The impact of changes in income and family composition on subjective measures of well-being
Kapteyn, A.J.; van de Geer, S.; van de Stadt, H.

Publication date:
1983

Link to publication

Citation for published version (APA):
REEKS "TER DISCUSSIE"
THE IMPACT OF CHANGES IN INCOME AND FAMILY COMPOSITION ON SUBJECTIVE MEASURES OF WELL-BEING

by

Arie Kapteyn
Sara van de Geer
Huib van de Stadt

Preliminary Draft

*) Arie Kapteyn and Sara van de Geer are at Tilburg University. Huib van de Stadt is at the Netherlands Central Bureau of Statistics. Financial support from the Netherlands Organization for the Advancement of Pure Research is gratefully acknowledged. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Netherlands Central Bureau of Statistics.
Appendix A will be added to the next version of the paper.
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 job and consequently they apply for welfare benefits. Should the welfare benefits for the two families differ because they have different needs?

Probably many people will say "no" to this question. But in a slightly different context they might say "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 the different countries have different reference groups. If we would choose to ignore these variations in needs 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 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 a fact is that for instance unemployment benefits in a number of western countries are related to previous earnings and decrease over time. At least one explanation for such a set-up is that one wants to
give people time to adjust their needs.

These two examples suggest that at least sometimes policy makers acknowledge that poverty is a relative concept, in that it is related to the standard of living of the society one lives in and to previous incomes. 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 incomes.

In this paper we employ a model that takes 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 one is a measure of how much an individual feels 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 paper.

In Section 2 we present the subjective measures and the poverty line definitions based on them. In Section 3 we present the model which 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 4. Taking the model for granted, we explore in Section 5
the optimality and consequences of different forms of income maintenance policies. Section 6 contains some concluding remarks.

As always, the analysis in the paper 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", "satisfaction" freely and interchangeably, these words have the very restrictive meaning implied by the two subjective measures used. Secondly, 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., eg., Moon and Smolensky 1978) and future work should use more elaborate concepts.
2. Two Poverty Line Definitions

2.1. The Subjective Poverty Line

The respondents to the survey used in this paper, were asked the following question (in Dutch):

"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, $y_{\text{min}}$. This minimum income is a subjective quantity that will probably depend on the respondent's characteristics, like his income, family composition, income in the reference group, etc. We write

\[ y_{\text{min}} = y_{\text{min}}(y,x), \]

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

Figure 1 about here

The lines labelled I, II and III represent three versions of (2.1) corresponding to three different $x$-vectors. Generally, if $x$
changes, the relation between \( y_{\text{min}} \) and \( y \) will change, as illustrated. Let us concentrate on one particular value of \( x \), say the value of \( x \) which 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 we have that \( y_{\text{min}} = y \). Let us call that income \( y^* \), so that \( y^* \) satisfies

\[
y^* = y_{\text{min}}(y^*, x).
\]

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

There is an alternative motivation to take \( y_{\text{min}}^* \) as a definition of a poverty line. Consider an individual with income \( \bar{y} \). His response to the MIQ is \( \bar{y}_{\text{min}}^* \), representing what he feels to be the minimum amount that will allow him to just make ends meet. Now imagine that we actually take \( y - \bar{y}_{\text{min}}^* \) away from him. Then at first he will consider \( \bar{y}_{\text{min}}^* = \bar{y} \) as minimal but after a while he will get used to the income level \( \bar{y} \) and according to (2.1) he will now consider \( \bar{y}_{\text{min}}^* \) as minimal. If we next take \( y - \bar{y}_{\text{min}}^* \) 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 \( y_{\text{min}} \) will keep adjusting until we have reached \( y_{\text{min}}^* \) (Later on we will have more to say about the dynamics of the adjustment of \( y_{\text{min}} \)). 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 \( y_{\min}^* \) no errors arise because the respondent's actual income is equal to his minimum income. It is this interpretation which led Goedhart et al. (1977) to adopt \( y_{\min}^* \) as their definition of a poverty line.

\( y_{\min}^* \) depends on \( x \), so 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. (1981) and Colasanto et al. (1983) have used this approach to derive poverty lines with equivalence scales accounting for differences in family size, sex of the family head, age of the family head (under or over 65), and whether or not a household lives on a farm. Below, \( x \) will be specified to include past incomes, reference group incomes, and family sizes.

It is worth noting that \( y_{\min}^* \) depends only on what people themselves consider to be minimal. There are no interpersonal utility comparisons involved and 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 on what is minimally needed that is the basis for this definition. This puts a heavy burden on the wording of the question and it 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 specified in this paper.
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 you consider, in your circumstances, to be very bad? And bad, insufficient, sufficient, good and very good?" Please enter an amount on each line

<table>
<thead>
<tr>
<th>Income Level</th>
<th>Dfl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>very bad</td>
<td>......</td>
</tr>
<tr>
<td>bad</td>
<td>......</td>
</tr>
<tr>
<td>insufficient</td>
<td>......</td>
</tr>
<tr>
<td>sufficient</td>
<td>......</td>
</tr>
<tr>
<td>good</td>
<td>......</td>
</tr>
<tr>
<td>very good</td>
<td>......</td>
</tr>
</tbody>
</table>

Please enter an amount on each line

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 Fig. 2.

