A Multi-dimensional Approach to Subjective Poverty

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Abstract

This paper addresses two key issues in modern policy- oriented poverty research.

First, we recognize that poverty is an individual feeling and not an objective status, describable in terms of command over goods. This leads to an operational definition of subjective poverty as being below a certain degree of satisfaction with the situation one is in. Second, we distinguish several domains of life, and consequently, several types of poverty, each pertaining to a specific life domain. It is found that, although the chance on being poor in one domain enhances the chance to be poor in another domain, it is justified to see poverty as a multi-dimensional concept. As it can be shown that satisfaction 'with life as a whole' can be see as an aggregate of satisfactions with life domains, it follows that poverty 'with life as a whole' may be decomposed into poverty components with respect to life domains. The proposed methodology is simple to apply. Our methodology is illustrated by means of a large German data set (GSOEP).

1. Introduction

The subject of this conference is elusive. On one hand poverty is a politically and psychologically loaded concept. It is the subject of novels and the subject of many scientific studies. On the other hand, there is no straightforward definition of the concept. This makes it difficult to use it in the political debate on poverty reduction.
How do we distinguish the poor of the non-poor and what are the main causes of poverty? These questions are pertinent for societies, which attempt to eliminate poverty by policy measures.

For long it has been thought that poverty is a condition that may be described in terms of income. If household income falls below a specific income level $y_{\min}$, which is called the poverty line, then the household is called *poor.* In many developed economies such a poverty line is defined and households are eligible for social assistance, if they earn less than $y_{\min}$. This approach is the cornerstone of the first poverty studies like Rowntree (1901).

Later on it was recognized that income as such is too crude a measure to describe the situation of poverty. Some households are able to spend their income more efficiently than others; there are serious differences in price levels between regions within a country or between the city and the countryside. Some households get income in kind, while others do not. One of the first thorough studies was that by Townsend (1979). A rather recent review is given in Citro and Michael (1995).
Sen (1985) pointed out that income or the material consumption level of the household is partly the result of a voluntary decision. Individuals may choose for a leisurely life with not much income or for a heavy workload with a lot of income. Income is an output

variable.

This idea triggers the quest for more basic household characteristics. Sen tries to define the *capabilities* of an individual or a household, which determine its *earning potential.* Although Sen's idea is intellectually and intuitively attractive, it turns out that it is very hard to define and measure capabilities empirically (see Cohen, 1993, Deutsch and Silber, 2005). This may be the reason that the capability approach has not been credibly implemented yet.

In the seventies an alternative approach was advocated by Goedhart et al. (1977) and Van Praag et al.(1980). They argued that poverty was a feeling and that we had to look for the psychological components. The objective approaches have a paternalistic flavor. The government or 'experts' decide which consumption level corresponds to poverty. Such a line is 'objectively' fixed. However, it is by no means clear that the household classified as 'poor' according to the objective definition of poverty recognizes itself as poor, while also households that feel poor are classified as being 'non-poor'. The subjective approach starts by *asking* households how they evaluate their own situation in terms of verbal labels 'bad', 'sufficient', 'good'. By assigning numerical values, e.g. between 0 and 10, to these ordered labels ,one may estimate a function $U = U(y)$, which describes the relationship between household income *y* and the resulting evaluation *U*. Defining a specific evaluation level $U_{\min}$ as the 'beginning of poverty', one may calculate the corresponding income level $y_{\min}$ by solving the equation $U(y_{\min}) = U_{\min}$ for $y_{\min}$. This yields the *subjective* poverty line. If we take into account that there are 'intervening variables' like family size, age, health, or in short a vector of variables *x*, we may estimate a function $U = U(y;x)$, yielding an *x*-differentiated poverty line $y_{\min}(x)$. For instance if *x* is

'family size' we get in this way a poverty line, differentiated according to family size. A slightly different method is to ask households what income they consider to be their minimum income 'to get along' or 'to make ends meet'. This approach is also known as the 'Leyden approach', named after the Dutch university where the method was thought out. We also refer to the thorough study by Hagenaars(1986). There is a voluminous literature on this method, but it is as yet nowhere adopted as an 'official' method. See also Garner and Short (2004), Buhmann et al(1988)., Pradhan and Ravallion, (2000), Kapteyn, Kooreman, and Willemse, (1988), Van den Bosch (2001).

