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1. Introduction.

In most sciences there are phenomena that are only partially understood or not at all. Nevertheless, if we take the basic phenomenon for granted it is frequently possible to build a theory on it explaining more complicated phenomena. The basic phenomena are called the *primitive* concepts of that science. When science progresses we do not only see an outward movement trying to explain and understand newly observed phenomena but also an inward movement where it is tried to explain phenomena hitherto taken as primitive concepts. Unavoidably this leads to the definition of more basic concepts as the primitive concepts of the theory. Nowadays two outstanding examples of this scientific evolution are seen in the developments in physics, where the atom is no longer the primitive concept but where it has become possible to dissect the atom in ever smaller particles and in medicine and biology where we are discovering the secrets of genetics.

In economics we have the same problem that some basic concepts are needed to build a theory on, but that those concepts itself are not well understood or even are not measurable for the time being. A prime example is the *welfare* or *utility* concept. It is taken to be a primitive concept. As the concept is also used in sociology and psychology as a basic concept, the understanding of that concept may be seen as a common task of the social sciences. The main objective of this paper will be to make a contribution to that understanding of the welfare concept.

In Section 2 we will sketch the mainstream approach in economic literature. In Section 3 we consider the measurability problem and suggest a measurement method. We report some results, which suggest measurability in a certain sense. In Section 4 we consider the differences between respondents and we try to explain those differences by relatively simple regression equations. In Section 5 we introduce some more complex models where we introduce the past and future expectations as co-determinants. In Section 6 we consider the social filter model, which incorporates the concept of a social reference group. In Section 7 we study a cardinal utility framework. Section 8 concludes.

2. The economic mainstream approach to utility.

The attitude of economics towards utility has always been ambiguous. On the one hand the concept was absolutely needed in order to develop a positive and a normative theory of economic behavior. On the other hand economists felt themselves very uneasy with the concept as its measurability was doubtful. As such it did not seem to be an operational concept (Samuelson(1947)). How can a science be based on non-measurable concepts?
At a non-scientific level welfare or well-being is a well-known concept. It is an evaluation by the individual of his situation. We know from introspection

and observation that it is fairly well possible to evaluate situations in terms of feeling "well" or feeling "badly". It follows that an intrapersonal comparison of situations is possible. Now this evaluation is done in terms of verbal labels and that is not a nice point of departure for the formation of a quantitative theory. However, it has been demonstrated that many esoteric things may be evaluated on a numeric scale. We think on the quality of wine, a music performance, commodity testing, etc. The evaluation of school results is frequently done in terms of a scale from 0 to 10, where the numbers are explicitly translated as 10 standing for "excellent", 9 standing for "very good", 8 standing for "good" and so forth. In the beginning when we are first confronted with such numerical evaluations they look strange and unfamiliar. When we have got some experience with that type of rating, they are ingrained in our value pattern and we begin to think in those numerical terms. Hence, we do not reject the idea that more general situations may be evaluated by human beings just as well in terms of numbers on a numerical scale as in terms of verbal labels on a verbal scale. This may apply for the welfare concept as well.

This was also the position of the classical economists. like Edgeworth (1881) and Cohen Stuart (1889). The first assumed that welfare positions could be described by the consumption levels $x_1,...,x_n$ of n commodities $X_1,...,X_n$, shortly denoted by the vector x. Then he assumed that an individual was able to evaluate each situation x by a number U(x) called the *utility* attached to that situation. Consumer behavior was then basically a search for the welfare position x with the highest utility given the constraint that total expenditures $p_1x_1 + ... + p_nx_n$ will not exceed a given income y, where $p_1,...,p_n$ stand for the prices of the different commodities. In this way demand for goods could be described as a function of prices and income. In this analysis utility is just a tool of analysis. The fact that individuals try to improve or even to optimize their behavior according to some criterion is more or less a tautology. If this were not the case, we could expect purely random behavior which is not observed in practice. As a result of this analysis we can also evaluate income levels y by assigning to them the utility value U corresponding to the optimal consumption pattern that can be reached given prices p and income y. That value U depends on y and p and it is nowadays called the indirect utility function V(y;p). If prices are taken fixed we denote it by V(y) and it is then also called the *utility function of income.*

This brings the second problem to the fore. Cohen Stuart looked for a tool to construct a just taxation model, as he realized that, although there was a case to tax all citizens by an equal amount as they get the same services of the public sector, in some way the pain caused by taxation is not the same for everyone. It is easier for a millionaire to pay $1000 than for someone with an annual income of $10,000. This points to progressive taxation. Then V(y) is a measuring rod by which the tax pain may be equalized. Let us assume that we tax someone with $10,000 by $500, then the pain inflicted will be V(10.000)-V(9500)= A. If we like to inflict the same pain to someone with $20,000 to begin with we have to tax him by T with V(20,000)-V(20,000-T) = A. In this approach there are two problems that are rather basic.

The first problem is whether equal *differences* in the value of the utility function imply equal pain differences for the individual. If we return to the evaluation by verbal labels this question may be translated into the question whether the fall from "very good" to "good" is equivalent to the fall from "good" to "amply sufficient", being the usual translations in Dutch schools of the grades 9,8,7. We are unable to solve this problem. We cannot say that the differences imply equal utility jumps, but neither can we say that they do not represent equal jumps. The reason for this is that we lack a measuring rod to measure utility in a different way, say, by a utilitymeter. (see also Suppes and Winet (1954)).

The second problem arises if we accept that equal utility differences imply equal pain differences. Then we still have to answer the problem whether *two* individuals have the same utility function of income and whether the fact that two individuals attach the same utility value to the same income implies that they *feel equally well* about their income. Again in terms of verbal labels: does the fact that two individuals call the same income level "good" imply that they feel equally satisfied or dissatisfied about their welfare position? Also here we have to confess our agnostic position. It follows that the utility function approach cannot be applied for intra- or interpersonal welfare comparisons without a reasonable measurement method and/or the willingness to accept some unproven assumptions.