Figure 2 about here

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 approximately lie on a lognormal distribution 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 which 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) and Antonides et al. (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 $\mu$ and $\sigma$. The parameter $\mu$ is a location parameter; $\exp(\mu)$ is the income level evaluated by 0.5. Thus, the larger $\mu$ (or $\exp(\mu)$, for that matter) is, the more income one needs to attain a certain welfare level. The parameter $\sigma$ determines the slope of someone's WFI. The larger $\sigma$ is, the flatter a WFI will be. The parameters $\mu$ and $\sigma$ are easily estimated per respondent by fitting a lognormal function through the scatter of points in Figure 1 (see, e.g., Van Herwaarden and Kapteyn 1981, for details).

Once WFI's 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 of non-poverty is a political decision. Suppose that politicians decide that $\alpha$ 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 $\mu$ and $\sigma$. Then this individual is poor or nonpoor depending on whether or not

\[(2.3) \quad U(y) < \alpha.\]

Given the lognormal specification of $U(y)$, (2.3) is equivalent with

\[(2.4) \quad \Lambda(y ; \mu, \sigma) < \alpha,\]

where $\Lambda(\cdot ; \mu, \sigma)$ is the lognormal distribution function with parameters $\mu$ and $\sigma$. Equation (2.4) is in turn equivalent with

\[(2.5) \quad N([\ln y - \mu] / \sigma ; 0,1) < \alpha,\]

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

Define $u_\alpha$ by

\[(2.6) \quad \alpha = N(u_\alpha ; 0,1),\]

i.e. $u_\alpha$ is then $\alpha$-quantile of the normal distribution. Then (2.5) is equivalent with

\[(2.7) \quad [\ln y - \mu] / \sigma < u_\alpha.\]
So, given $\mu$ and $\sigma$, it is easy to determine which income is required to make an individual nonpoor. The poverty line is simply

\[(2.8) \quad \hat{y} = \exp[\mu + \sigma u_\alpha].\]

It turns out, however, that both $\mu$ and $\sigma$ 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 $\alpha$ has to be a political one, Van Praag et al. (1980) dubbed this poverty line a "politically determined poverty line", which terminology was also adopted by Colasanto et al. (1983). Since, in the end, the adoption of any poverty line involves political decisions, the term "politically determined" is unfortunate. Van Praag et al. (1982) call this poverty line 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 does not distinguish it from the subjective poverty line, but at least the name "Leyden Poverty Line" is sufficiently uninformative to avoid confusion with other approaches. Hence we adopt this name here.
3. Determinants of $\mu$, $\sigma$ and $\gamma_{\text{min}}$

3.1. Determinants of $\mu$ and $\sigma$

The model for the explanation of $\mu$ and $\sigma$ follows straightforwardly from a theory of preference formation put forward in Kapteyn (1977). Recent investigations into the theory's validity are Kapteyn et al. (1980) and Van de Stadt et al. (1983).

Specialized to the present context, the theory amounts to the hypothesis that an individual's WFI is nothing else than a perceived income distribution. That is, an individual evaluates any income level by its ranking in the income distribution he perceives. This perceived income distribution summarizes the incomes the individual has experienced over his lifetime. These incomes may be his own past incomes or his 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 non-negative 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. 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 \( F_n(y|t) \), then its definition is

\[
(3.1) \quad F_n(y|t) = \sum_{\{k; y_k(t) < y\}} w_{nk}(t).
\]

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

\[
(3.2) \quad \sum_{t=-\infty}^{0} a_n(t) = 1, \quad n = 1, \ldots, N.
\]

The presently perceived distribution function \( F_n(y) \) can now be defined as

\[
(3.3) \quad F_n(y) = \sum_{t=-\infty}^{0} a_n(t) F_n(y|t).
\]

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 income, 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 incomes 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

$$Y_k(t) = \frac{Y_k(t)}{f_k(t)}.$$  

The reformulation of $U_n(y)$ in terms of per capita incomes amounts to a transformation of the income scale: $y$ is replaced by $\tilde{y} = \frac{y - \mu_n}{\sigma_n}$ and $e^n$ by $e_{\tilde{y}}$. Consequently,

$$U_n(y) = N(ln(y; \mu_n, \sigma_n)) = N(ln(\frac{\tilde{y}}{f_n}; \mu_n - ln f_n, \sigma_n)).$$

Replacing $y_k(t)$ and $y$ in (3.1) and (3.3) by $\tilde{y}_k(t)$ and $\tilde{y}$, we obtain the perceived distribution of per capita incomes $\tilde{F}_n(\tilde{y})$.

The theory of preference formation now states

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

Equation (3.6) 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, (3.6) is hardly operational, because $\tilde{F}_n$ has not been specified. Also for the purpose of policy simulations, the main goal of this paper, 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 $\tilde{F}_n(\tilde{y})$ by $\tilde{m}_n$.

$$(3.7) \quad \tilde{m}_n = \int_{-\infty}^{\infty} \ln \tilde{y} \, d\tilde{F}_n(\tilde{y}) = \sum_{t=-\infty}^{0} a_n(t) \sum_{k=1}^{N} w_{nk}(t) \ln \tilde{y}_k(t).$$

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

$$(3.8) \quad \tilde{\mu}_n = \ln f_n + \tilde{m}_n + \epsilon_n$$

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

$$(3.9) \quad \tilde{\sigma}_n^2 = \sum_{t=-\infty}^{0} a_n(t) \sum_{k=1}^{N} w_{nk}(t) [\ln \tilde{y}_k(t) - \tilde{m}_n]^2 + \delta_n.$$

The measurement errors in $\mu_n$ and $\sigma_n^2$ and errors in the equations are taken into account by means of the i.i.d. distributed disturbance terms $\epsilon_n$ and $\delta_n$, with zero means and variances $\sigma_{\epsilon}^2$ and $\sigma_{\delta}^2$.