An other strand of research was triggered by the observation that the households well-being does not exclusively depend on money income, but also on leisure time, health, etc. We mention Maassoumi(1986), Case and Deaton (2002), and Deutsch and Silber (2005). They stress that poverty is a multi-dimensional phenomenon.

In this paper we will make an attempt to mix the two approaches, that is the subjective element and the multi-dimensional element. The result will be a subjective multi-dimensional poverty concept. We shall make use of the approach to the measurement of happiness as developed by Van Praag, Frijters, Ferrer-i-Carbonell (2003) and Van Praag and Ferrer-i-Carbonell(2004). This builds also on the work of economists like Clark and Oswald (1994) . See also Blanchflower and Oswald (2004), and the thorough recent survey by Senik (2005), the monographs by Frey and Stutzer (2002) and Layard (2005).

In Section 2 we argue that poverty analysis should be considered within the framework of the measurement of happiness and we

describe the model, which we shall use. In Section 3 we consider various measures of multidimensional poverty. In Section 4 and 5 we present the empirical results for financial poverty and overall poverty, respectively. Section 6 concludes.

Section 2. Subjective poverty .

When we talk of poverty and consider it as a more general concept than just income poverty, then it is best interpreted as a 'lack of happiness'. Instead of happiness we might also use alternatively the terms well- being, welfare , utility or satisfaction with 'life as a whole'. There will be many who argue that these words do not have the same connotations, but that there are subtle or not so subtle differences between them. However, if those concepts have not been or cannot be operationalized by an operational measurement method , it is very hard to say what the differences are. For the sake of this paper we will use the word 'happiness'. Until recently mainstream economists thought that happiness was an unmeasurable concept. In recent years economists are not that sure anymore that satisfactions are empirically unmeasurable, while psychologists have no difficulty at all with the idea (cf. Frey and Stutzer, 2002, Clark and Oswald, 1994; Van Praag, Frijters, Ferrer-i-Carbonell, 2003; Layard, 2005). Instead of theorizing about the concept, it has been realized that so-called satisfaction questions may be used to operationalize the happiness concept. In fact, in various German, British and American questionnaires we find question modules, which run as follows (see GSOEP, 1996):

Satisfaction question module.

How satisfied are you today with the following areas of your life?
Please answer using the following scale:
O means totally unhappy
10 means totally happy
How satisfied are you with …
Your household income *0—1—2—3—4—5—6—7—8—9—10*
Your health *0—1—2—3—4—5—6—7—8—9—10*
…….

By means of this type of questions it is possible to get an idea how satisfied the respondent is with his income, his health, his job, his leisure, etc. This gives us an idea on income satisfaction, health satisfaction, job satisfaction, and so on. Assuming that life has different aspects, which we call *life domains* in conformity with psychological usage, we are able to assess domain satisfactions. Actually, the answer is numerically specified. In the above wording the scaling is between 1 and 10, but sometimes the scale is 1 to 5 or 1 to 7. In all cases we may rescale the answers between 0 and 1. The fact that thousands of respondents in various countries respond on those questions shows quite clearly that individuals understand such questions and that they feel able to evaluate their satisfactions with respect to income, health, etc. on a cardinal numerical scale. The fact that individuals in comparable situations give comparable answers makes it plausible that there is a common understanding between respondents and an approximately common response behavior. That is, given a scale from 0 to 10 a domain evaluation of '7' for person *A* has the same emotional meaning and significance for person *A* as for person *B*. Obviously, we do not know this for sure, as we do not have other proven calibrated or certified

instruments to measure domain satisfactions. However, if it would not be generally felt by psychologists, social scientists and marketeers that there is a rough comparability between the answers, such questions would be eliminated a long time ago from the hosts of national surveys, where they have been included since long as standard ingredients (see also Van Praag, 1991).

How do we extract information of such questions with the objective of poverty analysis? As an example let us consider *income* or *financial satisfaction*. It may be assumed that the individual's income satisfaction U_1 depends on his income and possibly other variables like family size.