These problems were recognized by Pareto (1904). It led him to the conclusion that the assumption of utility maximization was a useful device to explain consumer behavior but that such a function was actually only describing indifference curves in commodity space, indicating that people are indifferent between various consumption patterns and prefer more to less. But that it is not necessary for the explanation of the consumer problem to assume that utility differences may be comparable, or more technically, that no cardinal utility had to be assumed. Pareto did not state that the idea of cardinal utility was nonsense, but only that the assumption of cardinal utility was superfluous for dealing with the consumer problem. Robbins (1932), a man of tremendous influence in the Anglo-Saxon literature, went much further in denying the existence of a measurable cardinal utility function and proclaiming henceforth the impossibility of measuring such a concept. Mainstream economics accepted this verdict for a long time.

This position had a significant impact on the state of the art in economics. All welfare comparisons were forbidden, except for the assumption that, if an individual A has not less of anything than an individual B, he can not be worse off than B. It follows then that a social allocation of goods over individuals can be improved if nobody gets less and at least someone more in the new allocation.

Clearly this robbed any normative economics, which has to be based on the evaluation of individual situations and the evaluation of the state of the society as a whole by an aggregate of some sort of individual welfare evaluations, of any foundation. Nevertheless, it is widely felt that it is one of the basic tasks of economists to measure inequality and to advise on methods to reduce social inequality. In this light it is untenable to keep the position that welfare situations cannot be compared by some kind of utility function. On the other hand economists have developed economic theories on inequality (Atkinson (1970), Sen (1973)), taxation, uncertainty (Arrow (1964)) and economic growth that are either implicitly or explicitly based on a cardinal utility concept, including intra- and interpersonal utility comparisons, while on the other hand other or even the same colleagues profess their refusal to accept cardinality of some sort. Those studies are based on a postulate of the type:

"Let us assume that individuals have a common utility function U(.) and that there is a social welfare function of the type $W = W(U_1,...,U_m)$".

This being postulated one proceeds without further discussion or doubts on this basic postulate. This leads to a rather schizophrenic situation in economics as some authors on the one hand are painstakingly ordinal and, if need arises, in normative studies accept cardinality in the way pictured above. The only interpretation of this behavior is that an applicable theory is constructed, where the basic postulate has been verified beforehand or taken for granted as a primitive concept. In a sense it is building the first floor when the foundations are not laid yet. It may also be seen as accepting the reality of scientific method that one has to accept some primitive concepts and assumptions to come anywhere. The more one is willing to accept, the more specific will be the resulting theory. Nevertheless, it would be very nice if we could find some credible method to get evidence on utility.

3. A measurement method.

Individuals evaluate their situation in terms of "good" and "bad". Actually this idea involves three elements. Situations have to be described by means of observable variables $X_1,...X_k$ which assume values $x_1,..x_k$ on a domain **X**. The situation has to be evaluated by a welfare (or utility) function assigning a welfare value U to the situation denoted by the k-vector x and the welfare values are elements of an evaluation set **U**. The first question is how we would like to characterize our situations? What is the choice of our variables $X_1,...X_k$ that are required to describe our welfare position? Obviously an exact description would require an infinite set of variables like income, our consumption bundle, the number of working hours, our family life, the weather and even the political and legal system. In our analysis however we shall confine ourselves to one variable to begin with, viz., family income denoted by y. It does not imply that we believe that this provides a perfect characterization but we use it as a start. We take it that y varies from 0 to ∞, that is, **X** is the positive semi-axis. Which values $U(y)$ can assume is a much more problematic question. As we argued before, it does not seem obvious that welfare positions are evaluated by numbers on a numerical scale. Theoretically it may be possible, but individuals do not think in numerical values. They think in verbal labels like "good" or "bad". It follows that it is more natural to assume that the welfare function U(.) assumes values on the set of verbal labels. That set is denoted by **U**.

A question which is now crucial is whether different people assign the same emotional value to the same verbal label. For after all, the verbal labels are assumed to reflect emotional values, that are described in verbal language. We are not sure about that as emotions cannot be measured in an exact way. However, there are experiments where individuals have been asked to translate such verbal labels in figures on a (0,10)-scale or to draw lines of a specific length, where the normalizing convention was that "very bad" corresponded to zero length and "excellent" to, say, 8 centimeter. A consistent response pattern was found which suggests that those verbal labels have roughly the same connotation for most individuals. These experiments are described in Saris (1988). (see especially Van Doorn and Van Praag in that bundle).

Another argument, which is of a more philosophical nature, is the following. Human language is a transmitter of information between members of the language community. Hence ,words are symbols of concepts and things that must have about the same meaning for two individuals who communicate in that language. Obviously we cannot prove beyond all doubt that the word "table" has the same meaning for all English people, but on the other hand it does not seem far-fetched to assume that this is roughly the case. Otherwise, language would be no means of communication, and it is precisely that, which is the *raison d'être* of a language.

This is also in line with Sen's (1982. pag 9) statement on empirical economic methodology, where he refers to the predilection among economists for observable behavior.

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

A third signal that it is not odd to assume that verbal labels in U do approximately mean the same for all members of the language community can be constructed by posing the so-called *Income Evaluation Question* (IEQ), which runs as follows:

> "Please try to indicate what you consider to be an appropriate amount for each of the following cases? Under my (our) conditions I would call a net household income per week/month/year of:
>
> about .... very bad
> about .... bad
> about .... insufficient
> about .... sufficient
> about .... good
> about .... very good
>
> Please enter an answer on each line, and underline the period you refer to".

At first sight this attitude question , developed by Van Praag (1971), looks somewhat awkward. It would have looked more natural to specify income levels first and to ask the respondents for their corresponding verbal evaluations. The problem with that version is that different respondents have different incomes, one being a millionaire and one being a poor man. Hence, the evaluation of an income sequence of $ 10,000, $ 20,000, etc. would yield strongly *different* evaluations when offered to the poor man, but those income levels would yield identical evaluations, when offered to the millionaire. He would not be able to distinguish a real difference between such petty amounts. A typical response for this IEQ is the following:

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

about ....25....... very bad
about ....35....... bad
about ....45....... insufficient
about ....70....... sufficient
about ...120....... good
about ...160....... very good

*Underline the reference period chosen".