Although (3.8) and (3.9) 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 of all we assume that $w_n(t)$ is the same for all indivi-
duals 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 $\beta_0 + \beta_1 \ln f_{sk}(t)$ where $f_{sk}(t)$ 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{equation}
q_{nk}(t) = w_{nk}(t)/\beta_3, \quad k \neq n
\end{equation}

\begin{equation}
\equiv 0, \quad k = n
\end{equation}

\begin{equation}
\overline{m}_n(t) = \sum_k q_{nk}(t) \ln y_k(t),
\end{equation}

\begin{equation}
\overline{h}_n(t) = \sum_k q_{nk}(t) \ln f_k(t) = \beta_0 + \beta_1 \left\{ \sum_k q_{nk}(t) \ln f_{sk}(t) \right\} = \\
\equiv \beta_0 + \beta_1 \overline{h}_s(t),
\end{equation}

where $\overline{h}_s(t)$ is defined implicitly. So, $\overline{m}_n(t)$ and $\overline{h}_n(t)$ 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 (3.8) as

\begin{equation}
\mu_n = \ln f_n + (1-a) \sum_{t=0}^{\infty} a^{-t} \beta_2 \left\{ \ln y_n(t) - \ln f_n(t) \right\} + \\
+ \beta_3 \left\{ \overline{m}_n(t) - \overline{h}_n(t) \right\} + \epsilon_n
\end{equation}

Next we apply the Koyck transformation and use the expression for $\ln f_n$ to write (3.13) in lagged form as follows:
(3.14) \[ \mu_n = [1-\beta_2(1-a)]\beta_1 \lnfs - a\beta_1 \lnfs (-1) + \beta_2(1-a)\lny + \beta_3(1-a)\tilde{m}_n \]

\[- \beta_3(1-a)\beta_1 \lns_n + a\mu_n(-1) + \varepsilon_n - a\varepsilon_n(-1). \]

Going through a similar derivation regarding \(\sigma^2_n\) we find that (3.9) can be rewritten as

(3.15) \[ \sigma^2_n = \beta_2(1-a)d_n^2 + \beta_3(1-a)s_n^2 + \beta_3\beta_1(1-a)r_n^2 - 2\beta_3\beta_1(1-a)c_n \]

\[ + a\xi_n^2 + a\beta_1 p_n^2 - 2a \beta_1 \omega_n + a\sigma_n^2(-1) + \delta_n - a\delta_n(-1), \]

where

(3.16) \[ d_n^2 = (\lny_n - \xi_n)^2 \]

(3.17) \[ \xi_n = \mu_n - \varepsilon_n \]

(3.18) \[ s_n^2 = \sum_k q_{nk}(\lny_k - \xi_n)^2 \]

(3.19) \[ r_n^2 = \sum_k q_{nk}(\lnfs_k - \lnfs_n)^2 \]

(3.20) \[ c_n = \sum_k q_{nk}(\lny_k - \xi_n)(\lnfs_k - \lnfs_n) \]

(3.21) \[ \eta^2_n = [\xi_n - \xi_n(-1)]^2 \]

(3.22) \[ \xi_n(-1) = \mu_n(-1) - \varepsilon_n(-1) \]
Some details of the joint maximum likelihood estimation of (3.14) and (3.15) are given in Appendix A. Here we mention one aspect that will play a role in the simulations. In (3.14) and (3.15) there are still various quantities that involve the unknown reference weights. Consider, for example, \( \bar{m}_n \) defined by (3.11). We have constructed a proxy for \( \bar{m}_n \) 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 of individual \( n \) be equal to \( y_n^* \). Then we assume that we can write

\[
\bar{m}_n = \kappa \cdot \eta + (1-\kappa) \cdot y_n^* + u_n ,
\]

where \( \eta \) is mean log-income in society, \( u_n \) is an error term independent of \( y_n^* \) and \( \kappa \) an unknown parameter which is to be estimated along with the other parameters in the model.

The parameter \( \kappa \) 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 and if \( \kappa = 1 \), the social group is irrelevant for the determination of the reference group of the individual. In Van de Stadt et al. (1983) explicit assumptions are made which justify the approximation (3.25). For the other variables in (3.14)-(3.15)
involving $q_{nk}$, approximations analogous to (3.25) have been employed.

