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2 The Impact of Changes in Income and Family Composition on Subjective Measures of Well-Being

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2.1 Introduction

Consider two families with different reference groups—a rich one and a poor one, let us say. Most likely the family with the rich reference group will feel that it needs more income to make ends meet than the family with the poor reference group. Suppose the income earners in both families lose their jobs and consequently apply for welfare benefits. Should the welfare benefits for the two families differ because they have different needs?

Probably many people will answer no to this question, but in a slightly different context they might answer yes. In the European Community, people from different countries require different incomes (in real terms) to make ends meet. Part of these differences are due to the different standards of living in the various countries. In other words, people from different countries have different reference groups. If we would choose to ignore these variations in need and set one poverty line for the entire European Community, an income maintenance policy based on it would probably turn the welfare recipients in the poor member countries into sudden "nouveau riche."

Next consider two families with different income histories, who both apply for welfare benefits. Is the family that used to be rich, and therefore

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needs more money to make ends meet, entitled to a higher level of benefits than the family that has always been poor?

Again, many people may initially answer no to this question. But unemployment benefits in a number of Western countries are related to previous earnings and decrease over time. At least one explanation for such a setup (apart from the insurance component in unemployment compensation) is that it gives people time to adjust their needs.

These two examples suggest that sometimes policymakers acknowledge that poverty is a relative concept, in that it is related to the standard of living of one's society and to one's previous income. If one takes for granted that poverty is at least partly relative, the question naturally arises *how* a poverty line (or an income maintenance policy built on it) should be related to the standard of living in society and *how* account should be taken of previous income.

In this chapter we employ a model that assumes poverty to be entirely relative. We present evidence on the empirical validity of the model, which explains variations across families and over time of two subjective measures of well-being. One measure is the individual welfare function of income developed by van Praag (1968, 1971). The second is a measure of how much an individual believes he (or she) needs to make ends meet, introduced by Goedhart et al. (1977). Based on both subjective measures is a definition of a poverty line. Using the model for the explanation of the subjective measures, one can trace out the effects of various forms of income maintenance policy on individual well-being. Conversely, using the model and the corresponding poverty line definitions, one can devise income maintenance policies that are in some sense optimal. Both avenues are pursued in this chapter.

In section 2.2 we present the subjective measures and the poverty line definitions based on them. In section 2.3 we present the model that explains the variations of these measures over time as a consequence of variations in family size, own-household income, and incomes in one's reference group. The model is estimated on the basis of a longitudinal household survey in the Netherlands. The estimation results are presented in section 2.4. Taking the model for granted, we explore in section 2.5 the optimality and consequences of different forms of income maintenance policies. Section 2.6 contains some concluding remarks.

As always, the analysis in the chapter is subject to various qualifications and limitations. Two of them are worth mentioning at the start. First, although we use words like *utility, well-being, welfare,* and *satisfaction* freely and interchangeably, these words have the very restrictive meanings implied by the two subjective measures used. Second, the only source of well-being considered is cash-after-tax family income. The limitations of such a narrow concept of economic resources are well-enough

known (cf., e.g., Moon and Smolensky 1978) and future work should use more elaborate concepts.

2.2 Two Poverty Line Definitions

2.2.1 The Subjective Poverty Line

The respondents to the survey used in this paper were asked the following question (in Dutch; *Dfl.* stands for Dutch florin):

> Which after-tax family income would you, in your circumstances, consider to be absolutely minimal? That is to say that you would not be able to make ends meet with less.
> Absolutely minimal: Dfl. _____ per _____.

We shall refer to this question as the *minimum income question* (MIQ). A respondent's answer to the MIQ is referred to as his (or her) *minimum income,* $y_{\min}$. This minimum income is a subjective quantity that will probably depend on the respondent's characteristics, like his income, family composition,[1] income in the reference group,[2] etc. We write

$$y_{\min} = y_{\min}(y,x), \tag{1}$$

where y is the respondent's income and x is a vector of other characteristics influencing $y_{\min}$. Relation (1) is illustrated in figure 2.1.

The lines labeled I, II, and III represent three versions of equation (1), corresponding to three different x vectors. Generally, if x changes, the relation between $y_{\min}$ and y will change, as illustrated. Let us concentrate on one particular value of x, say the value of x that leads to the solid line I. Note the special role played by the intersection point, A, of line I and the 45° line. At point A, $y_{\min} = y$. Let us call that income $y^*_{\min}$, so that $y^*_{\min}$ satisfies

$$y^*_{\min} = y_{\min}(y^*_{\min},x). \tag{2}$$

Any individual with characteristics vector x whose income y is below $y^*_{\min}$ is not able to make ends meet; any individual with the same vector of characteristics and an income in excess of $y^*_{\min}$ is. If $y = y^*_{\min}$, income is just enough to make ends meet. All this makes $y^*_{\min}$ a natural candidate for a definition of a poverty line for any individual with characteristics vector x (cf. van Praag, Goedhart, and Kapteyn 1980).

1. *Income* is defined in this paper as after-tax family income. *Family* and *household* are used as synonyms. When we talk about *individuals* or *respondents* these are usually family heads. The words *he* and *she* are used indiscriminately.

2. This dependence follows immediately if we view $y_{\min}$ as an indicator of a respondent's aspiration level. See, e.g., Katona 1960, chap. 3.

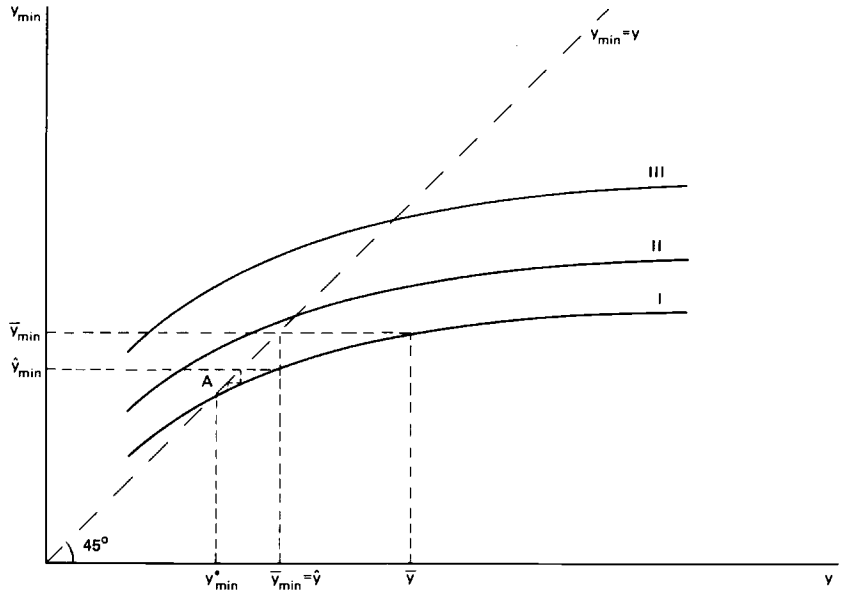

Fig. 2.1. The relation between minimum income and actual income for different values of x.

There is an alternative motivation to take y^*_{min} as a definition of a poverty line. Consider an individual with income $\bar{y}$. His reponse to the MIQ is $\bar{y}_{min}$, representing what he feels to be the minimum amount that will allow him to just make ends meet. Now imagine that we take $\bar{y} - \bar{y}_{min}$ away from him. At first he will consider $\bar{y}_{min} = \hat{y}$ as minimal, but after a while he will become used to the income level $\hat{y}$ and, according to equation (1), he will now consider $\hat{y}_{min}$ as minimal. If we next take $\hat{y} - \hat{y}_{min}$ away from him, he will first consider his new income to be minimal, but after a while his minimum income will be below his actual income. We can continue to take away income from this individual, and his y_{min} will keep adjusting until we have reached y^*_{min}. (Later on we will have more to say about the dynamics of the adjustment of y_{min}). We may describe this adaptation process by saying that the individual makes mistakes about his minimum income because his actual income differs from his minimum. Only at y^*_{min} are no errors made because the respondent's actual income is equal to his minimum income. It is this interpretation that originally led Goedhart et al. (1977) to adopt y^*_{min} as their definition of a poverty line.

Because y^*_{min} depends on x, we can have as many different poverty lines as there are different values of x. Thus we have implicitly defined poverty equivalence scales for different values of x. Both Danziger et al. (1984) and Colasanto, Kapteyn, and van der Gaag (1984) have used this approach to derive poverty lines with equivalence scales accounting for dif-

ferences in family size, sex of the family head, age of the family head (under or over sixty-five), and whether or not a household lives on a farm. Below, x will be specified to include past income, reference group income, and family size.

It is worth noting that $y^*_{\min}$ depends only on what people *themselves* consider to be minimal. No interpersonal utility comparisons are involved. The approach is subjective in the sense that a poverty line is not defined in terms of some prespecified commodity bundle that a household should be able to afford. It is only the respondent's own opinion of what is minimally needed that is the basis for this definition. This puts a heavy burden on the wording of the question and involves the assumption that somehow *make ends meet* has the same meaning to everyone, at least approximately. Although this is an important issue that merits more research, it will not be pursued in this paper.

2.2.2 The Leyden Poverty Line

In the panel survey used in this paper, respondents have been asked the following so-called *income evaluation question* (IEQ):

What after-tax family income would	very bad	Dfl. _____
you consider, in your circumstances,	bad	Dfl. _____
to be very bad? And bad, insufficient,	insufficient	Dfl. _____
sufficient, good, and very good?	sufficient	Dfl. _____
	good	Dfl. _____
Please enter an amount on each line.	very good	Dfl. _____

Care has been taken that before answering the MIQ and the IEQ, the respondent has gained a good understanding of the notion of after-tax family income. Actually the respondent has been asked to compute his own after-tax family income.

A hypothetical response has been plotted in figure 2.2. The verbal labels "very good," "good," etc. have been associated with the midpoints of six equal intervals that partition the [0,1] interval. Thus the verbal scale "very bad, bad, . . . very good" is transformed into a numerical scale 1/12, 3/12, . . . , 11/12. Given this procedure, one can fit a smooth function through the six points. According to a theory advanced by van Praag (1968), the points should lie approximately on a lognormal distribution function $\Lambda(.;\mu,\sigma)$. Tests by van Herwaarden and Kapteyn (1981) indicate a good fit for the lognormal function.