Let us denote such a response sequence by the vector $c = (c_1,\ldots,c_6)$. The dimension of this vector, that is, the number of levels supplied as stimuli to the respondent is not-essential. In practice the number of six levels works rather well in the sense that people are willing and able to answer, but that limitation is only suggested by practice. Similarly the monotonic ordering of the levels is useful to calibrate the answers and to make the answers comparable between respondents but any other ordering is also conceivable. As we already hinted at, the responses vary between individuals. It follows that there is certainly not one uniform opinion on what is a "good" income, etc.. This does not indicate, however, that the verbal labels represent different things to different people. Let us define the mean log-response by

$$m=\frac{1}{6}\sum_{i=1}^{6} c_i$$

and likewise the standard deviation by

$$s^2 = \frac{1}{5}\sum_{i=1}^{6}(c_i - m)^2$$

Then it may be expected that the mean response will vary over individuals. However, if the deviation pattern would be constant, say, "good" corresponds always to 20% above the mean and "bad" corresponds always to 20% below the mean, then this regularity would strongly suggest that people translate the verbal labels on the same emotional scale. As always when studying income it is advisable to study relative income differences rather than absolute differences. This implies that all responses are translated on a logarithmic scale and that we shall consider the log-vector $\ln(c) = (\ln(c_1),...,\ln(c_6))$. It follows then that equal log-differences stand for equal income proportions. The hypothesis that the difference $\ln(c_i) - \ln(c_j)$ is equal over respondents, i.e., that the verbal labels i and j give rise to the same proportional response, has to be rejected as well. However, let μ stand for the mean of the logarithmic answers and σ for the standard deviation of the log-answers about their mean μ, then we find that the "standardized" response

$$u_i = (\ln(c_i) - \mu))/\sigma$$

is practically constant.We present Table 1, borrowed from Van der Sar, Van Praag and Dubnoff (1986).

Table 1. Average u-levels and sample deviations.

Label	u_i	$\sigma(u_i)$
1	-1.291	0.236
2	-0.778	0.190
3	-0.260	0.241
4	0.259	0.239
5	0.760	0.190
6	1.311	0.229

The table refers to a sample of about 500 American respondents. We see that u_1 has an average value of -1.291 and that the sample dispersion about that value is 0.236. This table is very interesting. First, although there is variation among respondents it could not be explained by personal characteristics of the respondents, in other words, the observed variation is purely random. Second, the dispersion is roughly the same at each level. This implies that the response variation is not level-specific. Third, and this is the most interesting aspect, the values are roughly symmetric about zero. All this seems to imply that, for given μ and σ the values u_i are roughly predictible except for a random disturbance. It follows that for given μ and σ also $\ln(c_i) = \mu + u_i.\sigma$ is predictible. The proportional response pattern is for a fixed set of *stimuli* (i.e.verbal labels) not dependent on the respondent.

It follows that we feel justified to deal with the individual responses as meaningful. In the following sections we shall try to explain the differences in the values of μ and σ by personal variables. If we succeed in that explanation we are actually able to explain why people derive different welfare from a fixed amount of income.

But before doing so ,let us pose the question whether the values $u_1,...u_6$ may be considered as the numerical welfare levels assigned to the amounts $c_1,...,c_6$ by the respondent. Or phrased differently, are the values u the numerical translation of the verbal labels "bad", "good" etc.? The answer is yes *and* no. The answer is yes as we find statistically that log-standardization of the response yields always roughly the same u-values. So it makes sense to connect the label "sufficient" with 0.259 in Table 1. Obviously that value has no emotional connotation unless we use this scaling frequently. Think on the academic grading A,...,E in Britain or the grading on a (0,20)-scale as usual in the Belgian university. Also these gradings are completely arbitrary, but they have an emotional connotation for those, who are used to them. Another example is temperature measurement in Celsius or Fahrenheit degrees. The answer is no, as the log-standardization used above is an arbitrary procedure. We may continue by taking the exponential of u and we find a new scale defined on the positive semi-axis. Hence there are more value schemes, which may serve as translation of the verbal labels. However, the primary step of log-standardization seems essential, as we discard any effect of personal respondent characteristics by applying that transformation. Also here there is no mathematical certainty that there could not exist another transformation which would yield the same statistical effect that the transformed response does not depend on the respondent's personal characteristics, but we can only report that we were unable to find such an alternative.

4. Interpersonal differences explained.

In the previous Section we reported that the answers to the IEQ are pretty much constant over individuals, if we neutralize for the μ and σ.

Thus, our next task will be to discover systematic differences between those parameters between individuals. By *systematic* we mean that those differences have to be explained by intuitively understandable models and preferably models of a simple type. In this section we shall restrict ourselves to the investigation of μ, as σ did not appear to be fit for explanation by a simple model. We come back to that in Section 6.

Before we try to explain μ, let us try to interpret μ by means of an analogue. One of the pedestrian but not unimportant questions in quantitative measurement and reporting on that is the layout of the numerical tables. Let us assume that we have a list of numbers which reads as follows:

10
100
0.1
100,000
1,000

Given such a table, we find the choice of the unit a little clumsy and our artistic eye looks whether we can choose a unit, such that there are roughly as many digits before as after the decimal point. In this case defining the new unit as being 100 old units we get the following representation :

0.1
1.0
0.001
1000
10.

which looks more symmetric and balanced. Basically the operation may be translated in mathematical terms by taking as a unit the exponential of the average of the log-entries. That is, the new unit is just the so-called geometric mean of the entries and taking that unit results in getting on the average as many digits before as behind the decimal point. Sometimes one is working in microns, sometimes in kilometers, sometimes in pennies and sometimes in billions of dollars. The log-average of the observations in terms of the unit will be equal to zero. We call this unit the *natural unit* of measurement for this tabulation (see also Van Praag (1968). Which natural unit is chosen depends on the frame of reference.

In a similar way $\exp(\mu)$ may be interpreted as the natural unit for the income evaluation framework and our problem is now to find out what factors determine the value of $\exp(\mu)$ or rather μ. On the one hand we have our intuition, on the other hand we have a host of samples with Dutch and foreign data on which we may test the hypothesized relationships. We shall now report in a non-technical way on a number of such results, which have been described elsewhere in great detail (see references).