Let us assume that financial satisfaction U_1 is a function

$$U_1 = U_1(x_1; \beta_1) \tag{1}$$

where x_1 stands for personal variables, including income. The usual way to estimate such a function from a categorical response question is by Ordered Probit (or Ordered Logit), which yields qualitatively comparable answers. We introduce a latent variable u_1 and we assume that the response will equal category *i*, if the latent variable $u_1 \in (\mu_{i-1}, \mu_i]$, where the 'nuisance parameters' μ have to be estimated. In general the latent variable is thought to depend on the vector *x* of intervening variables and on a random error term ε which is assumed to be N(0,1)- distributed. The chance that individual *n* answers category *i* is then $P(\mu_{i-1} < u(x_n, \varepsilon_n) \leq \mu_i)$. Specifying *u*(.) as a linear function

$$\mathrm{u(x)} = \beta_1' x_n + C + \varepsilon_n \tag{2}$$

the chance on this observation becomes

$$P(\mu_{i-1} < u(x_n, \varepsilon_n) \le \mu_i) = P(\mu_{i-1} < (\beta_1' x_n + C + \varepsilon_n) \le \mu_i)$$
$$= N(\mu_i - \beta_1' x_n - C) - N(\mu_{i-1} - \beta_1' x_n - C) \quad (3)$$

where C stands for a constant to be estimated. Maximizing the log-likelihood of the sample with respect to the μ's, the β' s, and C [1], we estimate the function u(.). It is obvious that satisfaction changes when income changes and similar dependencies hold for the other variables. For instance, let us assume that we found that financial satisfaction depends on income *y* and family size fs; more precisely we found the following estimated relationship

$$u_1 = 0.5\ln(y) + 0.2\ln(fs) + C \quad (4)$$

where we assume ε = 0. If we fix the value for u_1, the equation describes an indifference curve in (*y,fs*)- space, corresponding to the satisfaction level u_1. Returning to the satisfaction question, we see that satisfaction may take any of the values 0,1,2,…,10. These values correspond to adjacent ranges of the latent variable u_1. For instance, when we assume that poverty starts if somebody evaluates his income satisfaction by 4, this corresponds with a value of μ_4 for the latent variable. Hence the indifference curve in (*y,fs*)-space, corresponding to 'the beginning of poverty', is given by the equation

$$0.5\ln(y) + 0.2\ln(fs) + C = \mu_4 \quad (5)$$

If the coefficient of *fs* is zero, we find only one solution for y, which we may call *the* poverty line $y_{\min}$. In all other cases we find a *poverty border*. When we distinguish between 'severe poverty',

'poverty', and 'near- poverty' and identify those labels with the satisfaction levels 4, 5, 6 respectively, the corresponding border lines are given by (4), with μ_4, μ_5, μ_6. In general, if $u_1(x) = \beta_1' x + C$, the corresponding poverty border corresponding to level *i* becomes

$$u_1(x) = \beta_1' x + C = \mu_i \tag{6}$$

or equivalently

$$u_1(x) = \beta_1' x = \mu_i - C \tag{7}$$

Let us now define poverty classes. We call a household *n* '*i*-poor' if for him holds $\mu_{i-1} < u_1(x_n) \le \mu_i$. The fraction of individuals in a population of size N, who are '*i*-poor', is now

$$p_i = \frac{1}{N} \sum_n I_{\mu_{i-1} < u_1(x_n) \le \mu_i} \tag{8}$$

where the characteristic function $I_{\mu_{i-1} < u_1(x_n) \le \mu_i}$ equals one if the condition holds and is zero otherwise. The chance on an individual observation to be *i*-poor, if we know the individual characteristics *x,* is according to the Probit model given by equation (3). Hence, we may write for the fraction of *i*-poor

$$p_i = \frac{1}{N} \sum_n I_{\mu_{i-1} < u_1(x_n) \le \mu_i} = \frac{1}{N} \sum_n \{N(\mu_i - \beta_1' x_n - C) - N(\mu_{i-1} - \beta_1' x_n - C)\} \tag{9}$$

Up to now we have considered only *financial* satisfaction. It is obvious that the same approach may be followed with respect to the other satisfaction types like job satisfaction, health

[1] We need one identifying constraint, but here we do not dwell on this technicality.

satisfaction…., in short with respect to domain satisfactions *2,3,…,j,…*

If those domain satisfactions *j* are explained by latent variables $u_j(x;\beta_j) = \beta_j' x + C_j$ we may also define poverty border-lines for those other life domains.