3.2. Determinants of $y_{\text{min}}$

There does not exist a theory from which a model for the explanation of $y_{\text{min}}$ is readily derived. One tempting approach is to assume that $y_{\text{min}}$ corresponds to a point on the welfare scale, i.e. any respondent associates "making ends meet" with a utility level $\tilde{u}$, say. Analogous to (2.8) we would find for the minimum income of individual $n$, $y_{\text{min},n}$:

$$(3.26) \quad \ln y_{\text{min},n} = \mu_n + \sigma_n \tilde{z},$$

where $\tilde{z}$ satisfies $\tilde{u} = N(\tilde{z}; 0,1)$. Relations (3.14) and (3.15) could be combined with (3.26) and we could estimate the three equations jointly. Since, (3.26) would add further nonlinearities to an already complicated model we prefer the simpler assumption

$$(3.27) \quad \ln y_{\text{min},n} = \mu_n - \gamma_0,$$

with $\gamma_0$ an unknown constant to be estimated; (3.27) implies that $y_{\text{min},n}$ is a constant fraction of $\exp(\mu_n)$. This immediately allows us to derive for $\ln y_{\text{min},n}$ a relation like (3.14), with $\mu_n$ and $\mu_n(-1)$ replaced by $\ln y_{\text{min},n}$ and $\ln y_{\text{min},n}(-1)$ respectively. We will estimate this equation jointly with (3.14) and (3.15), but we also test (3.27) by testing whether the parameters in the $y_{\text{min}}$ equation have the same value as in the $\mu$ and $\sigma^2$ equation.
4. Data and Estimation Results

The data consists of the first three waves of a panel of 616 households in The Netherlands. 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 socio-economic 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 bracket (less than 30, 30-39, 40-49, 50-65, over 65). This leads to maximum of 5.3.5 = 75 social groups, 51 of which are represented in the sample.

On the basis of this information (3.14), (3.15) and the $y_{\text{min}}$ equation analogous to (3.14) have been estimated by means of the LISREL-program (see Appendix A for details). A test has been carried out of the hypothesis that the parameters $\beta_1$, $\beta_2$, $a$, $\kappa$ are the same for the $y_{\text{min}}$ equation and (3.14)-(3.15) (this equality of parameters implies (3.27)). The results of the estimations with and without imposition of equality of parameters are given in Table 1.
Table 1. Estimation results (asymptotic standard errors in parentheses).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>(3.14)-(3.15)</th>
<th>$y_{\text{min}}$-equation</th>
<th>(3.14)-(3.15) and $y_{\text{min}}$-equation combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a$</td>
<td>0.36</td>
<td>0.36</td>
<td>0.37</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.06)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>0.17</td>
<td>0.21</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.05)</td>
<td>(0.04)</td>
</tr>
<tr>
<td>$\beta_2$</td>
<td>0.67</td>
<td>0.70</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.12)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>$\beta_3$</td>
<td>0.33</td>
<td>0.30</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.12)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>0.79</td>
<td>0.89</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.18)</td>
<td>(0.15)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>616</td>
<td>616</td>
<td></td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td>28</td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>

$\chi^2$ 33.96 37.89

The first two columns of Table 1 contain the parameter estimates for the case where (3.14)-(3.15) and the $y_{\text{min}}$-equation are estimated jointly, but without imposition of equality restrictions on the parameter in (3.14)-(3.15) on the hand and the $y_{\text{min}}$-equation on the other.
hand. The last column contains parameter estimates under the restriction
that \( a, \beta_1, \beta_2, \beta_3, \kappa_1 \) are identical in (3.14)-(3.15) and the \( \gamma_{\text{min}} \)
equation. According to the \( \chi^2 \)-statistic the restrictions are not re-
jected 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 (3.27).

Although the meaning of the parameters will probably become
clearer when we turn to policy analysis, a few interpretative comments
may be enlightening. 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 5 years.

The estimates of \( \beta_2 \) and \( \beta_3 \) suggest that one's own past incomes
have about twice as much influence on one's present needs (as reflected
by \( u \) and \( y_{\text{min}} \)) than the incomes of others. Referring back to (3.25), the
estimate of \( \kappa \) indicates that the social groups as we defined 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.

To conclude our brief discussion of the parameter estimates,
consider \( \beta_1 \). Remember that the number of equivalent adults in a family,
\( f_n \), is specified as

\[
(4.1) \quad \ln f_n = \beta_0 + \beta_1 \ln f_{sn}.
\]
This means that if the size of a family changes from $f_{s1}$ to $f_{s2}$ say, its cost of living increases by a factor $(f_{s2}/f_{s1})^\beta$. The equivalence scale implied by this is given in Table 2.

<table>
<thead>
<tr>
<th>Family size</th>
<th>Equivalence scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.79</td>
</tr>
<tr>
<td>2</td>
<td>0.89</td>
</tr>
<tr>
<td>3</td>
<td>0.95</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1.04</td>
</tr>
<tr>
<td>6</td>
<td>1.07</td>
</tr>
<tr>
<td>7</td>
<td>1.10</td>
</tr>
<tr>
<td>8</td>
<td>1.13</td>
</tr>
</tbody>
</table>

As was mentioned before, our model implies that welfare and poverty are entirely relative. In their wellknown 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 four in your community to get along?") is completely relative, i.e. it rises proportional with 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 in 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 \( y_{\text{min}} \) (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.
5. Simulations

Given the empirical results reported in the previous section, the two poverty line definitions in Section 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 and next 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. (3.14)-(3.15) and the analogous equation for $y_{\text{min}}$ are used without adaptations.

2. Politicians do not want to honor differences in reference groups, so that 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, so that 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. 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 it 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.