The lognormal function, dubbed the individual *welfare function of income* (WFI) (van Praag 1971), describes a relation between income levels (on the horizontal axis) and welfare levels (on the vertical axis). Our use of the term *welfare levels* means no more and no less than the numbers between zero and one that have been associated with the verbal labels in the IEQ. Whether respondents themselves associate the verbal labels with equal intervals on a numerical scale has been investigated by Buyze (1982)

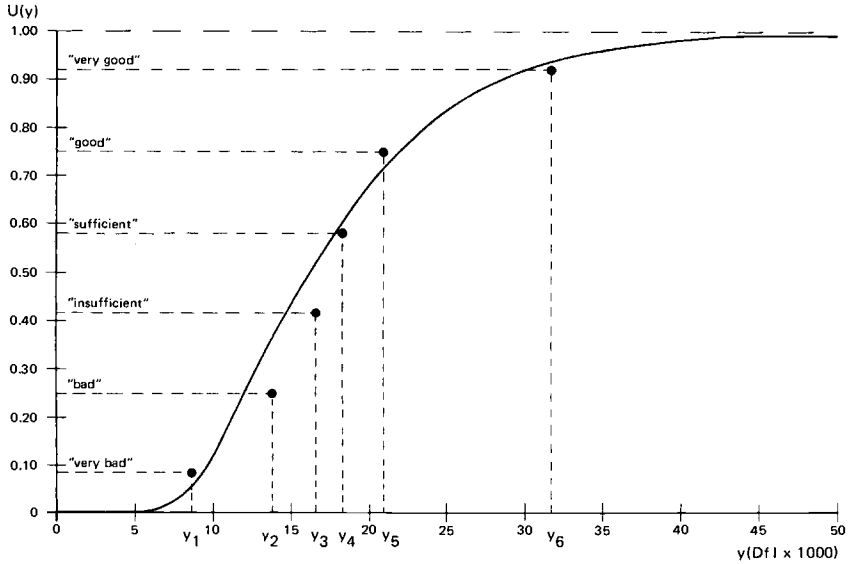

Fig. 2.2. A hypothetical response to the IEQ.

and Antonides, Kapteyn, and Wansbeek (1980). Their conclusion is that the intervals are not exactly equal, but that they are not dramatically different. For the present paper, both lognormality and the equal interval assumption are maintained hypotheses.

The lognormal function is completely determined by its parameters μ and σ. The parameter μ is a location parameter; $\exp(\mu)$ is the income level evaluated by 0.5. Thus, the larger μ (or $\exp(\mu)$, for that matter) is, the more income one needs to attain a certain welfare level. The parameter σ determines the slope of someone's WFI. The larger σ is, the flatter a WFI will be. The parameters μ and σ are easily estimated per respondent by fitting a lognormal function through the scatter of points in figure 2.2 (see, e.g., van Herwaarden and Kapteyn 1981, for details).

Once WFIs are measured per respondent, poverty lines can be derived from them on the basis of the following argument: poverty is a situation with a low level of welfare. Setting a poverty line amounts to a choice of a point on a welfare scale such that everyone with a welfare level below that point is called poor and everyone with a higher welfare level is called nonpoor. Which welfare level should be the dividing line between a state of poverty and nonpoverty is a political decision. Suppose that politicians decide that α is the welfare level (measured on a [0,1] scale) defining the poverty line (e.g., $\alpha = 0.45$) and let $U(y)$ be the WFI of a particular individual, whose WFI parameters are μ and σ. Then this individual is poor or nonpoor depending on whether or not

$$U(y) < \alpha \,. \tag{3}$$

Given the lognormal specification of $U(y)$, equation (3) is equivalent with

$$\Lambda(y\,;\,\mu,\sigma) < \alpha\,, \tag{4}$$

where $\Lambda(.;\,\mu,\sigma)$ is the lognormal distribution function with parameters μ and σ. Equation (4) is in turn equivalent with

$$N([\ln y - \mu]/\sigma\,;\,0,1) < \alpha\,, \tag{5}$$

where $N(.;0,1)$ is the standard normal distribution function.

Define u_α by

$$\alpha = N(u_\alpha\,;\,0,1)\,, \tag{6}$$

i.e., u_α is the α quantile of the normal distribution. Then equation (5) is equivalent with

$$[\ln y - \mu]/\sigma < u_\alpha\,. \tag{7}$$

Given μ and σ, it is easy to determine which income is required to make an individual nonpoor. The poverty line is simply

$$\hat{y} \equiv \exp[\mu + \sigma \cdot u_\alpha]\,. \tag{8}$$

It turns out, however, that both μ and σ depend on income y and on other characteristics x, in a way to be specified in the next section. So this poverty line becomes dependent on x, just like the subjective poverty line.

A concluding word on terminology is in order here. In Goedhart et al. (1977) where the subjective poverty line was introduced, the definition above was only mentioned in passing as "an alternative method." Since the choice of α has to be a political one, van Praag, Goedhart, and Kapteyn (1980) dubbed this poverty line a "politically determined poverty line," which terminology was also adopted by Colasanto, Kapteyn, and van der Gaag (1984). Since, in the end, the adoption of any poverty line involves political decisions, the term *politically determined* is unfortunate. Van Praag, Spit and Van de Stadt (1982) call this the Leyden poverty line, referring to the fact that at the time of writing all four authors of Goedhart et al. (1977) were working in Leyden. Of course, this term does not distinguish it from the subjective poverty line, but at least the name is sufficiently uninformative to avoid confusion with other approaches. Hence we adopt this name here.

2.3 Determinants of μ, σ, and $y_{\min}$

2.3.1 Determinants of μ and σ

The model for the explanation of μ and σ follows straightforwardly from a theory of preference formation put forward by Kapteyn (1977). Recent investigations into the theory's validity are by Kapteyn, Wans-

beek, and Buyze (1980) and van de Stadt, Kapteyn, and van de Geer (1985).

Specialized to the present context, the theory amounts to the hypothesis that an individual's WFI is nothing other than a perceived income distribution. That is, an individual evaluates any income level by its ranking in the income distribution he perceives. The idea is that in order to evaluate incomes, an individual needs a frame of reference. This frame of reference is formed by his perceived income distribution. This perceived income distribution summarizes the incomes the individual has perceived over his lifetime. These incomes may be his own past or present income, or they may be past or present incomes in his reference group. The idea of a perceived income distribution can be somewhat formalized as follows.

Let there be N individuals in society. Time is measured in years, $t = -\infty, \ldots, 0$, where $t = 0$ represents the present. At each moment of time an individual n ($n = 1, \ldots, N$) is assumed to assign nonnegative *reference weights* $w_{nk}(t)$ to any individual k in society ($k = 1, \ldots, N$), $\sum_{k=1}^{N} w_{nk}(t) = 1$. The reference weights indicate the importance individual n attaches to the income of individual k at time t. Obviously, quite a few of the $w_{nk}(t)$ will be zero. On the other hand, $w_{nn}(t)$, i.e., the weight that individual n attaches to his own income at time t, may be substantial. The set of individuals with $w_{nk}(t) > 0$, $k \neq n$, will sometimes be referred to as n's *social reference group* at time t. For notational simplicity, we adopt the convention (in sections 2.3 and 2.4 only) that arguments equal to zero are suppressed, e.g., $w_{nk} \equiv w_{nk}(0)$.

Furthermore, let $y_k(t)$ be the income of individual k at time t. The reference weights now allow for the definition of a *perceived income distribution at time t*. Denote this function by $G_n(y|t)$, then its definition is

$$G_n(y|t) \equiv \sum_{\{k; y_k(t) \leq y\}} w_{nk}(t). \tag{9}$$

The $G_n(y|t)$ for any t can be aggregated to one *presently perceived income distribution*, $G_n(y)$. To that end a nonnegative *memory function* $a_n(t)$ is introduced, which describes individual n's weighting of perceived income over time,

$$\sum_{t=-\infty}^{0} a_n(t) = 1, \quad n = 1, \ldots, N. \tag{10}$$

The idea behind the introduction of a memory function is that events that took place a long time ago will have less influence on a person's present frame of reference than more recent experiences. Hence, in building up a person's presently perceived income distribution out of income distributions in each time period we weigh each of these income distributions with a time-dependent weight $a_n(t)$.

The presently perceived distribution function $G_n(y)$ can now be defined as

$$G_n(y) \equiv \sum_{t=-\infty}^{0} a_n(t)\, G_n(y|t). \tag{11}$$

As indicated above, the preference formation theory claims that this perceived income distribution equals the utility function $U_n(y)$ of the individual.

The development of the argument so far has been in terms of individual incomes, whereas our data refer to family income (cf. the wording of the survey questions above). It may be expected that a family with children needs more income than a single person to reach the same utility level, so it stands to reason to reformulate the preference formation theory in terms of income per *equivalent adult* (or *per capita* as we will often say). Let $f_k(t)$ be the number of equivalent adults in family k at time t. The income per equivalent adult in this family at time t is denoted by

$$\tilde{y}_k(t) \equiv y_k(t)/f_k(t). \tag{12}$$

The reformulation of $U_n(y)$ in terms of per capita incomes amounts to a transformation of the income scale: y is replaced by $\tilde{y} \equiv y/f_n$ and e^{μ_n} by e^{μ_n}/f_n. Consequently,

$$\begin{aligned} Un(y) = N(\ln y;\, \mu n, \sigma n) &= N\left(\ln \left(\frac{y}{f_n}\right) ;\, \mu_n - \ln fn, \sigma n\right) \\ &\equiv N(\ln y; \tilde{\mu} n, \tilde{\sigma} n) = \tilde{U} n(y). \end{aligned} \tag{13}$$

Replacing $y_k(t)$ and y in equations (9) and (11) by $\tilde{y}_k(t)$ and $\tilde{y}$, we obtain the perceived distribution of per capita incomes $\tilde{G}_n(y)$.