It is obvious that such domain satisfactions might be correlated. Hence, we need to compute correlation coefficients between domain satisfactions. This requires a somewhat alternative approach, where Ordered Probit, difficult to do multi-dimensionally, will be replaced by a regression approach. In Van Praag and Ferrer-i-Carbonell (2004) we developed an alternative, the so-called Probit Ordinary Least-Squares (POLS) method, which estimates the same latent regression equation as Probit does. Due to a different normalisation the regression coefficients are equal to the Probit estimates except for a proportionality factor.

In this approach to financial poverty we see that income is just one of the satisfaction determinants, but not *the* determinant. In the unlikely case that income would have no significant effect in the Probit equation, financial poverty would not be affected by income at all.

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3. Empirical results

In order to see how this works we borrow the specification presented in Van Praag and Ferrer-i-Carbonell (2004). There the GSOEP sample was divided into four different sub-samples according to whether the household lives in former East- or West-Germany and whether the respondent works or not. This distinction was made as we assumed that the four subgroups would have different attitudes with respect to satisfaction (questions). In the present paper we will only present as an illustration of the methodology the results for the West-workers sample. The data set we will use is the wave 1996 of the German Socio-Economic Panel (GSOEP). In Van Praag and Ferrer-i-Carbonell (2004) we use the waves 1992 to 1997. Given that the main objective of the present paper is to discuss the subjective poverty method, we keep the empirical analysis simple by only using one wave and avoiding the introduction of time and individual effects.
For the present paper we are especially interested in the satisfaction questions, which are worded like the one, quoted earlier.

A simple count for the GSOEP 1996 wave yields the following results for domain poverties, that is, the individuals in the level groups 0,1,…,4 taken together. We see that financial poverty is 6.8% but that with respect to health the poverty is 11.3%, while job scores 10.4%.

Table 1. A simple count of domain poverties for GSOEP 1996, West-workers

Level	Life as a whole	Financial Situation	Health	Job	Leisure time	Environ-ment	Housing
0	0.002	0.003	0.007	0.008	0.010	0.008	0.009
1	0.003	0.003	0.005	0.005	0.013	0.007	0.005
2	0.007	0.008	0.020	0.017	0.036	0.018	0.015
3	0.014	0.019	0.036	0.030	0.055	0.047	0.025
4	0.028	0.035	0.045	0.043	0.063	0.066	0.035
5	0.097	0.093	0.121	0.109	0.137	0.170	0.079
6	0.111	0.106	0.101	0.100	0.115	0.146	0.077
7	0.240	0.222	0.175	0.180	0.169	0.221	0.149
8	0.335	0.301	0.261	0.279	0.214	0.203	0.257
9	0.116	0.135	0.132	0.137	0.100	0.077	0.179
10	0.048	0.075	0.096	0.091	0.088	0.037	0.171
%Poverty	0.053	0.068	0.113	0.104	0.177	0.147	0.089

This table shows that 'non-financial' poverty is a very realistic phenomenon, especially because it is frequently hard or even impossible to compensate the lack of satisfaction by giving more money to the individual. Apart from the fact that enormous money amounts may be needed for those compensations (see Ferrer-i-Carbonell and Van Praag (2002)), money is not a determinant of some domain satisfactions.

As an example we reproduce the estimation result for financial satisfaction in Table 2. The other satisfaction - equations are presented in the Appendix *A*. We see that financial satisfaction depends on household net income and on a set of additional variables like age, number of children and education.

Age has a log - parabolic influence where the individual becomes less satisfied with his financial situation when growing older until the age of 43. After that age satisfaction grows under *ceteris paribus* conditions. Males are slightly less content than females. Financial satisfaction is strongly dependent on the number of adults (16 years and older) in the household and the number of children.