5.1. Poverty Lines in a Steady State

5.1.1. The Subjective Definition

By hypothesis (not rejected by the data) there holds

\[ \ln y_{\text{min},n} = \mu_n - \gamma_0, \]

where \( \gamma_0 \) has been estimated to be equal to 0.12, implying that \( y_{\text{min},n} \) equals 88% of \( \exp(\mu) \). Combining (3.14) and (5.1), and indicating per capita variables by a tilde on top, one finds

\[ \ln \tilde{y}_{\text{min},n} = -\gamma_0(1-a) + \beta_2(1-a)\ln \tilde{y}_n + \beta_3(1-a)\tilde{m}_n + a \ln \tilde{y}_{\text{min},n}(-1) \]

We define an income maintenance scheme based on the subjective definition as one where \( \tilde{y}_n(t) = \tilde{y}_{\text{min},n}(t-1) \). An alternative approach would be to set \( \tilde{y}_n(t) \) equal to \( \tilde{y}_{\text{min},n}(t) \). However, we interpret the data in such a way that reported family income \( y_n \) refers to the past period, whereas
\( y_{\text{min},n} \) refers to the present period. So someone is able to just make ends meet if \( y_n(t) = \tilde{y}_{\text{min},n}(t-1) \) since in that case actual family income and stated minimum income refer to the same period and are equal. Whenever \( y_n(t) = \tilde{y}_{\text{min},n}(t-1) \) we shall indicate this 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 \( \delta \). Setting \( y_n(t) = \tilde{y}_{\text{min},n}(t-1) \) in (5.2), it is easy to show that \( \tilde{y}_{\text{min},n}(t) \) and \( y_n(t) \) converge to a steady state in which both grow at the same rate \( \delta \), provided that \( 0 < a < 1 \) and \( 0 < \beta_2 < 1 \). In the steady state there holds in each period:

\[
\begin{align*}
\ln y_n^* &= \frac{\tilde{y}_n}{m_n} - \frac{1}{\beta_3} \left[ y_0 + \frac{\delta}{1-a} \right] \\
\ln \tilde{y}_{\text{min},n} &= \ln y_n^* + \delta.
\end{align*}
\]

The poverty line is simply a certain fraction of median income in the reference group of individual \( n \). If politicians do not accept that different people have different reference groups, but substitute, for instance, \( \tilde{n} \) (median per capita income in society) for \( m_n \), 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 \( y_{\text{min}}^* \) to median income depends on \( \beta_3 \). The more weight one gives to other people the closer \( y_{\text{min},n}^* \) will be to \( m_n \) (or \( \tilde{n} \)).

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.
If incomes go down ($\delta < 0$), the poverty line tends to be closer to the median and 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 co-determine one's minimal needs and 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 $\tilde{m}_n$ nor $\tilde{n}$ is the appropriate anchoring point in (5.3). It might be argued that poor people mainly refer to other people who are poor as well, so that $\tilde{m}_n$ in (5.3) 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 $y_{min}$, there does not exist a well-defined equilibrium anymore.

5.1.2. The Leyden Poverty Line

Rewrite (3.14) and (3.15) in per capita terms:

\begin{equation}
\tilde{\mu}_n = \beta_2(1-a) \ln \tilde{y}_n + \beta_3(1-a) \tilde{m}_n + a \tilde{\mu}_n (-1)
\end{equation}
As with the subjective definition, we assume that $\bar{m}_n$ grows at a constant rate $\delta$. In addition, we assume that the log-variance of per capita incomes in the reference group $\bar{\tau}_n^2 = \sum k q_{nk} (\ln y_k - \bar{m}_n)^2$ remains constant. We assume that a measured WFI pertains to the present period whereas $\bar{y}_n$ (and $\bar{m}_n$) pertain to the previous period. A Leyden poverty line at time $t$ is then defined as an income $y_n(t)$ satisfying $\ln y_n(t) = \bar{\mu}_n(t-1) + u \bar{\sigma}_n(t-1)$, with $u$ chosen by policy makers (cf. (2.8)). One can show that under certain conditions (which are given below) $\bar{\mu}_n(t)$ and $\bar{y}_n(t)$ converge to a steady state. In the steady state, $\ln y_n^*, \bar{\mu}_n^*$, and $\bar{\sigma}_n^2$ are the solutions of the system

\begin{align*}
(5.6) \quad & \bar{\mu}_n^* = \beta_2 \ln y_n + \beta_3 \bar{m}_n - \frac{a}{1-a} \delta \\
(5.7) \quad & \bar{\sigma}_n^2 = \beta_2 (\ln y_n - \bar{\mu}_n^*)^2 + \beta_3 (\bar{m}_n - \bar{\mu}_n^*)^2 + \beta_3 \bar{\tau}_n^2 + \frac{a}{1-a} \delta^2 \\
(5.8) \quad & \ln y_n^* = \bar{\mu}_n^* - \delta + u \bar{\sigma}_n^* \\
\end{align*}