The theory of preference formation now states

$$\tilde{U}_n(\tilde{y}) = \tilde{G}_n(\tilde{y})\,;\, n = 1, \ldots, N;\, \tilde{y} = [0, \infty). \tag{14}$$

Equation (14) implies that utility is a completely relative concept. The utility of a certain income per equivalent adult is obtained by comparing it with the perceived distribution of incomes per equivalent adult.

As it stands, equation (14) is hardly operational, because $\tilde{G}_n$ has not been specified. Also for the purpose of policy simulations—the main goal of this chapter—we have to be more specific, altogether we will have to introduce quite a few new symbols before the model is in a form suitable for estimation and simulation.

Denote the first log moment of $\tilde{G}_n(\tilde{y})$ by $\tilde{m}_n$.

$$\tilde{m}_n = \int_0^{\infty} \ln \tilde{y}\, d\tilde{G}_n(\tilde{y}) = \sum_{t=-\infty}^{0} a_n(t) \sum_{k=1}^{N} w_{nk}(t) \ln \tilde{y}_k(t). \tag{15}$$

The equality of the two distribution functions $\tilde{U}_n$ and $\tilde{G}_n$ implies the equality of the first log moments:

$$\begin{aligned} \mu_n &= \ln f_n + \tilde{m}_n + \epsilon_n \\ &= \ln f_n + \sum_{t=-\infty}^{0} a_n(t) \sum_{k=1}^{N} w_{nk}(t) \ln \tilde{y}_k(t) + \epsilon_n . \end{aligned} \tag{16}$$

Also the second log moments of $\tilde{U}_n$ and $\tilde{G}_n$ have to be equal:

$$\sigma_n^2 = \sum_{t=-\infty}^{0} a_n(t) \sum_{k=1}^{N} w_{nk}(t) [\ln \tilde{y}_k(t) - \tilde{m}_n]^2 + \delta_n . \tag{17}$$

The measurement errors in μ_n and σ_n^2 and errors in the equations are taken into account by means of the independently identically distributed disturbance terms ϵ_n and δ_n, with zero means and variances σ_ϵ^2 and σ_δ^2.

Although equations (16) and (17) relate observable variables on the left-hand side to observable variables on the right-hand side, there are still far too many parameters, in particular the reference weights $w_{nk}(t)$, that would have to be estimated. So we need further simplifications. First we assume that $w_{nn}(t)$ is the same for all individuals and constant over time, i.e., all individuals give themselves the same constant weight. We write $\beta_2 = w_{nn}(t)$ and $\beta_3 = \sum_{k \neq n} w_{nk}(t) = 1 - \beta_2$. The function $\ln f_k(t)$ is specified as $\beta_0 + \beta_1 \ln fs_k(t)$ where $fs_k(t)$ is the number of members of family k at time t. The memory function $a_n(t)$ is assumed to be the same for everyone and is specified as $a_n(t) = (1-a)a^{-t}$. Furthermore, we define

$$\begin{aligned} q_{nk}(t) &\equiv w_{nk}(t)/\beta_3 , k \neq n \\ &\equiv 0 \qquad , k = n , \end{aligned} \tag{18}$$

$$\overline{m}_n(t) \equiv \sum_k q_{nk}(t) \ln y_k(t) , \tag{19}$$

$$\begin{aligned} \overline{h}_n(t) &\equiv \sum_k q_{nk}(t) \ln f_k(t) = \beta_0 + \beta_1 \left\{ \sum_k q_{nk}(t) \ln fs_k(t) \right\} \\ &\equiv \beta_0 + \beta_1 \overline{hs}_n(t) , \end{aligned} \tag{20}$$

where $\overline{hs}_n(t)$ is defined implicitly. So, $\overline{m}_n(t)$ and $\overline{hs}_n(t)$ are the log means of incomes and family sizes in family n's social reference group at time t.

All this makes it possible to rewrite equation (16) as

$$\begin{aligned} \mu_n = \ln f_n + (1 - a) \sum_{t=-\infty}^{0} a^{-t} [\beta_2 \{\ln y_n(t) - \ln f_n(t)\} \\ + \beta_3 \{\overline{m}_n(t) - \overline{h}_n(t)\}] + \epsilon_n . \end{aligned} \tag{21}$$

Next we apply the Koyck transformation and use the expression for $\ln f_n$ to write equation (21) in lagged form as follows:

$$\mu_n = [1 - \beta_2(1 - a)]\beta_1 \ln fs_n - a\beta_1 \ln fs_n(-1) + \beta_2(1 - a)\ln y_n + \beta_3(1 - a)\overline{m}_n - \beta_3(1 - a)\beta_1\overline{hs}_n + a\mu_n(-1) + \epsilon_n - a\epsilon_n(-1). \tag{22}$$

Going through a similar derivation regarding equation (17) we can derive an expression for σ_n^2 analogous to equation (12). This more complicated expression is given in Appendix A.

Some details of the maximum likelihood estimation of equation (22) are given in Appendix B.[3] Here we mention one aspect that will play a role in the simulations. In equation (22) there are still various quantities that involve the unknown reference weights. Consider, for example, $\overline{m}_n$ defined by equation (19). We have constructed a proxy for $\overline{m}_n$ as follows. The sample is partitioned into groups of individuals who share certain characteristics, i.e., within a group individuals have the same education level, are of about the same age, and have a similar employment status (see the next section for the exact definition of the characteristics). We call such groups *social groups*. Let the unweighted mean log-income in the social group to which individual n belongs be equal to y_n^*. Then we assume that we can write

$$\overline{m}_n = \kappa \cdot \eta + (1 - \kappa)\, y_n^* + u_n, \tag{23}$$

where η is mean log-income in society, u_n is an error term independent of y_n^*, and κ an unknown parameter that is to be estimated along with the other parameters in the model.

The parameter κ measures what share of the reference group of individual n lies within his social group. If $\kappa = 0$, the social group comprises the reference group; if $\kappa = 1$, the social group is irrelevant for the determination of the reference group of the individual. In van de Stadt, Kapteyn, and van de Geer (1985) explicit assumptions are made that justify the approximation equation (23). For $\overline{hs}_n$, which also involves q_{nk}, an approximation similar to equation (23) has been employed.

2.3.2 Determinants of $y_{\min}$

A theory does not exist from which a model for the explanation of $y_{\min}$ is readily derived. One tempting approach is to assume that $y_{\min}$ corresponds to a point on the welfare scale, i.e., any respondent associates "making ends meet" with, say, a utility level $\bar{u}$.[4] Analogous to equation (8) we would find for the minimum income of individual n, $y_{\min,n}$:

$$\ln y_{\min,n} = \mu_n + \sigma_n \cdot \bar{z}, \tag{24}$$

where $\bar{z}$ satisfies $\bar{u} = N(\bar{z}; 0,1)$. Equation (22) could be combined with equation (24), and we could estimate the two equations jointly. Because

3. Available from the authors on request.
4. This would make the subjective poverty line and the Leyden poverty line equivalent, except for the fact that in the subjective approach the welfare level associated with the poverty line would not be determined by politicians, but by the respondents themselves.

equation (24) would add further nonlinearities to an already complicated model we prefer the simpler assumption,

$$\ln y_{\min,n} = \mu_n - \gamma_0 , \tag{25}$$

with γ_0 an unknown constant to be estimated; equation (25) implies that $y_{\min,n}$ is a constant fraction of $\exp(\mu_n)$. This immediately allows us to derive for $\ln y_{\min,n}$ a relation like that in equation (22), with μ_n and $\mu_n(-1)$ replaced by $\ln y_{\min,n}$ and $\ln y_{\min,n}(-1)$ respectively. We will estimate this equation jointly with equation (22), but we also test equation (25) by testing whether the parameters in the $y_{\min}$ equation have the same value as in the μ equation.

2.4 Data and Estimation Results

The data consist of the first three waves of a panel of 616 households in the Netherlands (drawn randomly from the Dutch population). The main breadwinner of each household was interviewed in March 1980, and the same person was reinterviewed in March of 1981 and 1982. The items in the questionnaire included the IEQ, the MIQ, after-tax family income, family composition, and a number of demographic and socioeconomic characteristics. Three of the characteristics were used to construct the social groups mentioned in the previous section: education, employment status, age. Five education levels are distinguished, three states of employment (self-employed, employee, not employed), and five age brackets (less than 30, 30–39, 40–49, 50–65, over 65). This leads to a maximum of $5 \cdot 3 \cdot 5 = 75$ social groups, 51 of which are represented in the sample.

On the basis of this information, equation (22) and the $y_{\min}$ equation analogous to equation (22) have been estimated by means of the LISREL program (see Appendix B for details). A test has been carried out of the hypothesis that the parameters β_1, β_2, a, κ are the same for the $y_{\min}$ equation and equation (22). This equality of parameters implies equation (25). The results of the estimations with and without imposition of equality of parameters are given in table 2.1.

The first two columns of table 2.1 contain the parameter estimates for the case where equation (22) and the $y_{\min}$ equation are estimated jointly, but without imposition of equality restrictions on the parameters in equation (22), on the one hand, and the $y_{\min}$ equation on the other hand. The last column contains parameter estimates under the restriction that a, β_1, β_2, β_3, κ_1 are identical in equation (22) and the $y_{\min}$ equation. According to the χ^2 statistic the restrictions are not rejected by the data at any reasonable level of significance. Hence we will use the numbers in this last column for the policy simulations. Moreover, we maintain equation (25).

Although the meaning of the parameters will probably become clearer when we turn to policy analysis, a few interpretative comments may be en-

Table 2.1 **Estimation Results**

Parameter	Equation (22)	y^{min} Equation	Equations (22) and y^{min} Combined
a	0.36	0.36	0.37
	(0.05)	(0.06)	(0.05)
β_1	0.17	0.21	0.17
	(0.04)	(0.05)	(0.04)
β_2	0.67	0.70	0.67
	(0.10)	(0.12)	(0.10)
β_3	0.33	0.30	0.33
	(0.10)	(0.12)	(0.10)
κ	0.79	0.89	0.81
	(0.15)	(0.18)	(0.15)
Number of observations	616		616
Degrees of freedom	28		32
χ^2	33.96		37.89

Note: Asymptotic standard errors are in parentheses.

lightening. The estimate of the memory parameter a implies that the weights given to years 0, -1, -2, etc., are 0.64, 0.23, 0.08, 0.02, 0.01, 0.003, etc. Roughly speaking, the horizon is about five years.