If individuals are saving, it is a strong signal of satisfaction. Individuals who live together with a partner are more content and the same holds for individuals with a job Individuals whose partner has a job are less satisfied than those who live in a household in which only one adult works. 'Missing'- dummies are included to account for the relatively few incomplete observations.

Table 2. Financial Satisfaction GSOEP, 1996, west-workers, POLS

	Estim.	t-value
Constant	3.764	2.400
Ln(age)	-3.820	-4.310
Ln(age) ^ 2	0.508	4.110
Min. Age	43	
Ln(household income)	0.254	7.390
Ln(years of education)	0.309	4.810
Ln(adults)	-0.082	-2.560
Ln(children+1)	-0.062	-2.320
Male	-0.077	-2.990
Ln(Savings)	0.115	6.180
Living together?	0.200	4.810
2nd Earner	-0.098	-2.730
Self-employed	-0.042	-0.940
Number Observations	5179	
R^2	0.078	

Dummies for non-missing variables are not included in the table.

4. Is poverty really multi-dimensional?

An interesting question is in how far these one-dimensional types of poverty are related to each other? Is it not very probable that someone with a low income, and consequently in financial poverty, will also suffer from bad health, and hence be 'health- poor' as well? In how far are the different types of poverty are really different or are they really indicators of the same underlying status? If that would be the case, there would be no room nor need for a concept of multi-dimensional poverty, because a one-dimensional concept

would do. In order to get a clearer look, let us consider two domains *1,2* with

$$\begin{aligned} u_1(x;\beta_1) &= \beta_1' x_n + C_1 + \varepsilon_{1n} \\ u_2(x;\beta_2) &= \beta_2' x_n + C_2 + \varepsilon_{2n} \end{aligned} \tag{10}$$

We are interested in the covariance of the two poverty indicators.
We have

$$\operatorname{cov}(u_1, u_2) = \operatorname{cov}(\beta_1' x + C_1, \beta_2' x + C_2) + \operatorname{cov}(\varepsilon_1, \varepsilon_2) \tag{11}$$

It follows that the covariance between the two domain satisfactions can be split up into two parts. First, a *structural* covariance caused by the fact that both satisfactions partly depend on the same explanatory variables. Second, a *residual* covariance because the error terms are correlated. Given the hypothesized independence between ***x*** and the residual error this decomposition is additive. Now the latent variables are discretely observed, as we do not know the exact value of *u*, but we know only that for *u* holds $\mu_{i-1} < u(x_n, \varepsilon_n) \le \mu_i$, where the μ 's are different for the two domains. Assessing the first term at the right-hand side by means of the corresponding sample moment (see equation (13)) is no problem. The second term is somewhat more difficult. Actually, we observe the satisfactions bracket-wise. We know for a specific observation *n* that he/she has answered satisfaction level i_n, hence we have $\mu_{i_n-1} < u_n \le \mu_{i_n}$. So we have to replace the ε 's by their conditional expectations

$$\bar{\varepsilon}_n = E(\varepsilon_n \,|\, \mu_{i_n-1} - (\beta' x_n + C) < \varepsilon_n \le \mu_{i_n} - (\beta' x_n + C))$$
$$= \frac{n(\mu_{i_n-1} - (\beta' x_n + C)) - n(\mu_{i_n} - (\beta' x_n + C))}{N(\mu_{i_n} - (\beta' x_n + C)) - N(\mu_{i_n-1} - (\beta' x_n + C))} \qquad (12)$$

where n(.) and N(.) stand for the standard normal density and distribution function, respectively. We use here a formula, known in normal distribution function theory (see e.g. Maddala(1983,p.??). We calculate the 'in- between' covariance $\mathrm{cov}(\bar{\varepsilon}_1, \bar{\varepsilon}_2)$ by means of the sample analogue, using (14). Notice that we may group either with respect to the categories 0,1,…,10 or that we may group still further in line with the poverty concept into 'poor' (1,2,3,4) and 'non-poor' (response 5 or higher). We present the variance-covariance matrices as given for the first more refined type of categorization.

In Table 4, 5 and 6 we present instead of the correlation matrices the so-called *variance-correlation* matrices. These are correlation matrices where the trivial diagonal elements, equal to 1 by definition, are replaced by the corresponding variances[2].

