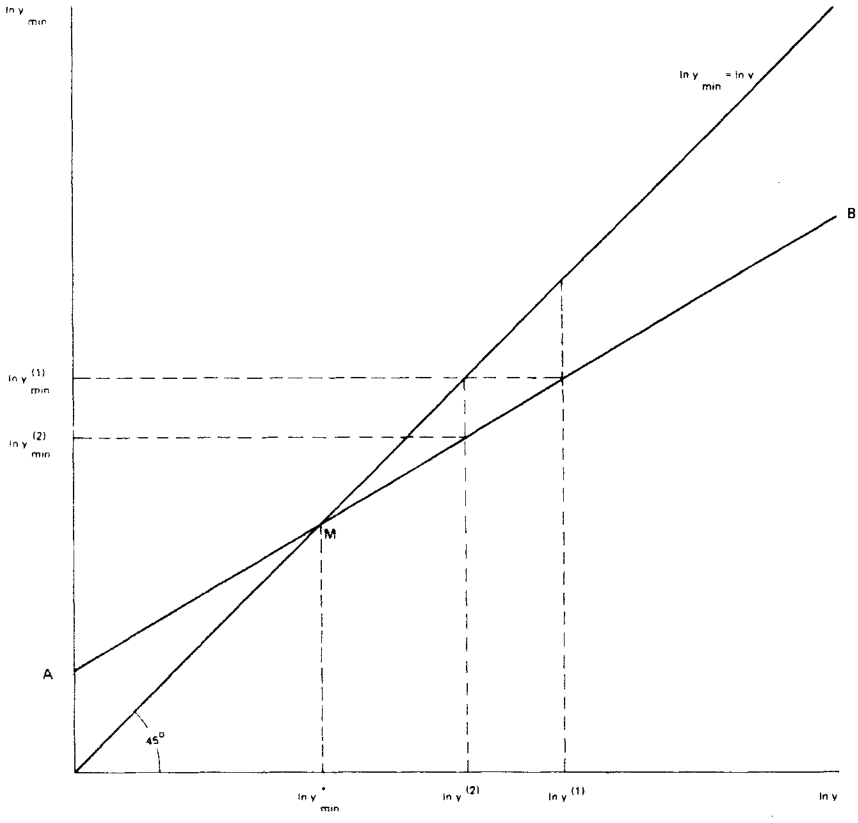
$$\ln y^{*}_{min} = (\alpha_0 + \alpha_1 \ln fs_0)/(1 - \alpha_2) \tag{4.2}$$

Model (4.1) can be complicated along the lines of the preference formation theory, so that the poverty line is differentiated with respect to more characteristics than family size, but that need not concern us here.

The approach has two aspects which tie it to the individual welfare function. The first is its directness, similar to the direct measurement of family equivalence scales; no observations on economic behavior are

Figure 1

The Relationship Between Log-Minimum Income
and Log-Income for a Given Family Size



used, the estimation of equation (4.1) requires minimal information per respondent. At the same time the heavy reliance on one question, which yields y_{min} per respondent, makes it particularly important that the question probes for the correct minimum income concept. For example, some respondents may provide a short run minimum (*e.g.*, ignoring the necessity of replacing durables after some time) whereas others may provide a long run minimum which would be sufficient during a longer period.

Hitherto these aspects have not been studied in depth. The results obtained up till now have therefore to be viewed primarily as illustrative.

The second link with WFI's is provided by the fact that in various surveys WFI's have been measured for the same respondents who gave their minimum income. One can therefore compute the evaluation of y_{min} per respondent and one can estimate the evaluation of y^*_{min} by somebody whose actual income would be equal to y^*_{min}. GOEDHART et al. find the latter evaluation to be about 0.35. In a later study for ten European countries, VAN PRAAG, GOEDHART and KAPTEYN [1979, 1980] find evaluations ranging from 0.36 in The Netherlands to 0.53 in Italy, for a one person family. The evaluation of y^*_{min} appears to vary slightly with family size.