The estimates of β_2 and β_3 suggest that one's own past incomes have about twice as much influence on one's present needs (as reflected by μ and $y_{\min}$) than the incomes of others. Referring back to equation (23), the estimate of κ indicates that the social groups as we define them are rather poor proxies of the reference groups of individuals; we cannot reject the hypothesis that $\kappa = 1$. Although we would have liked to have better proxies, the standard errors of the other parameter estimates indicate that these parameters have been estimated with acceptable reliability. Ideally, of course, one would like to have information on the reference group of a respondent. Hence, this is one of our priorities for future data-collecting activities.

To conclude our brief discussion of the parameter estimates, consider β_1. Remember that the number of equivalent adults in a family, f_n, is specified as

$$\ln f_n = \beta_0 + \beta_1 \ln fs_n . \tag{26}$$

This means that if the size of a family changes, say, from fs_1 to fs_2, its cost of living increases by a factor $(fs_2/fs_1)^{\beta_1}$. The equivalence scale implied by this is given in table 2.2.

These equivalence scales are very flat. Obviously, specification (26) is rather primitive and perhaps too restrictive, as it implies that the cost of

Table 2.2 **Estimated Equivalence Scale**

Family Size	Equivalence Scale
1	0.79
2	0.89
3	0.95
4	1
5	1.04
6	1.07
7	1.10
8	1.13

an additional child is a fixed percentage of family income, for any level of family income. In addition, the definition of family size in the survey questionnaire was ambiguous because children away from home, still partly supported by their parents, were counted as part of the family. On the other hand, it should be mentioned that the cost of children in the Netherlands is considerably less than, for instance, the cost of children in the United States, due to various government programs that provide among other things, free education and subsidized housing. Results by Danziger et al. (1984) and Colasanto, Kapteyn, and van der Gaag (1984) for the United States, based on the same subjective measures, show substantially steeper equivalence scales.

As was mentioned before, our model implies that welfare and poverty are entirely relative. In their well-known analyses of Gallup poll data, Rainwater (1974) and Kilpatrick (1973) come to somewhat contrasting conclusions. Rainwater finds that the Gallup measure ("How much does it take a family of four in your community to get along?") is completely relative, i.e., it rises in proportion to median family income in society. Kilpatrick finds that its elasticity with respect to median family income is less than one. The difference between the two authors' results is partly due to differences in method and data. But it is worth noticing that both studies are static. The Gallup measure in a given year is related to median family income in society in the same year, so no allowance is made for the effect of past incomes as in our model. As will be seen in the next section, our model predicts that $y_{\min}$ (which has a rather close relation with the Gallup measure) will tend to be a smaller proportion of median family income, the faster incomes grow. Thus, Kilpatrick's result that the income elasticity of the poverty line falls to a lower level sometime after the war could possibly be explained by a change in the pace of economic growth.

Finally, it should be noted that in the model we have ignored differences in cost of living due to causes other than family size differences. This implies for instance that people in Mississippi and Wisconsin are predicted to have similar responses, as long as their reference groups show a similar in-

come distribution, even though the cost of living may differ substantially between both regions. In contrast, people in Ireland would be predicted to have very different responses than people in West Germany, even though the cost of living might be similar in both countries. For a homogenous country like Holland we did not consider it necessary to account for regional differences in the cost of living. Were the same analysis applied to the United States, for example, then the model should be extended to incorporate regional cost differences similar to the way the effect of family composition has been incorporated. If it were true, however, that people in a region only refer to other people within the same region, then our completely relativistic model would imply that the regional cost differences will come out insignificant.

2.5 Simulations

Given the empirical results reported in the previous section, the two poverty line definitions in section 2.2, and some additional political assumptions, one can derive various income maintenance schemes. In this section we take both the empirical results and the two poverty line definitions for granted and explore the effect of various policy decisions. We first consider some long-term (steady-state) implications; then we turn to some dynamic aspects of the two poverty line definitions.

As far as policy decisions are concerned we consider three possibilities:

1. In the computation of the poverty line, the actual reference group and the actual income history are taken into account, i.e., equations (22) and (A1), and the analagous equation for $y_{\min}$ is used without adaptations.

2. Politicians do not want to honor differences in reference groups, so income maintenance schemes are based on a hypothetical reference group, identical for everybody (e.g., the whole society serves as a reference group for everyone).

3. Politicians, in addition, ignore income histories, thus welfare benefits vary only with family composition. In this case, both the incomes in the reference group and an individual's income history are set at a hypothetical level.

We study the implications of these different policy principles for the two poverty line definitions introduced in section 2.2. We also pay attention to the role played by the rate of economic growth (or decline).

Generally, the analysis will be carried out in per capita terms, i.e., in terms of family income per equivalent adult. This greatly simplifies the algebra and implies that poverty lines always compensate fully for differences in family size. When appropriate, we pay some attention to the welfare effects of not fully compensating for variations in family composition. We ignore the error terms in the estimated equations and the uncertainty in the parameter estimates.

2.5.1 Poverty Lines in a Steady State

The Subjective Definition

By hypothesis (not rejected by the data) there holds

$$\ln y_{min,n} = \mu_n - \gamma_0 , \tag{27}$$

where γ_0 has been estimated to be equal to 0.12, implying that $y_{\min,n}$ equals approximately 88 percent of $\exp(\mu)$. Combining equations (22) and (27), and indicating per capita variables by a tilde on top, one finds

$$\begin{aligned} \ln \tilde{y}_{\min,n} = & -\gamma_0(1 - a) + \beta_2(1 - a)\ln \tilde{y}_n \\ & + \beta_3(1 - a)\tilde{\bar{m}}_n + a \ln \tilde{y}_{\min,n}(-1). \end{aligned} \tag{28}$$

We define an income maintenance scheme based on the subjective definition as one where $\tilde{y}_n(t) = \tilde{y}_{\min,n}(t - 1)$. An alternative approach would be to set $\tilde{y}_n(t)$ equal to $\tilde{y}_{\min,n}(t)$. However, in the data, family income y_n refers to the past period, whereas the MIQ (see beginning of section 2.2) asks for $y_{\min}$ in the present period. So one is able to just make ends meet if $\tilde{y}_n(t) = \tilde{y}_{\min,n}(t - 1)$, since in that case actual family income and stated minimum income refer to the same period and are equal. Whenever $\tilde{y}_n(t) = \tilde{y}_{\min,n}(t - 1)$, we shall so indicate by an asterisk.

To incorporate the possible effect of economic growth, let us assume that median income in the reference group of individual n grows at a constant rate δ. Setting $\tilde{y}_n(t) = y_{\min,n}(t - 1)$ in equation (28), it is easy to show that $\tilde{y}_{\min,n}(t)$ and $\tilde{y}_n(t)$ converge to a steady state in which both grow at the same rate δ, provided that $0 < a < 1$ and $0 < \beta_2 < 1$. In the steady state there holds in each period:

$$\ln \tilde{y}_n^* = \tilde{\bar{m}}_n - \frac{1}{\beta_3}\left\{\gamma_0 + \frac{\delta}{1 - a}\right\} \tag{29}$$

and

$$\ln \tilde{y}_{\min,n}^* = \ln \tilde{y}_n^* + \delta .$$

The poverty line is simply a certain fraction of median income in the reference group of individual n.[5] If politicians do not accept that different people have different reference groups, but substitute, for instance $\tilde{\eta}$ (median per capita income in society) for $\tilde{\bar{m}}_n$, then the poverty line is a certain fraction of median income in society. In either case differences in family size are fully compensated. The distance of $y_{\min}^*$ to median income depends on β_3. The more weight one gives to other people, the closer $y_{\min,n}^*$ will be to $\tilde{\bar{m}}_n$ (or $\tilde{\eta}$). To get an idea of what the number may look like in practice, let $\delta = 0$, and use our estimate for β_3 ($= 0.33$). Then $\gamma_0/\beta_3 = 0.36$. The poverty

5. We call $\exp(\tilde{\bar{m}}_n)$ median per capita income in the reference group. Strictly speaking this terminology is only correct if the geometric mean of incomes, $\tilde{\bar{m}}_n$, coincide with the median, as in the case where incomes are lognormally distributed.

line is then exp(−0.36), 70 percent of median income. In the Netherlands the official poverty line is also approximately 70 percent of median income (again, after tax).

If there is economic growth, $\delta > 0$, the poverty line becomes a smaller fraction of median income. The faster incomes grow, the greater the relative distance between median income and the poverty line can be. (For instance, if $\delta = 0.02$, m_n^* is approximately 63 percent of median income; if $\delta = 0.05$, m_n^* is about 55 percent of median income.) If incomes go down ($\delta < 0$), the poverty line tends to be closer to the median; in fact if $\delta < -\gamma_0 (1 - a)$, the poverty line will even exceed the median. For our parameter estimates this happens if $\delta < -0.08$. In view of the model, this makes perfect sense, because previous incomes codetermine one's minimal needs. If incomes fall quickly enough, not even a median income earner will be able to make ends meet.

It is of interest to contrast this with political practice in the Netherlands, where in times of rising incomes the poverty line was moved closer to the national median income, and where in the present stagnation the poverty line appears to fall slightly faster than median income.

Politicians might decide that neither $\tilde{\bar{m}}_n$ nor $\bar{\eta}$ is the appropriate anchoring point in equation (29). It might be argued that poor people mainly refer to other people who are poor as well, so that $\tilde{\bar{m}}_n$ in equation (29) should be replaced by $\ln \tilde{y}_n^*$. Obviously in that case the poverty line is not defined. This is according to expectation, because the model for the explanation of $y_{\min}$ is relativistic, i.e., the reference group incomes serve as an anchoring point. If these reference group incomes are themselves dependent on $y_{\min}$, a well-defined equilibrium no longer exists.