Table 4. Domain Total Variance/Correlation Matrix; GSOEP 1996 West-workers

	Job Satisf.	Financial Satisf.	Health Satisf.	House Satisf.	Leisure Satisf.	Environ. Satisf.
Job Sat.	*0.916*					
Financial Sat.	0.419	*0.808*				
Health Sat.	0.442	0.350	*0.834*			
House Sat.	0.292	0.487	0.219	*0.825*		
Leisure Sat.	0.288	0.411	0.268	0.360	*0.833*	
Environm. Sat.	0.288	0.390	0.261	0.297	0.263	*0.888*

[2] Notice that this may imply that diagonal elements are smaller than non-diagonal entries. Covariances are found by the formula $\sigma_{ij} = \rho_{ij}\sigma_{ii}\sigma_{jj}$.

Table 5. Domain Structural Part Variance/Correlation Matrix; GSOEP 1996 West-workers

	Job Satisf.	Financial Satisf.	Health Satisf.	House Satisf.	Leisure Satisf.	Environ. Satisf.
Job Sat.	*0.026*					
Financial Sat.	0.472	*0.063*				
Health Sat.	0.606	0.317	*0.064*			
House Sat.	0.227	0.543	-0.309	*0.033*		
Leisure Sat.	0.159	0.129	0.049	0.143	*0.063*	
Environm. Sat.	0.338	0.476	0.056	0.400	0.436	*0.015*

Table 6. Domain Residuals Part Variance/Correlation Matrix; ; GSOEP 1996 West-workers

	Job Satisf.	Financial Satisf.	Health Satisf.	House Satisf.	Leisure Satisf.	Environ. Satisf.
Job Sat.	*0.890*					
Financial Sat.	0.407	*0.746*				
Health Sat.	0.432	0.355	*0.769*			
House Sat.	0.287	0.460	0.248	*0.793*		
Leisure Sat.	0.289	0.424	0.285	0.367	*0.773*	
Environm. Sat.	0.284	0.384	0.271	0.290	0.263	*0.873*

We see that in general there is a significant positive correlation between the domain satisfactions. However, there are some exceptions in Table 5. For instance, older people live in better houses or at least enjoy more housing satisfaction, while at the same time their health is worse than that of younger people. This may explain the negative correlation between health and housing. A similar explanation may hold for the low correlation between health and environment and leisure satisfactions.

The sizeable correlation between domains implies that the domain satisfactions can not be seen as independent of each other. There is

a considerable linear dependency. A high satisfaction in domain *A* predicts a high satisfaction in *B*, and consequently a strong inequality in domain *A* entails a strong inequality in domain *B* as well. This picture does not change very much when we take account of the fact that the structural variables *X*, which play a role in one domain satisfaction, play also a role in another domain, as is found by looking at the error matrices.

Our conclusion is that although there is linear correlation, it is not perfect at all. It follows that it is justified to distinguish between different types of poverty and to see poverty as a multi-dimensional concept.

5. Overall poverty

However plausible a multi-dimensional poverty vector concept is, it is obvious that some type of poverty may be more life- destroying than another type of poverty. The first question is then whether there is a trade-off between domain poverties or rather between domain satisfactions? And second, is there a natural aggregate of domain poverties, which may be interpreted as an aggregate poverty concept, 'overall poverty'?

The answer may be found in the survey questionnaire. In many questionnaires that carry domain satisfaction questions we also find a question about General Satisfaction (GS). GS is obtained from respondents in a similar way as in the Domain Question. The only difference is that we ask about *'satisfaction with life as a whole'* instead of *'satisfaction with a particular domain'*. Hence we may define a u_{GS} and explain it by the domain satisfactions $u_1,...,u_k$. Graphically we assume a two-layer- model structure, like pictured in fig.1. (see also Van Praag, Frijters, Ferrer-i-Carbonell, 2003).