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

\begin{align*}
(5.9) \quad & x^2 \beta_3 (\beta_3 - \beta_2 u_a^2) + 2 \beta_3 x z + (1-u_a^2)z^2 - u_a^2 (\beta_3 \bar{\tau}_n^2 + a \delta z) = 0,
\end{align*}

where $x \equiv (\ln y_n^* - \bar{m}_n^*)$ and $z = \delta/(1-a)$. The solution for $\ln y_n^*$ is:
(5.10) \( \ln y_n = \frac{1}{\beta_3} \left( \ln \beta^2_n + \frac{\beta_3^2 (\beta_2^2 - \beta_2^2 u^2 + \beta_2^2) z^2 + (\beta_3 - \beta_2^2 u^2) (\beta_2^2 + a, d, z)}{\beta_3} \right)^{-\frac{1}{2}} \)

This solution has some interesting properties. First of all \( \ln y_n \) is monotonically increasing in \( u_a \), as long as \( 0 < \beta_2 < 1 \) and \( 0 < a < 1 \). Secondly, there are vertical asymptotes at \( u_a = \frac{\beta_2}{\beta_2} \) and \( u_a = -\frac{\beta_3}{\beta_2} \). In other words, we can let \( \ln y_n \) vary from \(-\infty \) to \(+\infty \) and \( u_a \) will vary only from \(-\frac{\beta_3}{\beta_2} \) to \( \frac{\beta_2}{\beta_2} \). In view of our estimates of \( \beta_2 \) and \( \beta_3 \), this means that \( u_a \) has to lie in the interval \((-\frac{1}{2} \sqrt{2}, \frac{1}{2} \sqrt{2})\), 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 \( \beta_2 \) is relative to \( \beta_3 \), the smaller the range of attainable welfare levels will be. The reason for this is that if the habit formation parameter \( \beta_2 \) 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 socio-economic policy to influence welfare permanently.

In the third place, (5.10) implies that, 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 \( \tilde{m}_n \) by \( \tilde{n} \)) if there is economic stagnation (\( \delta < 0 \), so \( z < 0 \)) than when there is economic growth.
Finally let us consider two special cases. For $\alpha = 0.5$, (so $u_\alpha = 0$), (5.10) reduces to

$$\ln \tilde{y}_n = \tilde{m}_n - \frac{\delta_\alpha}{\beta_3 (1-\alpha)},$$

which is equivalent to (5.3) for $\gamma_0 = 0$. For $\delta = 0$ (no economic growth), (5.10) becomes

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

In this case the poverty line is a certain fraction of median reference group income, where the fraction is smaller if $u_\alpha$ 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 cut-off point, or if incomes in society are more dispersed, or if people pay less attention to the incomes of others.

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.
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 present 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, $\delta$, is set at 0.02.

The eight different income maintenance policies are 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. The labels of the figures are self-explanatory.

In Fig. 3a the income-paths of the three families converge to trajectories that are close to each other, but not identical because the three families perceive slightly different income dispersions in their reference group ($\tau_n^2$, cf. (5.10)).

The corresponding utility levels, drawn in Fig. 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 group coincide.

In Fig. 3c the income paths do not converge to the same trajectory either, but the welfare paths in Fig. 3d do. If we would choose $T_n$ equal for everyone, then the income paths in Fig. 3a would converge to the same trajectory, but not so in Fig. 3c. In this case we are faced with a choice between equity in income-terms (Figs. 3a-3b) or equity in welfare terms (Figs. 3c-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.\(^7\)

The families in Figures 4a-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). As indicated by Fig. 3a, the steady states differ for the three families because they experience a different dispersion of incomes in their reference groups. The differences are small, though, Figure 4b shows that the first few years are quite 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 4c-4d are similar to Figures 4a-4b. The first year welfare dips of the well-to-do and median family are somewhat mitigated in this case. After approximately 5 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.
Figures 5a-5b are quite similar to 3a-3b. 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 that numerically the Leyden poverty line and the subjective poverty line are close together. Again, the choice for a hypothetical reference group causes the incomes of the three families to converge to the same trajectory, but the utility trajectories remain different. Figures 5c-5d show exactly the opposite phenomenon (although the utility levels do not coincide completely, due to differences in $\tau^2_n$).

Figures 6a-6b are similar to 4a-4b, but the welfare dips of the previously non-poor families are even deeper. Since the subjective poverty line comes out somewhat lower than the Leyden poverty line, the poorest family now also experiences a fall in income and welfare.

Figures 6c-6d are similar to 6a-6b. Notice that taking into account one's actual reference group leads to a somewhat less severe welfare dip for the well-to-do family and a somewhat deeper dip for the poor family.

Finally, Figures 7a-7d give income and utility-paths for the same cases as considered in Figure 4a-4b, but now the income compensation is based on a family size of three for every family, irrespective of its size. In Figure 7a-7b we see what this means for a family of size one, whilst Figure 7c-7d tell the story for a family of size eight. 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.
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 assumptions that poverty is at least partly relative. Let us briefly summarize some of the issues.

**Habit formulation.** 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 the sense 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. A punishment for his incompetent management of the firm?
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. Figures 3a-b, 4a-b, 5a-b, 6a-b). If one conceives of a social welfare function as being 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 would yield similar conclusions, as long as these allow for a relativistic component in poverty. As the Leyden poverty line and the subjective poverty line lead to such similar results, there is really not much to choose between the two. The main difference between them is that with the Leyden poverty line there is a degree of freedom left for politicians, since they bear the responsibility of choosing the utility cut-off point $a$. 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 of them influences parameters of the utility function. The thing that sets family size apart is probably the term "cost-of-living" that lends it an objective nature. For the same
reason distinctions according to region or farm/non-farm 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 that is necessary to let families of different composition attain the same level of well-being. Precisely according to this definition, we can say that someone faces a high cost of living because he or she has rich friends.
Notes

1) "Income" is defined in this paper as after tax family income.