The Leyden Poverty Line

In order not to burden the exposition with too many technicalities, most of the mathematics for this section are given in Appendix A. The same assumptions are made here as in the "Subjective Definition" section, but in addition it is assumed that the log variance of per capita incomes in the reference group remains constant. As with $y_{\min}$, we assume that a measured WFI pertains to the present period, whereas $\tilde{y}_n$ and $\tilde{\bar{m}}_n$ pertain to the previous period. A Leyden poverty line at time t is then defined as an income $\tilde{y}_n(t)$ satisifying $\ln \tilde{y}_n(t) = \tilde{\mu}_n(t-1) + u_\alpha \cdot \tilde{\sigma}_n(t-1)$, with u_α chosen by the policymakers (cf. equation (8)).

The steady-state behavior of the Leyden poverty line is derived in Appendix A. We mention the following characteristics of the steady state:

1. $\ln \tilde{y}_n$ is monotonically increasing in u_α, as long as $0 < \beta_2 < 1$ and $0 < a < 1$.

2. There are vertical asymptotes for $\ln \tilde{y}_n$ at $u_\alpha = (\beta_3/\beta_2)^{1/2}$ and $u_\alpha = -(\beta_3/\beta_2)^{1/2}$. In other words, we can let $\ln \tilde{y}_n$ vary from $-\infty$ to $+\infty$ and u_α will vary only from $-(\beta_3/\beta_2)^{1/2}$ to $(\beta_3/\beta_2)^{1/2}$. In view of our estimates of β_2

and β_3, this means that u_α has to lie in the interval $(-1/2\sqrt{2}, 1/2\sqrt{2})$, which corresponds to a range of welfare levels between 0.24 and 0.76. Thus it is impossible to create a steady state in which someone is completely satisfied or completely dissatisfied with his income!

The higher β_2 is relative to β_3, the smaller the range of attainable welfare levels will be. The reason for this is that if the habit formation parameter β_2 is high, an individual adjusts her WFI strongly to own income, so no matter how high (or low) her income is, the WFI always catches up with it. It is doubtful, of course, whether the model still holds true for extremely low values of $\tilde{y}_n$, simply because below some point, $\tilde{y}_n$ will be insufficient to purchase enough food to sustain a biological minimum, which makes the notion of a steady state itself illusive. In any case, the results illustrate an important phenomenon: The stronger habit formation is, the less scope there is for socioeconomic policy to influence welfare permanently.

3. Similar to the subjective poverty line, the Leyden poverty line will be closer to the median (of either the reference group or society as a whole if politicians replace $\tilde{\bar{m}}_n$ by $\tilde{\eta}$) if economic stagnation, rather than economic growth, occurs.

4. For $\alpha = 0.5$, (so $u_\alpha = 0$), the Leyden poverty line is given by

$$\ln \tilde{y}_n = \tilde{\bar{m}}_n - \frac{\delta \cdot a}{\beta_3 (1-a)}, \tag{30}$$

which is equivalent to equation (29) for $\gamma_0 = 0$.

5. For $\delta = 0$ (no economic growth) the Leyden poverty line is

$$\ln \tilde{y}_n = \tilde{\bar{m}}_n + \frac{u_\alpha \tilde{\tau}_n}{(\beta_3 - \beta_2 u_\alpha^2)^{1/2}}, \tag{31}$$

where τ_n^2 is the log variance of per capita incomes in the reference group. In this case the poverty line is a certain fraction of median reference group income, where the fraction is smaller if u_α is smaller (assuming $u_\alpha < 0$), $\tilde{\tau}_n$ is larger, and habit formation is stronger. So the poverty line is lower if politicians pick a lower welfare level as a cutoff point, or if incomes in society (or reference group) are more dispersed, or if people pay less attention to the incomes of others.

2.5.2 Dynamics

Let us now investigate some dynamic aspects of income maintenance policies, maintaining the assumptions made above. The analysis in this section is purely numerical. We consider three representative families. The first family comes from a social group with a high median income; the second family comes from a social group with median income equal to median income in the sample (we take the sample median as a proxy for the median in the population); the third family belongs to a social group with a low median income.

For each family eight income paths are considered. The income paths correspond to eight different income maintenance policies. These policies are characterized by three traits.

1. The policy is either based on the Leyden poverty line, based on a welfare level equal to 0.4, or on the subjective poverty line.

2. In setting the poverty line, either the actual reference group of a family is taken into account or the family is assigned the whole society as a reference group (we call that a *hypothetical reference group*).

3. Either the income maintenance policy is only based on steady-state values of all variables, or benefits also depend on one's income history (we call the latter case *smooth adaptation*).

These three traits define a complete design of eight different income maintenance policies. For each policy we also consider the satisfaction with income in each period. All analyses are in per capita terms. For some selected cases we will also present the effects of not compensating for differences in family size. The rate of economic growth, δ, is set at 0.02.

The eight different income maintenance policies can be presented by means of four sets of diagrams. The first two sets refer to the Leyden poverty line and the last two sets refer to the subjective poverty line. For reasons of space only the first two sets are given here. The labels on the figures are self-explanatory.

In figure 2.3a the income paths of the three families converge to identical trajectories. The corresponding utility levels, drawn in figure 2.3b, each converge to a constant, but this constant is highest for the family with the poorest reference group and lowest for the family with the richest reference group. The only family that actually attains the prescribed welfare level of 0.4 is the middle family, for which actual and hypothetical reference groups coincide.

In figure 2.3c the income paths do not converge to the same trajectory, but now the welfare paths in figure 2.3d do. Apparently we are faced with a choice between equity in income terms (figs. 2.3a and 2.3b) or equity in welfare terms (figs. 2.3c and 2.3d), but in the latter case we have to accept that different families receive different amounts of benefits simply because they happen to have different reference groups.[6]

The families in figures 2.4a and 2.4b are not given time to adjust to their new income situation after they become eligible for benefits. The benefit level is set at the steady-state level (with a hypothetical reference group). Figure 2.4b shows that the first few years are hard on the previously well-to-do family. The poorest of the three families enjoys an increase in income and welfare by entering the income maintenance program.

Figures 2.4c and 2.4d are similar to figures 2.4a and 2.4b. The first-year welfare dips of the well-to-do and median family are somewhat mitigated