The first factor which will influence the response is clearly the *current* income of the respondent or the respondent's household. Let current income be denoted by y_c, then the idea would be that

$$\mu = \mu(y_c)$$

The expectation would be that people with higher income will also state higher income levels as being "good", "bad", etc. than respondents with a low income. That would imply that $\mu(.)$ would be an increasing function in current income. We said above that this dependency on current income would *clearly* be the first to think of. But is that so clear after all? There seem to be two stands of opinion. The first one is that of the economist. In economics the assumption of a common preference structure and a unique utility function of income is the basic point of departure. This would imply that there can be no individual variation on what a "good" income is. The second stand is that of the psychologist or rather the psychofysicist (Helson (1964), Stevens (1975)). It is well known from measurement experiments on the individual perception of the brightness of light or the volume of sound that such perceptions on what is a "lot" and what not are heavily influenced by the environment before the experiment. Respondents refer to the situation they have presently in mind as their "anchor"-situation. If we assume that the income evaluation question is a similar experiment with for subject-matter "income" it is rather natural to assume that respondents are heavily influenced by their own current income, which plays the role of an "anchor" in this case. However, let statistical analysis of data inform us on the value of either assumption. For the time being we shall assume that σ is constant over individuals, or more exactly, it is not a function of y_c.

The simplest specification we can think of is the following

$$\mu = \beta_0 + \beta_1 \ln(y_c)$$

where β_1 is positive. If we assume that the response is governed by

$$\ln(c_i) = \mu + u_i\sigma$$

$$= \beta_0 + \beta_1 \ln(y_c) + u_i\sigma$$

it follows that $\beta_1 = 0$ would imply that current income is irrelevant for the response, while $\beta_1 = 1.$ would imply that all income levels responded increase with a percentage α when current income increases with α %.

The first situation is the case implicitly assumed by most economists. The second situation reflects pure relativity. In reality the relationship is estimated by[1]

$$\mu = \beta_0 + 0.6 \ln(y_c)$$

The fact that the value β_1 is estimated at 0.6 indicates that people with different incomes have different standards with respect to what level represents a"good" income. In other words, contradictory to what is frequently assumed there is not *one* social norm with respect to income, but each individual has its own standards with respect to income. This presents

[1] In this presentation we focus on the essentials. In reality the value of β_1 varies from sample to sample about an average of 0.6. The statistical quality of this regression estimate as measured in terms of standard deviations is always satisfactory and significantly different from zero, while the variance explained in samples of 1000 observations is always about 60%.

obviously a major difficulty when we try to evaluate the welfare situation of individuals or of society as a whole. The problem is according to whose standards we have to evaluate. The poor citizen believes that nearly everybody is fairly rich, while the rich man believes that nearly everyone is poor (according to his standards).

The phenomenon that people shift their norms with their income I (1971) called *preference drift* and the value of β_1 was called the *preference drift ratio.* The existence of preference drift is a disturbing factor for social policy. First, the top of society may have a different view on the social distribution than the population's majority, the rank and file. Second, we may expect a difference in the evaluation *ex ante* and *ex post* of social changes. Ex ante a wage increase may look marvellous, but ex post the standard has shifted upwards and people evaluate their wage increase as being relatively minor. Such a phenomenon obviously will create frustration.

We call the standards used by different individuals *virtual* standards. They are called virtual, because the evaluation of all incomes, especially other incomes than their current income, will change when their current income changes. Is it possible to find out how people evaluate their present income? Remember that

$$\ln(c_i) = \mu + u_i \, \sigma$$

where the values u_i correspond to the verbal labels i=1,...6. It is only for survey-technical reasons that we restrict the number of labels to six, but theoretically we may take u to vary continuously. The value $(u_4 + u_5)/2$ would then be interpreted as an evaluation half-way between "sufficient" and "good".

Let us then utilize the dependency between μ and current income y_c by writing

$$\ln(c_i) = \beta_0 + \beta_1 \ln(y_c) + u_i \sigma$$

In that case it is possible to find the u-value corresponding to the current income y_c by noticing that there must hold for that value, say, u_c

$$\ln(y_c) = \beta_0 + \beta_1 \ln(y_c) + u_c \sigma$$

Solving this equation for u_c we find

$$u_c = ((1-\beta_1)\ln(y_c) - \beta_0)/\sigma$$

Notice that the value increases with y_c and that the rate of increase becomes smaller, the larger the preference drift. In the pathological case that β_1 = 1., there is *no relationship with current income while* $\beta_1 > 1$ *would imply an* inverse relationship between welfare and current income.

This relation does not imply that the utility of income is a function of the type

$$U(y_c) = y_c^{1-\beta_1}$$

The value u is found by a log-standardization and derives its value content only from the scale of verbal labels in the IEQ. As soon as we apply a second transformation on u *the analytical specification of U(.) will change.* Nevertheless it is remarkable that we come to the same specification, which is frequently used in psychofysics and which has a history dating back to the

Weber-Fechner Law. Rainwater (1974) found a similar specification in a completely different context.

Although we do not claim any cardinal significance for this result, we shall see that the result is most helpful for welfare comparison between individuals in different circumstances. We shall consider two examples:

a. the welfare implications of differences in *family size*,

b. the welfare implications of differences in *climate*.

It is generally recognized that it makes a difference whether one has to support a small family or a large family from a fixed amount of income. Let us characterize *family size* quite simply by the number of household members to be supported out of household income. That number is denoted by fs. It is obvious that we may think of more elaborate definitions that take into account the ages as well, but that would be outside the scope of this article (see e.g. Kapteyn and Van Praag (1976)).

Again the way in which we can try to discover the empirical relationship between fs and the response on the IEQ, i.e., income standards of the individual, is to estimate μ as a suitable function of fs and of course of y_c. It was found that a log-linear regression gave very satisfactory results. More specifically we found

$$\mu = \beta_0 + \beta_1 \ln(y_c) + \beta_2 \ln(fs)$$

In practice we found a numerical specification of about

$$\mu = \beta_0 + 0.6 \ln(y_c) + 0.1 \ln(fs)$$

The value of β_2 =0.1 indicates that there is a positive relationship between income standards and family size. Using and generalizing the previous analysis it becomes now simple to derive *family- equivalence scales*. Such scales indicate what income increase a family needs in order to stay at the same welfare level, if its family size increases.