2) "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.

3) For convenience, we generally omit arguments equal to zero, so $f_n = f_n(0)$.

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.

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

6) Notice that within this range for $u_q$, the expression under the square root sign in (5.10) is always non-negative.

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


Figure 1. The relation between minimum income and actual income for different values of x.

Figure 2. A hypothetical response to the IEQ.
Fig. 3a. Leyden poverty line; hypothetical reference group; smooth adaptation.
Fig. 3b. Leyden poverty line; hypothetical reference group; smooth adaptation
Fig. 3c. Leyden poverty line
actuale reference group
smooth adaptation
Fig. 3d. Leyden poverty line
actual reference group
smooth adaptation
Fig. 4a. Leyden poverty line; hypothetical reference group; steady state
Fig. 4b. Leyden poverty line; hypothetical reference group; steady state
Fig. 4c. Leyden poverty line
actual reference group
steady state
Fig. 4d. Leyden poverty line
actual reference group
steady state
Fig. 5a. Subjective poverty line
hypothetical reference group
smooth adaptation
Fig. 5b. Subjective poverty line
hypothetical reference group
smooth adaptation
Fig. 5c. Subjective poverty line
actual reference group
smooth adaptation
Fig. 5d. Subjective poverty line
actual reference group
smooth adaptation
Fig. 6a. Subjective poverty line
hypothetical reference group
steady state
Fig. 6b. Subjective poverty line
hypothetical reference group
steady state
Fig. 6c. Subjective poverty line
actual reference group
steady state
Fig. 6d. Subjective poverty line
actual reference group
steady state
## IN 1982 REEDS VERSCHENEN

<table>
<thead>
<tr>
<th>No.</th>
<th>Author</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>W. van Groenendaal</td>
<td>Building and analyzing an econometric model with the use of a hybrid computer; part I.</td>
</tr>
<tr>
<td>02.</td>
<td>M.D. Merbis</td>
<td>System properties of the interplay model.</td>
</tr>
<tr>
<td>03.</td>
<td>F. Boekema</td>
<td>Decentralisatie en regionaal sociaal-economisch beleid.</td>
</tr>
<tr>
<td>04.</td>
<td>P.T.W.M. Veugelers</td>
<td>Een monetaristisch model voor de Nederlandse economie.</td>
</tr>
<tr>
<td>05.</td>
<td>F. Boekema</td>
<td>Morfologie van de &quot;Wolstad&quot;. Over het ontstaan en de ontwikkeling van de ruimtelijke geleding en structuur van Tilburg.</td>
</tr>
<tr>
<td>06.</td>
<td>P. van Geel</td>
<td>Over de (on)mogelijkheden van het model van Knoester.</td>
</tr>
<tr>
<td>07.</td>
<td>J.H.M. Donders F.A.M. van der Reep</td>
<td>De betekenis van het monetaire beleid voor de Nederlandse economie, presentatie van een analyse aan de hand van een eenvoudig model.</td>
</tr>
<tr>
<td>08.</td>
<td>R.M.J. Heuts</td>
<td>The use of non-linear transformation in ARTMA-models when the data are non-Gaussian distributed.</td>
</tr>
<tr>
<td>09.</td>
<td>B.B. van der Genugten</td>
<td>Asymptotic normality of least squares estimators in auto-regressive linear regression models.</td>
</tr>
<tr>
<td>10.</td>
<td>J. Roemen</td>
<td>Van koetjes en kalfjes I.</td>
</tr>
<tr>
<td>11.</td>
<td>J. Roemen</td>
<td>Van koetjes en kalfjes II.</td>
</tr>
<tr>
<td>13.</td>
<td>P. Slangen</td>
<td>Bepaling van de optimale beleidsparameters voor een stochastisch kasbeheersprobleem met continue controle.</td>
</tr>
</tbody>
</table>

**Dates:**
- Jan.
- Jan.
- Maart
- Maart
- April
- Mei
- Mei
- Juni
- Juni
- Juli
- Juli
- Juli
- Juli
- Aug.
- Aug.
- Sept.
IN 1982 REEDS VERSCHENEN (vervolg)

16. A. Hendriks
   T. v.d. Bij-Veenstra
   "Van Bedrijfsverzamelgebouw naar
   Bedrijvencentrum".          okt.

17. F.W.M. Boekema
    A.J. Hendriks
    L.H.J. Verhoef
   Industriepolitiek, Regionaal
   beleid en Innovatie.       okt.

18. B. Kaper
   Stability of a discrete-time,
   macroeconomic disequilibrium model.  okt.

19. P.F.P.M. Nederstigt
   Over de toepasbaarheid van het
   Amerikaanse 'Diagnosis Related
   Group'-systeem in Nederland.   nov.

20. J.J.A. Moors
    Auditing and Bayes' Estimation.  nov.

21. J. Plasmans
    H. Meersman
    An Econometric Quantity Rationing
    Model for the Labour Market.  nov.

22. J. Plasmans
    H. Meersman
    Theorieën van de werkloosheid.  nov.

23. B.B. van der Genugten
    Een model ter beschrijving van de
    ontwikkeling van de veestapel
    in Nederland.                  nov.