The use of WFI's to find the welfare level associated with the poverty line generates an interesting alternative definition. The evaluations of y^*_{min} quoted were fairly low. Politicians may feel that they are too low and decide for instance that nobody in society should experience a welfare level below 0.45, say. Using the WFI, and the relation between the parameters of an individual's WFI and his income and family size, makes it possible to compute a poverty line which guarantees that everyone is at 0.45, say, or higher. Such computations have been carried out by GOEDHART et al. [1977] and VAN PRAAG, GOEDHART and KAPTEYN [1980].

V. CONCLUDING REMARKS

Ultimately, socio-economic policy deals with human welfare. This is recognized in theoretical welfare economics where utility functions play a fundamental role. With a few, rather arbitrarily chosen, examples we have tried to show how theoretical welfare economics and direct utility measures can be blended into a useful tool of policy analysis.

Somewhere along the line economists have come to believe that their discipline should only deal with 'objective', 'hard' measures like income or output. These hard measures often appear to be misleading indicators of well-being (like *per capita* national income which appears not to have any relation with citizens' self-reported happiness, *cf.* EASTERLIN [1974]). Consequently, one may doubt whether economic policy has served people as well as it could have. The hard measures appear not to be so objective after all and soft methods, like using survey questions, provide information with a closer relation to economic theory.

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SUMMARY

Utility functions play a central role in welfare economics. At a theoretical level the same is true in the analysis of public policy problems. Examples are: the construction of true cost of living indices, cost benefit analysis, optimal taxation. Since economists typically measure utility indirectly, or not at all, the applied work in public policy analysis uses 'hard' measures, like income or consumption. Consequently, the relation between application and theory often becomes tenuous. In the paper it is shown how direct measures of utility obtained from survey questions can be used to tackle policy issues in a way that does more justice to economic theory. In the cases where this 'soft' approach has been used, the results appear to be quite sensible. The data requirements are usually substantially less than with the traditional methods.

ZUSAMMENFASSUNG

Nutzenfunktionen spielen in der Wohlfahrtsökonomik eine zentrale Rolle. Theoretisch gesehen gilt das auch für die Analyse der Programme staatlicher Politik, etwa bei der Konstruktion eines «wahren» Lebenshaltungskostenindex, bei der Kosten-Nutzen-Analyse, bei der Frage der optimalen Besteuerung. Weil man in der Ökonomie den Nutzen typischerweise – wenn überhaupt – indirekt misst, verwendet die Analyse der Programme staatlicher Politik «harte» Messinstrumente, wie Einkommen und Verbrauch. Demzufolge wird der Zusammenhang zwischen Theorie und praktischer Anwendung oft fragwürdig. Der Beitrag zeigt, wie direkte Nutzenmessungen, wie sie aus Befragungen gewonnen werden, bei der Programmbewertung in einer Weise verwendet werden können, die der ökonomischen Theorie besser entspricht. Wo dieser «weiche» Ansatz verwendet worden ist, ergaben sich durchaus sinnvolle Resultate. Der hierfür erforderliche Datenbedarf ist in der Regel wesentlich geringer als bei den herkömmlichen Methoden.

RÉSUMÉ

Les fonctions d'utilité jouent un rôle central dans l'économie du bien-être. Au niveau théorique il en est de même pour l'analyse des problèmes de la politique publique. Par exemple: la construction des indices du coût vrai de la vie, l'analyse des profits et charges, la taxation optimale. Comme, typiquement, les économistes mesurent l'utilité indirectement ou ne le font pas du tout, les études appliquées dans la politique

publique emploient des mesures «dures», comme le revenu ou la consommation. Par conséquent, la relation entre l'application et la théorie devient souvent minime. Dans cet article, on a montré comment des mesures directes de l'utilité qui sont le résultat de diverses questions d'une enquête peuvent être employées dans l'analyse des affaires publiques d'une façon qui fait valoir la théorie économique. Dans les cas où cette approche «molle» a été utilisée, les résultats se trouvent être raisonnables. Les conditions requises des données sont généralement beaucoup moins strictes que dans le cas où l'on opère selon les méthodes traditionnelles.