Replacing β_0 by $(\beta_0 + \beta_2 \ln(fs))$ we find

$$u_c = ((1-\beta_1)\ln(y_c) - \beta_0 - \beta_2 \ln(fs))/\sigma$$

Let us now assume that family size increases by a factor $\exp(\delta)$ which is approximately equal to $(1+\delta)$ for small δ. By which factor $\exp(\varepsilon)$ we have to multiply current income to *compensate* for the increase in family size, that is, to keep u_c constant? There must hold

$$u_c = ((1-\beta_1)(\ln(y_c) + \varepsilon) - \beta_0 - \beta_2 (\ln(fs) + \delta))/\sigma$$

Equalizing both expressions for u_c we get

$$\varepsilon = \delta \beta_2 / (1 - \beta_1)$$

For instance, let family size increase by 10 % ,i.e., $\delta = 0.1$, then we will get

$$\varepsilon = 0.1 \cdot (0.1/(1-0.6)) = 0.025$$

It follows that a 10 % increase of family size may be compensated by a (net) income increase of 2.5 %, that is an elasticity of 25 %.

Several observations are appropriate at this point. At first, we notice that the compensation rule does not depend on the specific income level at the point of departure; neither is the rule utility-specific, the compensation factor does not depend on u_c. This is clearly implied by the choice of the log-linear specification of μ. That specification was not dictated by a theory, but it was simply the best-fitting specification within a class of non-complex functional specifications. So we do not exclude that there are better fitting specifications which yield utility- or income-specific compensation factors. Secondly, we found for a number of roughly comparable societies (see Van Praag, Van der Sar (1988)) β_2 values of roughly the same order of magnitude, although the elasticity value of 25 % is certainly not an empirical law. We may think of rural societies where children are primarily a production instead of a consumption good for the household. In such societies we would expect a lower value of β_2; it might be even *negative* .

Looking back to this analysis we see that the result is twofold. First, it gives an empirical insight into the welfare differences corresponding to differences in family size; this is a *positive* result. Second, it yields a compensation factor according to which welfare differences due to family size may be compensated by income changes. This is a *normative* result.

Now we shall consider an analogous analysis dealing with the influence of *climate differences* on welfare (see Van Praag (1988)). The naïve approach would be to define a variable called *climate* denoted by C and to hypothesize a relationship

$$\mu = \mu(y_c, fs ,C)$$

We have to create a sample of households which do exhibit not only variation with respect to current income and family size, but also with repect to the climate they live in. Then it would be possible to estimate that relation; a first specification would be

$$\mu = \beta_0 + \beta_1 \ln(y_c) + \beta_2 \ln(fs) + \beta_3 \ln(C)$$

If this specification would fit well, the coefficient $\beta_3 /(1-\beta_1)$ could be interpreted as a climate elasticity. The only problem in this analysis is the definition of the climate variable C. We would like to know a climate index which gives a good presentation of the phenomenon. However, there is more than one variable which is relevant. First we have temperature, either measured as an annual average or as a maximum or as a minimum per year. But the hours of sunshine may also matter. Anybody who knows a dry climate like California or the French Massif Central will be aware of the fact that rain, measured in centimeters per year, is also a relevant variable, while air humidity is also important. Finally, altitude of the household's site and a measure of the windiness and especially the chilliness of the wind may be important as well. In short, climate may be a multi-dimensional phenomenon. Then the problem is how to define C.

A practical start was to experiment with some alternative selections of climate variables and to end up with a best- fitting and intuitively interpretable estimated equation.We used a sample of about 10,000 European households, surveyed among the "old" members of the European Community. This guaranteed a climate variation from Berlin to the Channel Islands and from the

North of Denmark to the South of Italy. We ended up with the following regression equation

$$\mu = \beta_0 + \beta_1 \ln(y) + \beta_2 \ln(fs) + \ldots$$

$$+ [\ \gamma_1 \ \ln(TEMP) + \gamma_2 \ \ln(HUM) + \gamma_3 \ln(PREC)\ ]$$

where *TEMP*, *HUM*, and *PREC* stand for the average annual temperature in centigrades, average humidity in % and for precipitation in millimeters per year respectively. The last part of the equation is estimated by

$$\ln(C) = -\ [\ 0.15 \ln(TEMP) + 0.40 \ln(HUM) + 0.10 \ln(PREC)\ ]$$

This expression is the climate index we looked for. If $\ln(C)$ increases by δ, it follows that $\ln(y_c)$ has to be multiplied by a factor $\delta/(1-\beta_1)$. In Table 2 we give the resulting climate indices for some European cities where we set the climate index of Paris at 100.

Table 2.Climate compensation factors for some European sites.

Paris	1.00	Copenhagen	1.10
Berlin	1.11	Sicily	0.94
London	1.08	Amsterdam	0.99
Rome	0.95	Channel Isl.	0.87
Nice	0.91		

We notice that this regression exercise has brought us two results. First, we have estimated the climate effect on income evaluation. It follows that we are able to find the effect of a change in temperature, humidity or precipitation on the evaluation of income, a *positive* result. Second, we have found a *normative* result, viz. which compensation factor would be needed in terms of income to neutralize a climate change. Moreover, we have come more or less unexpectedly to the definition of a climate index which is an aggregate of three dimensions of climate.

In this section we used a relatively simple method to estimate the effects of differences in personal conditions on income evaluation.

In the first instance, we estimated the effect of differences in family size. The method is rather unorthodox, as it uses responses to attitude questions as the basic observations. The effect itself is intuitively fairly obvious, and it is investigated elsewhere in the economic literature by observing consumer behavior under the hypothesis that equal purchasing behavior implies an equal preference structure, and hence, although this is not necessarily true, that people with the same consumption pattern evaluate their welfare situation equally.