24. F.A. Kense
    De omzet/artikel concentratiecurve
    als beleidsinstrument.        nov.

25. R.T.P. Wiche
    Populatie wetten/specificatieve
    wetten, oftewel
    Over het ethisch en maatschappe-
    lijk belang van een korrekte in-
    terpretatie van generische uit-
    spraken.                      dec.

26. J.A.M. Oonincx
    Micro-computers, standaardpakket-
    ten, administratieve gegevensver-
    werking en informatieverzorging.  dec.
<table>
<thead>
<tr>
<th>No.</th>
<th>Authors</th>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>J. Kriens, J.Th. van Lieshout, J. Roemen, P. Verheyen</td>
<td>Management Accounting and Operational Research.</td>
<td>jan.</td>
</tr>
<tr>
<td>4</td>
<td>P. Meys</td>
<td>Het autoritair etatisme.</td>
<td>jan.</td>
</tr>
<tr>
<td>5</td>
<td>H.J. Klok</td>
<td>De klassieke politieke economie geherwaardeerd.</td>
<td>febr.</td>
</tr>
<tr>
<td>6</td>
<td>J. Glombowski, M. Krüger</td>
<td>Unemployment benefits and Goodwin's growth cycle model.</td>
<td>febr.</td>
</tr>
<tr>
<td>7</td>
<td>G.J.C.Th. van Schijndel</td>
<td>Inkomstenbelasting in een dynamisch model van de onderneming.</td>
<td>febr.</td>
</tr>
<tr>
<td>8</td>
<td>F. Boekema, L. Verhoef</td>
<td>Local initiatives: local enterprise agency/trust, business in the community.</td>
<td>febr.</td>
</tr>
<tr>
<td>9</td>
<td>M. Merbis</td>
<td>On the compensator, Part II, Corrections and Extensions.</td>
<td>febr.</td>
</tr>
<tr>
<td>10</td>
<td>J.W. Velthuijsen, P.H.M. Ruys</td>
<td>Profit-non-profit: een wiskundig economisch model.</td>
<td>febr.</td>
</tr>
<tr>
<td>11</td>
<td>A. Kapteyn, H. van de Stadt, S. van de Geer</td>
<td>The Relativity of Utility: Evidence from Panel Data.</td>
<td>maart</td>
</tr>
<tr>
<td>12</td>
<td>W.J. Oomens</td>
<td>Economische interpretaties van de statistische resultaten van Lydia E. Pinkham.</td>
<td>maart</td>
</tr>
<tr>
<td>13</td>
<td>A. Kapteyn, J.B. Nugent</td>
<td>The impact of weather on the income and consumption of farm households in India: A new test of the permanent income hypothesis?</td>
<td>april</td>
</tr>
<tr>
<td>14</td>
<td>F. Boekema, J. van der Straaten</td>
<td>Wordt het milieu nu echt ontregeld?</td>
<td>april</td>
</tr>
</tbody>
</table>
IN 1983 REEDS VERSCHENEN (vervolg)

15. H. Gremmen
   Th. van Bergen
   De universitaire economen over het
   regeringsbeleid.
   april

16. M.D. Merbis
   On the compensator, Part III,
   Stochastic Nash and Team Problems.
   april

17. H.J. Klok
   Overheidstekort, rentestand en groei-
   voet; terug naar een klassieke norm
   voor de overheidsfinanciën?
   mei

18. D. Colasanto
    A. Kapteyn
    J. van der Gaag
    Two Subjective Definitions of
    Poverty: Results from the Wisconsin
    Basis Needs Study.
    mei

19. R.C.D. Berndsen
    N.P. Coenders
    Is investeren onder slechte
    omstandigheden en ondanks slechte
    vooruitzichten zinvol?
    mei

20. B.B. v.d. Genugten
    J.L.M.J. Klijnen
    Een Markovmodel ter beschrijving
    van de ontwikkeling van de rundvee-
    stapel in Nederland.
    juni

21. M.F.C.M. Wijn
    Enige fiscale-, juridische- en be-
    drijfseconomische aspecten van
    goodwill.
    juni

22. P.J.J. Donners
    R.M.J. Heuts
    Een overzicht van tijdsvariërende
    parametermodelspecificaties in
    regressieanalyse.
    juni

23. J. Kriens
    R.H. Veenstra
    Steekproefcontrole op ernstige
    en niet-ernstige fouten.
    juli

24. M.F.C.M. Wijn
    Mislukken van ondernemingen.
    juli

25. A.L. Hempenius
    Relatieve Inkomenspositie,
    Individuele en Sociale Inkomens-
    bevrediging en Inkomensongelijkheid.
    aug.

26. B.R. Meijboom
    Decomposition-based planning
    procedures.
    sept.

27. P. Kooreman
    A. Kapteyn
    The Systems Approach to Household
    Labor Supply in The Netherlands
    sept.

28. B.B. v.d. Genugten
    K. v.d. Sloot
    M. Koren
    B. de Graad
    Computergebruik bij propedeuse-
    colleges econometrie
    sept.

29. W. de Lange
    Korter werken of
    Houden wat je hebt
    Tendenzen, feiten, meningen
    okt.