6. We have equated equity with equality here, which is not necessarily the best thing to do.

Figure 3a

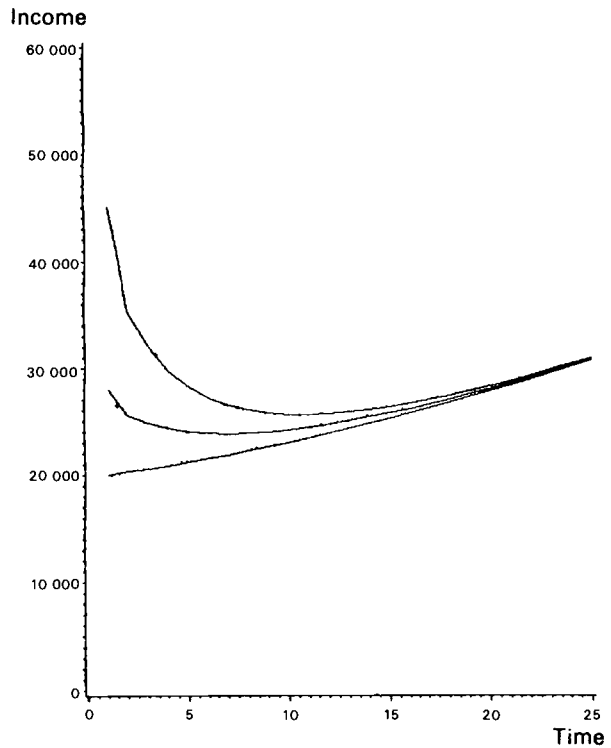

Figure 3c

D 4765.3

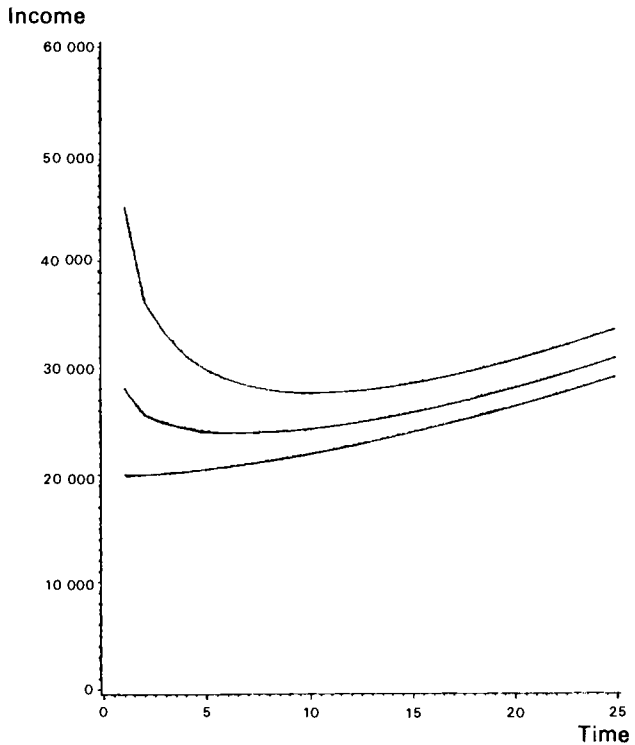

Figure 3b

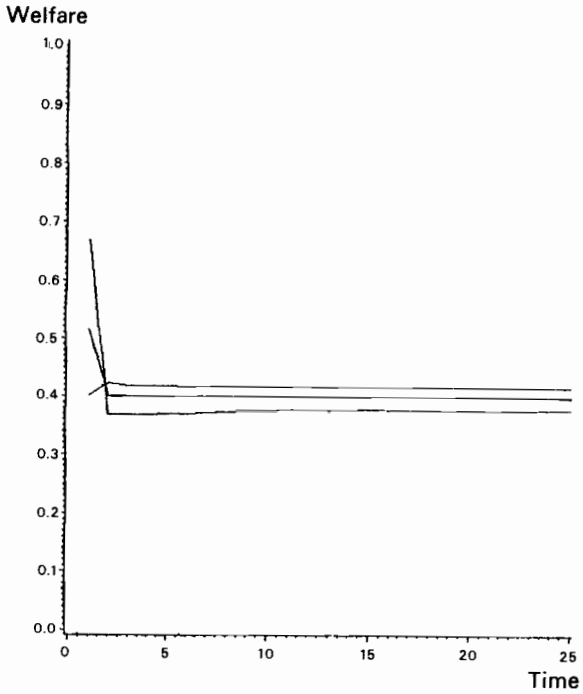

Figure 3d

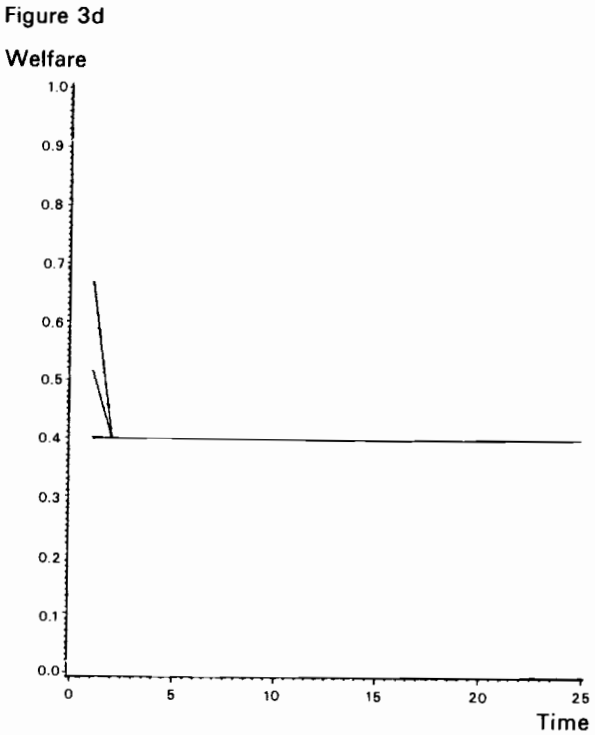

Fig. 2.3. Income paths and corresponding welfare paths for the Leyden poverty line, with smooth adaptation and hypothetical (left) and actual reference group (right).

Figure 4a

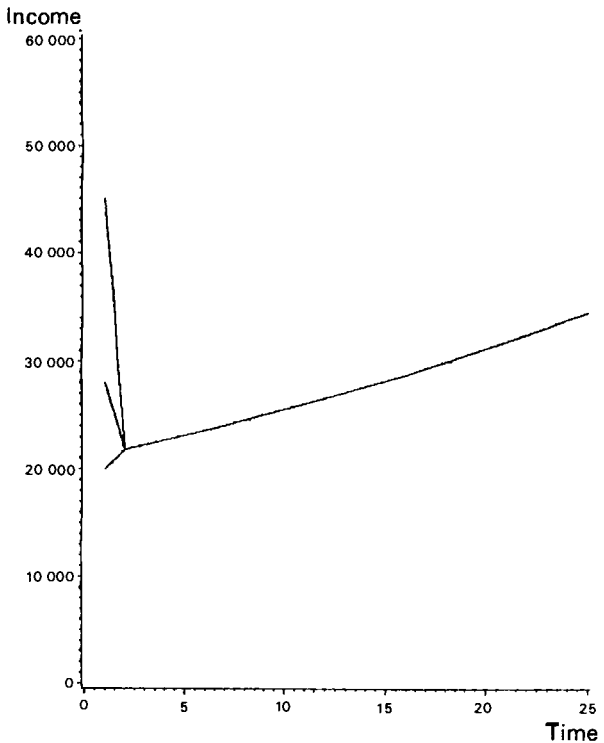

Figure 4c

D 4765.4

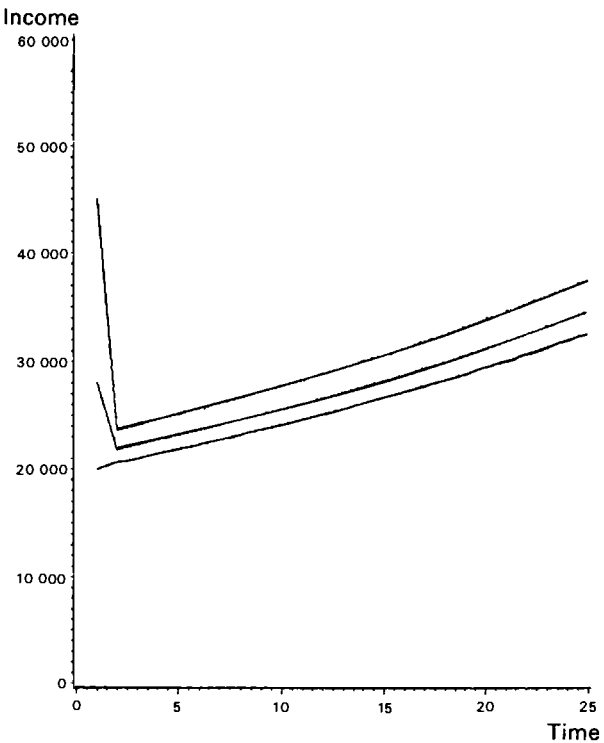

Figure 4b

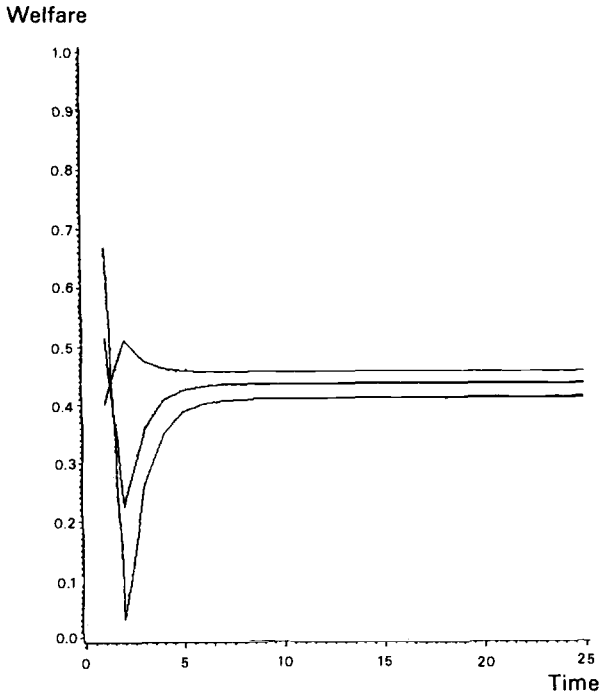

Figure 4d

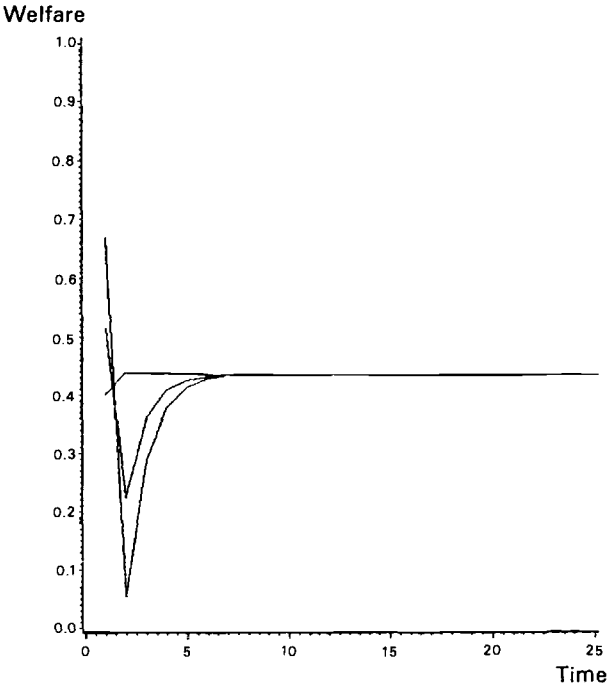

Fig. 2.4. Income paths and corresponding welfare paths for the Leyden poverty line, with prompt adaptation and hypothetical (left) and actual reference group (right).