The second example deals with a much more esoteric case. Climate is not an individual variable but rather a public good. It is part of the environment similarly like public health, safety in the street, etc. In the second analysis we analysed its effect, while simultaneously constructing an aggregate index which best reflects climate differences in the framework of this problem. Obviously there is no reason, why the same method would not be viable to estimate the money value to individuals of changes in the *environment*, *health*, or *public goods*.

In the scope of this paper we found that there are traceable welfare differences between individuals, that are caused by specific external factors. It should be remembered that we consider here a narrow welfare concept, as it refers only to that part of welfare which is related to money income.
In the following section we shall consider a more difficult model, where we consider the influence of past and anticipated income on the evaluation of *present* income.

5. The impact of the past and the future on present income evaluation.
(see van Praag and Van Weeren (1988))

In the previous models we stressed the dependency between standards on income and the concept of an "anchor-income", which we defined to be (net) *current* income. Although the empirical results are intuitively plausible and statistically of good quality, we have to admit that the choice of current income is a rather rough one, dictated by the circumstances. It is well- known that income fluctuates a great deal even for regular employees, and that apart from those more or less random fluctuations, income over life is not constant but will follow a first rising and then falling profile with a maximum somewhere near the age of 40, although the situation of the top income depends evidently on the job and the schooling of the individual. This relation between income and age is frequently called an earnings profile (see Mincer (19[illegible])).
It follows that we may doubt whether the income level of a specific individual at a specific age is the best operationalization of the "anchor"-income. Are

we not looking for a sort of "permanent income" in the sense of Friedman (1957) which we would like to use as an "anchor"? Let us denote that concept by y_π. Let us assume we know the earning profile of an individual; it is the sequence $\ldots y_{-1}$, y_0, y_1, $y_2\ldots$ where the moment zero is located at present. Then we assume that the permanent income must be a weighted average of the individual's earning profile.That is, we assume

$$\ln(y_\pi) = \sum_{t=-\infty}^{t=+\infty} w_t \ln(y_t)$$

where the w_t are weights adding up to one. The weights before time 0 may be interpreted as *memory* weights adding up to W_P and the weights after zero may be interpreted as *anticipation* weights, adding up to W_F. So we have $W_P + w_0 + W_F = 1$. Likewise we may define the w-weighted average past log-income $\ln(y_P)$ and future log-income $\ln(y_F)$and we get

$$\ln(y_\pi) = W_P \ln(y_P) + w_0 \ln(y_0) + W_F \ln(y_F)$$

We estimated the equation

$$\mu = \beta_0 + \beta_2 \ln(fs) + \beta_1 \ln(y_\pi)$$

by non-linear regression where we specified a specific weight pattern which depends also on *age* in order that the intuitive fact is reflected that people's time horizon both backwards and forwards varies with age. It turned out that the weight pattern could be estimated. It is depicted graphically for three typical ages in Fig.1.

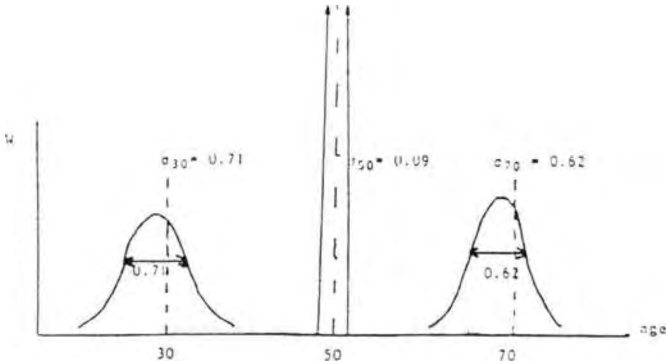

Figure 1. Time–discounting density functions for various ages

We see two remarkable things. First, the distribution is not symmetric about the present. Second, the top at μ_τ is for young and old people situated in the past and for people in midlife in the near future. Also the shape of the density varies with age and becomes very peaked at midlife. We reproduce a table from Van Praag, Van Weeren.

Table 2. Values of μ_τ ,W_P,w_O,W_F for various ages.

Age	μ_τ	W_p	w_0	W_f
20	−1.32280	0.71557	0.18098	0.10345
30	−0.31780	0.39848	0.47742	0.12409
40	0.27360	0.00135	0.80874	0.18992
50	0.45140	0.00000	0.69937	0.30063
60	0.21560	0.00041	0.90787	0.09172
70	−0.43380	0.45750	0.47642	0.06608

In this paper we do not have the possibility to dwell on the methodological problems nor to devote time to the psychological interpretation of these results. We get however the result

$$\mu = \beta_0 + \beta_2 \ln(fs) \ + \beta_1 \ [_P\ln(y_P) + w_0 \ln(y_0) + W_F \ln(y_F)]$$

where the weights are *age*-dependent. It follows that μ increases if past income increases. This implies that people have higher standards if their past earnings were higher. Likewise standards rise if expectations on the future increase. Moreover, one sees that the same earnings profile relative to the respondent's age has a different impact on his standards depending on his age via his age-dependent distribution of memory and anticipation weights.

This implies that young populations and old populations will have different income standards, given the same distribution of present incomes. It does also *imply that the same distribution is differently perceived in terms of welfare*, according to whether one arrives at that distribution from "below" in a situation of steady growth or from "above" in a situation of steady decline.

We may observe again that the analysis yields a *positive* and a *normative* result. First, it describes the impact of income changes over time on income standards. Second, it becomes possible to find equivalent income profiles which yield either momentarily or permanently the same welfare. Finally, we found as a by-product an interesting quantification of the memory and anticipation process, as far as it concerns income perception and evaluation This is properly speaking a product of experimental psychology, which sheds light on perception of time by individuals at different stages of life. We shall resist the temptation to look into it any further at this place.

6. The social reference process.

At this point it will be sufficiently clear that the evaluation of income varies a lot among individuals and that that variation may be explained to a considerable extent by observable variables related to the respondent. We saw that the main determinants were own current income, family size, climate, and the income history and expectations about future income. Up to now all explanation referred to the average log-response μ, and we did not consider the standard-deviation of log-response, that is σ. In this section we will take the whole response pattern into consideration.

Apart from the individual determinants considered before, it is frequently thought that the question whether an income is *good* cannot be decided outside of a context. The context is then the incomes of other individuals in the individual's social reference group (s.r.g.). If I do know practically no one with an income of more than $ 50,000, then I will find that income mighty good. On the other hand, if all my social peers would earn more than that amount, I would consider the same amount a very bad income. This would suggest *that the verbal labels would correspond to quantiles in the income* distribution of the social reference group of the respondent. For instance, the label "good" would correspond to the 80 %-quantile. The fact that different respondents give different answers would then reflect the fact that different people have different social reference groups with different income distributions. The response pattern would then be a discrete image of the income distribution of the respondent's reference group. Let us be more specific now. Let us denote the density function of the income distribution in the population by $f(y)$ and the income distribution in the social reference group of individual n by $f_n(y)$ then we define the social filter function $\phi_n(y)$ by the relation

$$f_n(y) = \phi_n(y) \cdot f(y)$$

If we interpret the value $f(y)$ as the *fraction* of the income bracket y in the population and $f_n(y)$ as the correponding fraction in the individual's social reference group, the factor ϕ gets an interesting interpretation. If ϕ equals one, the bracket y has equal importance in the s.r.g. as in the objective income distribution. If ϕ is larger than one, the individual assigns more than proportionate weight to that bracket, and if ϕ is smaller than one that bracket is less weighted in the s.r.g. than corresponds with its share in the objective income distribution.

It is empirically established that all income distributions look pretty much alike. They are roughly *lognormal*,that is, the distribution of log-incomes resembles the well-known Gaussian bellshape. The point of symmetry lies at μ_0 and the variance is σ_0^2 . The median income value is $\exp(\mu_0)$. If we assume that this holds not only for the objective distribution $f(.)$ but also for the income distribution of the s.r.g. with density function $f_n(.)$, it follows automatically that $\phi(.)$ is a lognormal density as well with parameters μ_n and

$\tilde{\sigma}_n^2$ respectively[2]. The filter function is depicted together with the objective density in fig.2.

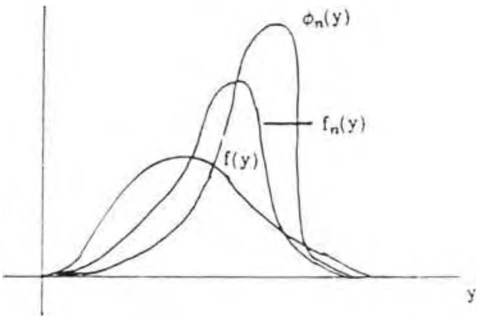

Fig.2. The objective income density and the social filter function.

We call the income level exp $(\tilde{\mu})$ the *focal point* of the filter. There is the maximum value of the filter. The value $\tilde{\sigma}^2$ will be called the *myopia factor*. If it tends to zero, it implies that the s.r.g. shrinks to the focal point. If it tends to infinity, the s.r.g. becomes equal to the population, and the filter function is constant, that is, the individual does not apply a social filter.

We have to distinguish between the three concepts carefully. There is the objective income distribution, the income distribution of the reference group, and their connection: the filter function. Let us denote the parameters of

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2 For the connaisseur we observe that $\phi(.)$ is not necessarily a density function in the sense that its integral converges. However, this technical *finesse* is not relevant here as the empirical result yields parameter estimates for which the integral converges.

$f_n(.)$ by μ_n and σ^2_n, then there are some simple relations between the parameters. First we define

$$q_n^2 = \sigma_n^2/\sigma_0^2$$

The value q will be mostly smaller than one, which indicates that the variance of the income distribution in the s.r.g. is smaller than the objective variance. This reflects the fact that individuals are myopic and that society is not perfectly transparant. It can be shown that

$$\tilde{\sigma}_n^2 = \sigma_0^2/\ (1/q_n^2 - 1)$$

Now we may derive

$$\mu_n = (1-q_n^2)\tilde{\mu}_n + q_n^2\mu_0$$

It follows that the median income of the individual's s.r.g. is a weighted average of his filters focal point and the objective median income. If q is near one it tends to the objective median; if q tends to zero the median of the s.r.g. tends to his own social focal point. If we assume now that

$$\tilde{\mu}_n = \beta_0 + \beta_1 \ln(y_n) + \beta_2 \ln(fs_n)$$

we can also relate μ_n with *y* and *fs* and their coefficients become $(1-q^2)\ \beta_1$ and $(1-q^2)\beta_2$ respectively. If q varies over individuals it follows that the coefficient β_1 in the μ-equation, taken constant before, becomes variable over individuals as well. The variable q has been modelled as

$$q_n^2 = \exp(\gamma_0) \cdot sc_n^{\gamma_1} \cdot pex_n^{\gamma_2}$$

where sc stands for schooling and pex for experience.

The parameters β and γ have been estimated on the basis of a sample of more than 500 American respondents and they give insight in the width of the social reference group, or said differently, the situation of the social focal point and the myopia of different individuals. The main results were that

1. social myopia becomes less if people are better schooled.
2. social myopia increases with experience, where we have to be aware that experience and age are strongly correlated.
3. the social focal point varies positively with the income of the respondent
4. in general the social focal point is situated at a higher income than one's own; people are looking upwards.

Sociologists will not be very surprised by those results. Nevertheless, there are some remarks to be made. The first is that the definition of a s.r.g. is not given *a priori* in terms of who is belonging to the s.r.g. and who not, but that the s.r.g. itself is *estimated* from the data. Second, we observe that in most literature each member of the s.r.g. gets the same weight in influencing the individual, i.e., zero or one, while in this model the weight varies continuously according to the social filter mechanism[3].

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3 The reader will notice that we used terms that suggest an optical filter. Indeed we may think of the social filter mechanism as looking through a lens to society. Some social groups will be magnified, while others become less important than their proper share. Another analogue of this mechanism is the Bayesian model, where the objective distribution acts as a priori density, the filter as the sample likelihood and the income distribution of the reference group as the a posteriori density.

Unfortunately we do not have the space to dwell on the technicalities of the estimation procedure, for which we refer to Van Praag and Spit (1981) or Van der Sar and Van Praag (1988).