Figure 5a

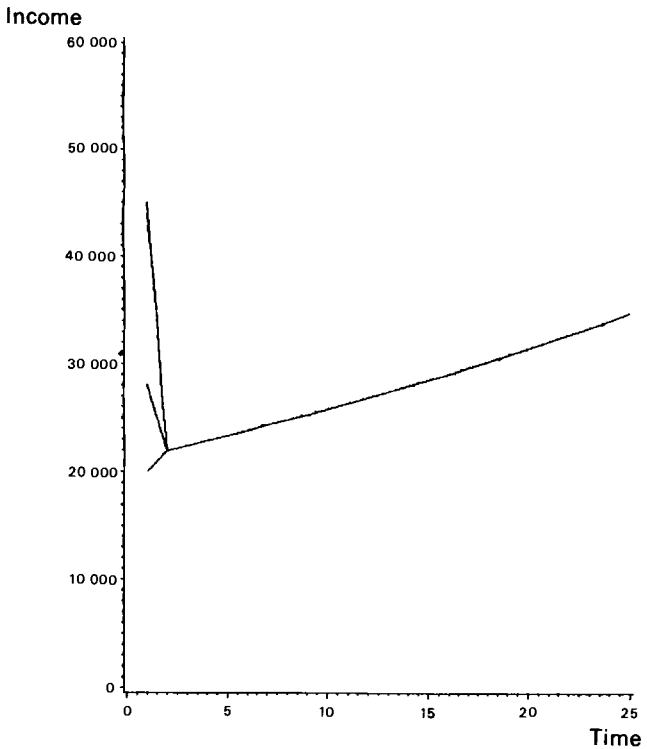

Figure 5c

D 4765.5

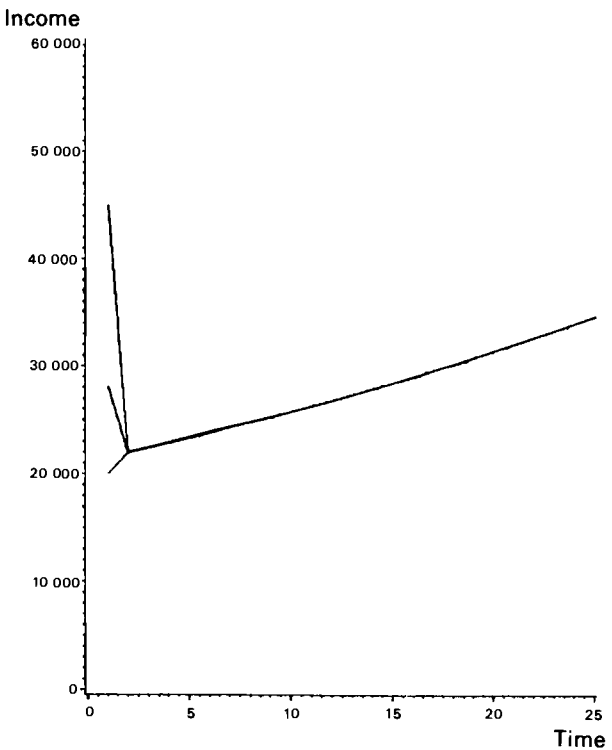

Figure 5b

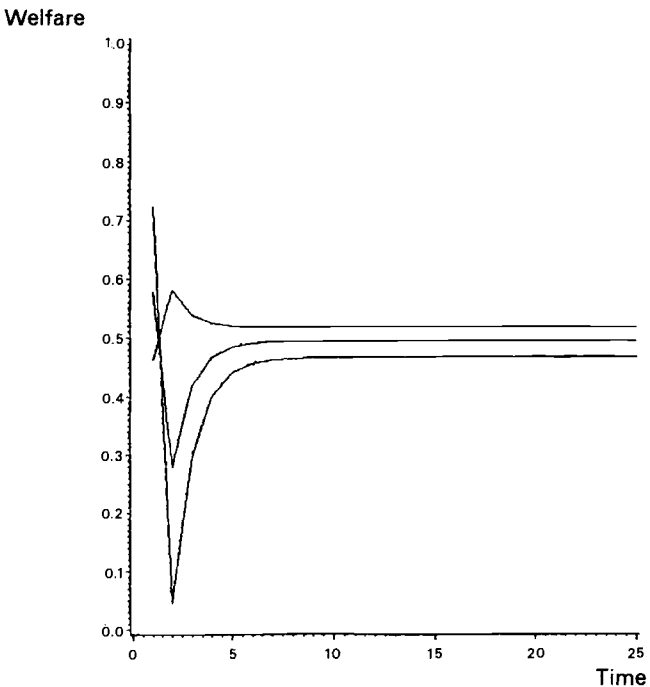

Figure 5d

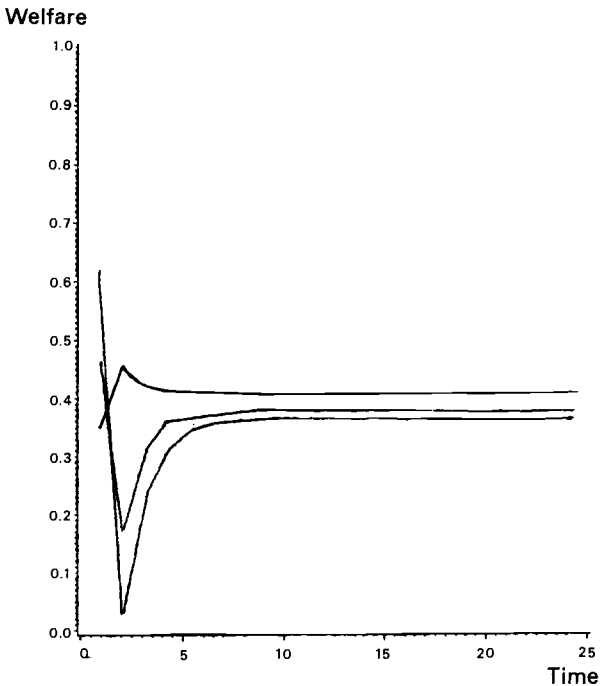

Fig. 2.5. Income paths and corresponding welfare paths for the Leyden poverty line, with prompt adaptation and hypothetical reference group, for family size = 1 (left) and family size = 8 (right).

in this case. After approximately five years the three families enjoy the same welfare level. This equality of welfare levels is achieved by allotting different amounts of benefits to the three families.

It so happens that, in the steady state, the subjective poverty line corresponds to a utility level of only slightly less than 0.4, so numerically the Leyden poverty line and the subjective poverty line are close together. As a consequence, the time paths for the subjective poverty line in the various cases are very similar to those of the Leyden poverty line. For reasons of space we do not present these graphs.

Finally, figures 2.5a and 2.5b give income and utility paths for the same cases as considered in figures 2.4a and 2.4b, but now the income compensation is based on a family size of three for every family, irrespective of its size. In figures 2.5a and 2.5b we see what this means for a family of size 1, whilst figures 2.5c and 2.5d tell the story for a family of size 8. The drawings are very much according to expectation. The one-person household gets a bonus and the eight-person family will have a hard time making ends meet.

2.6 Concluding Remarks

Given the model, one can simulate the effects of a variety of income maintenance programs on the distribution of well-being (as measured by our two subjective measures) of program participants. At the present stage, that would seem far too pretentious. The model is based on a rather small longitudinal data set for one country, and the specification of family composition effects is primitive. More importantly, the model does not have any behavioral relations.

However, the policy simulations have revealed a number of issues that have to be dealt with in the design of income maintenance policies. These issues do not depend heavily on the correctness of the model, but they do rest on the assumption that poverty is at least partly relative. Let us briefly summarize some of the issues.

Habit formation. The policy principles embodied in the two poverty line definitions require families to be able to make ends meet or to attain some prescribed minimum welfare level. To be consistent with these principles, we may have to pay very high initial compensations to, for instance, a former top executive of a firm that went bankrupt (leaving aside the possibility that this man can draw from savings accumulated in more prosperous times or from some kind of insurance policy). Politically, such high initial compensations will probably be considered absurd. Yet not paying these large sums amounts to a policy that is inconsistent in that the basic principle is not applied to all citizens. Former top executives of bankrupt firms apparently get a very small weight in the social welfare function.

Reference groups. We have seen various instances where consistent application of the policy principles leads to different benefit levels for people

with different reference groups. If you have rich friends you are entitled to more support. Politically, this is once again hard to accept. It might mean, for example, that blacks would in general receive less income support than whites. But not taking reference groups into account means that differences in utility persist (cf. figs. 2.3a and 2.3b, 2.4a and 2.4b). If one conceives of a social welfare function as defined in terms of individual utilities, this means that people get less weight the richer their reference group is.

Which poverty line? Our analysis has been based on only two, perhaps rather special, definitions of poverty. We believe that other definitions, as long as they allow for a relativistic component in poverty, would yield similar conclusions. As the Leyden poverty line and the subjective poverty line lead to such similar results, not much of a choice exists between the two. The main difference between them is that, with the Leyden poverty line, a degree of freedom is left for politicians, since they bear the responsibility of choosing the utility cutoff point α. Whether politicians will appreciate having this responsibility remains to be seen.

Family size. In the policy simulations we have paid little attention to the effect of family size, because we took it for granted that most people would agree that differences in the cost of living caused by differences in family composition should be compensated for. Still one could argue that habit formation, reference groups, and family size all play the same role in that each influences parameters of the utility function. What sets family size apart is probably the term *cost of living,* which lends itself an objective nature. For the same reason distinctions according to region or farm/nonfarm are often accepted as a basis for differentiating benefit levels.

Of course *cost of living* is a rather arbitrary expression. It refers to the income compensation necessary to allow families of different composition to attain the same level of well-being. Precisely according to this definition, we can say that a person faces a high cost of living because he or she has rich friends.

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Appendix A
Steady-State Analysis of the Leyden Poverty Line

Analogous to equation (22) the following expression for σ_n^2 can be derived:

$$\begin{aligned}\sigma_n^2 &= \beta_2(1-a)d_n^2 + \beta_3(1-a)s_n^2 \\ &\quad + \beta_3\beta_1^2(1-a)r_n^2 - 2\beta_3\beta_1(1-a)c_n \\ &\quad + al_n^2 + a\beta_1^2p_n^2 - 2a\beta_1\omega_n + a\sigma_n^2(-1) + \delta_n - a\delta_n(-1),\end{aligned} \tag{A1}$$

where

$$d_n^2 = (\ln y_n - \xi_n)^2, \tag{A2}$$

$$\xi_n = \mu_n - \epsilon_n, \tag{A3}$$

$$s_n^2 = \sum_k q_{nk}(\ln y_k - \xi_n)^2, \tag{A4}$$

$$r_n^2 = \sum_k q_{nk}(\ln fs_k - \ln fs_n)^2, \tag{A5}$$

$$c_n = \sum_k q_{nk}(\ln y_k - \xi_n)(\ln fs_k - \ln fs_n), \tag{A6}$$

$$l_n^2 = [\xi_n - \xi_n(-1)]^2, \tag{A7}$$

$$\xi_n(-1) = \mu_n(-1) - \epsilon_n(-1), \tag{A8}$$

$$p_n^2 = [\ln fs_n - \ln fs_n(-1)]^2, \tag{A9}$$

$$\omega_n = [\xi_n - \xi_n(-1)][\ln fs_n - \ln fs_n(-1)]. \tag{A10}$$

In principle, we can estimate equations (22) and (A1) jointly, by means of maximum likelihood, assuming that ϵ_n and δ_n are jointly normally distributed. Equation (A1) is substantially more difficult to estimate than equation (22), because it contains quadratic terms like c_n, s_n^2 and l_n^2 that involve the unobservables ξ_n and $\xi_n(-1)$. Since equation (22) contains the same parameters as equation (A1), the parameters can also be estimated by just using equation (22). This neglect of equation (A1) may cause loss of accuracy of the estimates, but it does not cause inconsistency. For the sake of simplicity we have chosen to use only equation (22) in estimation. In the simulations, equations (22) and (A1) are both used.