7. Cardinality or not?

Up to now our analysis has been cast in ordinal welfare terms. We observed that individuals assign different verbal labels to the same income levels depending on their personal circumstances and outlook on society. Or differently said, there are differences between what people call a *good* income and those differences may be quantitatively explained and predicted. The mechanisms discovered conform pretty well with our intuitive feelings and with other results of the social sciences. The fundamental question of normative welfare economics is whether we can compare welfare positions of different individuals in society in the sense that we can evaluate trade-offs. One person gets less and another gets more: what is the net result for society? Does the gain of the second person outweigh the welfare loss of the first person? If we like to answer that question we have to require that such welfare losses and gains can be measured per individual *and* that they may be compared between the two individuals. It appears to me that these requirements are only realized if we adopt *conventions* of measurement and comparison.Let us make again an excursion to the physical concept of *temperature*. Whether the change from 15^0 C to 20^0 C represents the same change in temperature for an individual as from 20^0 to 25^0 is impossible to answer. If we assume that it does, it is a pure convention. If we carry out psychophysical experiments, where we measure transpiration or ask the test person at what temperature above 20^0 he feels that the change is equal to the first change from 15^0 to 20^0, we are able to construct subjective measures of temperature perception, but such measures give the same problem. They only represent comparable changes if we agree by convention that they may be compared. And similar remarks can be made with respect to interpersonal comparability.

The upshot is that there is no natural measure but:

that measures have to be accepted by convention

that a measurement method defines an empirical concept

that theoretical concepts are of a metaphysical nature

that an empirical concept is acceptable as reflecting the theoretical concept, if the empirical concept, thus defined. behaves as the theoretical concept it is supposed to measure.

that in case of insufficient conformity between theoretical and empirical concept either the theory has to be modified or/and consequently the measurement method the empirical concept has to be modified. Actually the majority of scientific progress is basically a reshaping of theory or/and empirics to improve insufficient conformity between both.

Where do we have to situate our own research briefly outlined in the previous sections? We believe that it may be situated as follows. We have defined a measurement method and found an empirical concept: the values $u_1,...,u_6$, the average log-response μ and the standard deviation σ of log-responses. We have been able to derive interesting empirical laws about those concepts. We did not formally say which theoretical concept we attempt to measure. At this moment we are typically in the situation that **we have found an empirical phenomenon in search of a theoretical metaphysical counterpart.**

We could call that metaphysical concept W. Then we would have found that someone's W increases with income and that W is essentially a function of income and two individually determined parameters μ and σ. We would find that

$$W(y_i;\mu,\sigma) = u_i \qquad (i=1,\ldots,6)$$

where y_i stands for the response on the IEQ. We would like to equate the empirical W with the metaphysical concept of *welfare*.[4] As long as $W(.)$ empirically behaves as the theoretical welfare concept should behave, we do not see much problem to stick to that convention. However, we are certainly unable to *prove* that we measure the metaphysical concept of *welfare*. On the other hand it cannot be disproved either.

There is one thing which makes us reluctant to accept the value u, that varies between $-\infty$ and $+\infty$, as a measure of welfare. As human beings we are unable to differentiate our feelings on an unbounded scale. All evaluations and ratings we know of are defined on finite bounded scales like 1 to 10 or A to E. This prompts us to normalize welfare between zero and one. So we define

$$W(\ln y_i\ ;\mu,\sigma) = F(u_i)=F((\ln y_i - \mu)/\sigma)$$

[4] As in this whole paper the welfare concept is a partial concept: it is only related to to income. The concepts of happiness,satisfaction and welfare in the general sense are wider concepts.

where F(.) is a distribution function and consequently $W(.;\mu,\sigma)$ is a distribution function as well. We saw in Table 1 that the values of u were practically symmetric about zero. If we consider them as quantiles of the normal distribution, we see that they roughly correspond with equal probability jumps. That is, $N(u_i) = (2i-1)/12$. This does not hold exactly, but to a striking extent. Now, there is a theoretical argument that this is not an accident. (see van Praag (1971), Kapteyn (1977)). The respondent who responds to the IEQ does this with a certain response strategy. His objective is to give a most-informative response. This is clearly not done if all response levels were so near to each other that all income levels would roughly correspond to the same welfare level. On the contrary, the response is given in that way that the welfare differences between the levels are maximal. This is realized by choosing the six levels in such a way that each level corresponds with the midpoint of one sixth of the interval [0,1], the range of W(.).[5]

It follows that this would imply that F(.) would be taken to be the normal distribution function. Welfare taken as a function of y instead of $\ln(y)$ would be described by a lognormal distribution function.

In view of our earlier interpretation of the IEQ-response as a description of the income distribution of the individual's social reference group, we come now to the equality:

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[5] Exactly speaking we have $W(\ln(y_i)) = (2i-1)/12$.

welfare evaluation of y = percentage below that income in the s.r.g.[6]

If we accept this cardinalization we may formulate welfare comparisons. This cardinalization has a certain plausibility. In Van Praag (1968) I formulated the same cardinalization but without any empirical corroboration like the one given here. There I gave other theoretical arguments, which I believe still to be valid, but which I will leave out of the present context.

The same cardinal applications may be based on any other functional increasing specification of F(.). However, then the attractive identification of the u-values gets lost.

8. Conclusion.

In this paper we outlined a method and results to get some idea of how individuals evaluate income levels. We saw that this is possible by a fairly simple and intuitively plausible set of questions, the so-called IEQ. The result can only be stamped as ordinal welfare measurement, when we assume that verbal labels have the same emotional connotation to different respondents. If we are willing to apply a plausible cardinalization, such that welfare differences between levels are equalized, we have also found a cardinal welfare measure, useful for normative intra- and interpersonal welfare comparisons.

[6] This statement has been formulated as a basic hypothesis by Kapteyn (1977) and by Kapteyn,Wansbeek, Buyze (1978).

Obviously the method has to be corroborated still further. Moreover, it may be applied to the measurement of standards to other concepts as well, e.g., wealth, amount of education , age, expenditures on specific commodities. Some work has been done in that direction (see for instance Van Praag, Dubnoff and Van der Sar (1985)).

We believe that this is a new and fruitful alley to tackle welfare comparison problems in the sense of positive and normative science.

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