Rewrite equations (22) and (A1) in per capita terms:

$$\tilde{\mu}_n = \beta_2(1 - a)\ln \tilde{y}_n + \beta_3(1 - a)\,\tilde{\bar{m}}_n + a\tilde{\mu}_n(-1), \tag{A11}$$

$$\tilde{\sigma}_n^2 = \beta_2(1 - a)\,\tilde{d}_n^2 + \beta_3(1 - a)\,\tilde{s}_n^2 + a\,\tilde{l}_n^2 + a\tilde{\sigma}_n^2(-1). \tag{A12}$$

Under the assumptions of the section "Leyden Poverty Line," the steady-state solutions for $\ln \tilde{\bar{y}}_n, \tilde{\mu}_n$, and $\tilde{\sigma}_n^2$ have to satisfy the following three equations:

$$\tilde{\mu}_n = \beta_2 \ln \tilde{\bar{y}}_n + \beta_3 \tilde{\bar{m}}_n - \frac{a}{1 - a}\,\delta, \tag{A13}$$

$$\tilde{\sigma}_n^2 = \beta_2(\ln \tilde{\bar{y}}_n - \tilde{\mu}_n)^2 + \beta_3(\tilde{\bar{m}}_n - \tilde{\mu}_n)^2 + \beta_3\,\tilde{\tau}_n^2 + \frac{a}{1 - a}\,\delta^2, \tag{A14}$$

$$\ln \tilde{\bar{y}}_n = \tilde{\mu}_n - \delta + u_\alpha \cdot \tilde{\sigma}_n, \tag{A15}$$

where

$$\tilde{\tau}_n^2 \equiv \sum_k q_{nk}(\ln \tilde{y}_k - \tilde{\bar{m}}_n)^2.$$

Elimination of $\tilde{\mu}_n$ and $\tilde{\sigma}_n^2$ from this system yields the following quadratic equation in $(\ln \tilde{y}_n - \tilde{m}_n)$:

$$x^2\beta_3(\beta_3 - \beta_2 u_\alpha^2) + 2\beta_3 xz + (1 - u_\alpha^2 a^2)z^2 - u_\alpha^2(\beta_3\tilde{r}_n^2 + a.\delta.z) = 0, \tag{A16}$$

where

$$x \equiv (\ln \tilde{y}_n - \tilde{m}_n) \text{ and } z = \delta/(1 - a).$$

The solution for $\ln \tilde{y}_n$ is:

$$\ln \tilde{y}_n = \tilde{m}_n + \frac{-\beta_3 z + u_\alpha[\beta_3\{(\beta_3 a^2 - \beta_2 u_\alpha^2 a^2 + \beta_2)z^2 + (\beta_3 - \beta_2 u_\alpha^2)(\beta_3\tilde{r}_n^2 + a.\delta.z)\}]^{1/2}}{\beta_3(\beta_3 - \beta_2 u_\alpha^2)}. \tag{A17}$$

Note that there are vertical asymptotes at $u_\alpha = (\beta_3/\beta_2)^{1/2}$ and $u_\alpha = -(\beta_3/\beta_2)^{1/2}$ as claimed in section 2.5.1. The condition that u_α is between those extreme values guarantees convergence of the system to the steady state. The various characteristics of the steady state reported in section 2.5.1 follow from equation (A17).

Comment

Harold W. Watts

This chapter develops a theory about how individuals' subjective evaluation of their income status depends on social context and accumulated experience. The framework the authors present lends itself to two alternate approaches to the definition of poverty thresholds. An empirical section provides estimates of a particular specification of this model, and from these estimates illustrative examples show how income support targets would adapt for families with differing starting points in a world of steady growth.

As a part of the growing literature on subjective measures of utility, the first part of this chapter is very interesting and valuable. There are some interesting empirical regularities in the data from subjective questions such as the MIQ and IEQ; they must mean something. I am not yet fully convinced that we have figured out what question is really being answered, but the structure spelled out in this paper is a welcome addition to the conjectures. I fully share the notion that normative standards of some sort are formed in some way for some set of social groupings. I see a major challenge in eliciting and understanding their more precise meaning.

The process postulated by the authors for forming the perceived income distribution places familiar strains on the "as if" method of theorizing

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about complex data-processing problems. The expressions presented in the paper are formidable for a person not yet familiar with household computers, so the typical individual must simply act "as if" he or she had evaluated such expressions. Aside from that, however, where do people get quantitative perceptions about money income levels? If television is as pervasive as it seems, and if the life-styles observed there can influence individual perceptions, then a very important societywide influence should be recognized. But I still have trouble understanding how money income (adjusted to a per-adult-equivalent basis of course) is estimated by everyone for everyone on the basis of every-day observations. People do not directly advertise their (normalized) income levels and may even try to deceive. Neither are such levels to be found as part of the documentation presented at the end of films and television programs. I would like to see more attention given to the problem of data gathering and processing, which must provide some plausible counterpart to the elaborate structure devised by the authors.

On a more basic level I have a problem with the identification of the empirical measures as "utility." Our training as economists may make utility a useful metaphor in this case, but repetition of the term may lead to taking the idea too seriously. In fact, we have some empirical regularities in search of a concept and, in utility, a concept in search of empirical realization. They have found each other, but I am not sure it is a stable union. The authors acknowledge that the proposed utility is partial—it is based only on income status, and at least a few other aspects of one's life and circumstances would have to be considered in a comprehensive measure. But this partial utility is expressed by a single member of a household, and whether that one is a despot, dependent, or something else, some question remains about how well that person can represent all family members. A parent who enjoys his or her large family may have a very different view about income adequacy than the children who were never canvassed about their preferred number of siblings. How, indeed, does one aggregate this "utility"? Is it assumed that each member of the family enjoys the same, undiminished common level of utility indicated by the respondent, or is the answer a measure of a total that must be shared out among all persons (and not just the "equivalent adults")?

When the model is specified for purposes of estimation, the double-log specification for the adult equivalent function was introduced. That specification was not tested, or at least the tests are not reported, but the elasticity seems extreme enough to suggest further examination. The implied economies of scale—12 to 15 percent more income provides the same utility for twice as many persons—would seem to have enormous policy implications if it could be believed. A campaign to raise real income by forming confederations of households would seem irresistable. Otherwise the estimates are not very remarkable, nor are they strongly inconsis-

tent with the convenient approximations involved in ignoring reference groups smaller than nations and assuming that most adjustments to changed circumstances take place within a year or so. The strong influence of personal experience relative to perceptions of others leaves a need for careful modeling of relative income status, but places a definite limit on the homogeneity of income utility scales among individual respondents. The minimum or "ends meet" income appears to be at about 88 percent of the median of individual perceived income distributions, which seems rather high on an intuitive basis, but there may be reasons in the particulars of Dutch society or policies that can explain this finding.

The attempt to apply the utility model to public policy issues is what I find least persuasive. This part of the chapter seems naïve at least and may well be misleading. First, the simulated policy is a simplistic and generally discredited form of policy—that of "filling the gap" by granting whatever is the shortfall from some guarantee level stated either in income per adult equivalent or in terms of a prescribed dose of "utility" as defined in the theory. Such a policy is appropriate only if households are behaviorally inert. They must be subject only to exogenous determination of income flows, wealth accumulation, and family composition, making no decisions on their own that influence these matters. The authors recognize the absence of any behavioral response, but they do not indicate that features sensitive to such responses might largely dominate the choice of policies.

Even if the problem of incentives is ignored, it is doubtful that the objectives of public policy are well captured by seeking to maximize or equalize the narrowly defined utility (of money income only) as perceived through the eyes of one household "spokesperson." Indeed it seems quite likely that the purpose and justification of policy intervention is based on considerations that are *not* well reflected in the sort of additive and separable (by family) social welfare function (or fragment of one) that is represented here. In particular, the social objective may be more closely related to the external consequences of the household's investment and production activities than to its self-evaluated consumption. Certainly the impact of child-rearing activities on the productivity of future generations carries part of the justification for antipoverty transfers. Just how that issue is reflected in answers to survey questions about the level of a "good" income is far from clear.

We might ask what levels of deprivation or adequacy impair or enhance the next generation's capacity to support itself and the dependents it will inherit and produce. This form of the question may also have important relative aspects and may even be evoked from responses to survey questions. But it is not likely that this notion is the same as the more hedonistic assessment suggested by the IEQ and by the utility metaphor presented here.

Again, even if the consumption flow is given high priority in the social purpose, the current money income measure is a very weak proxy, and it certainly is not uniformly related to consumption among different low-income (or low-consumption) groups. Hence policies that contemplate giving higher public grants to those who have experienced higher consumption (either directly or vicariously) should consider whether that same history of well-being is reflected in wealth, credit, and access to private transfers. If so, the paradox of giving more to the formerly rich is not likely to occur.

The things not considered in the specimen policies examined in this paper will generally outweigh the weak influences of reference group and lagged response of perceptions on any realistic policy. In most cases I can think of, real policies would probably tilt in the opposite direction. Those with rich friends and family connections would get less so as to maintain rough equity with those whose family and friends cannot provide access to private resources of various kinds. Similarly, a loss of income for a low-earning person cannot plausibly be supplemented by drawing on past savings or credit lines. Those in low-cost and low-income areas might sometimes receive higher benefits as an attempt to "catch up" in development of that human capital that had suffered from prior deprivation. Effects on the incentive to migrate are likely to receive the most intense political attention, and some of that is deserved. All of these considerations are more important and more directly related to public policy than the issues introduced in this paper. There is little danger that well-formed policies will give bigger benefits to the formerly rich, even if full allowance is made for the influences discussed by the authors.

In the matter of making utility or happiness a direct focus of policy, I am inclined to demur. I remain more comfortable with the notion of happiness as something to be pursued, not something that the government catches and presumes to dole out. I think public policy has more urgent and more feasible tasks.

So where are we? The chapter presents an interesting rationale for a fascinating empirical regularity. The resulting model, when implemented, yields plausible or at least interpretable estimates that give a definite but limited role to lagged adjustments and to the influence of prevailing general income levels in forming perceptions and income standards. The leap to policy prescriptions is very premature and ill considered in my view. The issues raised by the model are among the least important for income maintenance policies, and considered alone, as they are, lead to apparently paradoxical results that probably would not be noted in realistic policies. Whether the subjective and relative approaches can give real guidance to policy in this area remains to be seen, but a much more sophisticated specification of public (and private) objectives is a clear prerequisite.

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