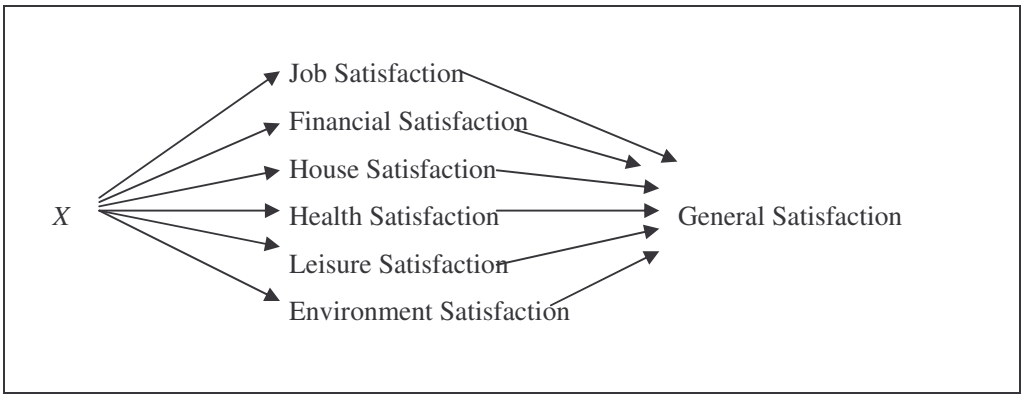

Figure 1: The two layer model

Doing this we may analyse the following equation

$$u_{GS} = u_{GS}(\mathrm{u}_1, \ldots, \mathrm{u}_k) \tag{13}$$

For instance, we might think of a linear aggregate:

$$u_{GS} = \alpha_1 \mathrm{u}_1 + \ldots + \alpha_k \mathrm{u}_k + \beta_{GS} x + \varepsilon_{GS}. \tag{14}$$

This is precisely what we will do, where we operationalize the u_j variables ($j=1, , , k$) by their conditional expectations $\bar{u}_{j,i_n}$ and where x stands for a vector of 'other' variables. We define:

$$\bar{u}_{j,i_n} = E(u_j \,|\, \mu_{j,i_n-1} < u_j \leq \mu_{j,in}) = \frac{n(\mu_{j,i_n-1}) - n(\mu_{j,i_n})}{N(\mu_{j,i_n}) - N(\mu_{j,i_n-1})}. \tag{15}$$

and $\bar{u}_{GS}$ likewise. Notice that we do *not* use the *x-corrected* structural predictions but the real 'observations'. Those observations are not exact, but the best estimate we can get. Now the problem of such a regression may be that the error term ε_{GS} is

correlated with the explanatory variables $\overline{u}_j$. For instance, the satisfaction response of an optimist will be structurally higher than that of a pessimist. Hence, if this psychological trait is not explicitly included as an explanatory variable the effect will pop up in the error term. As this psychological trait will affect all satisfaction responses we may expect positive correlation between the error terms of the $\overline{u}_j$-equations. However, we may expect the same effect for satisfaction with life as a whole, that is $\overline{u}_{GS}$. It follows that estimation of (15) may suffer from an endogeneity bias, as the error term ε_{GS} is correlated with the explanatory variables $\overline{u}_j$. Hence, we attempt to assess this common hidden effect by the first principal component of the domain error matrix. We denote it by Z. Hence we estimated the equation

$$\overline{u}_{GS,n} = \alpha_1 \overline{u}_{1,n} + \ \ldots + \alpha_k \overline{u}_{k,n} + \beta_{GS} x_n + \gamma Z_n + \varepsilon_{GS,n} \qquad (16)$$

The estimation results are presented in Table 7. We see that the variable Z in this example is not significant.

Table 7 German General Satisfaction explained (GSOEP, 1996 west-workers), method: POLS

	West Workers	
	Estim.	t-value
Constant	0.080	7.740
Job Satisfaction	0.192	11.290
Finan. Satisfaction	0.325	17.780
House Satisfaction	0.081	4.650
Health Satisfaction	0.257	15.610
Leis. Satisfaction	0.121	7.300
Envir. Satisfaction	0.011	0.720
First-Component	-0.042	-1.350
Number Observations	5062	
R^2:	0.446	

It is obvious that we can now define an overall- poverty border line as

$$u_{GS}(u,x) = \alpha'_{GS}u + \beta'_1 x + C = \mu_{GS,i} \qquad (17)$$

where u stands for the vector of domain satisfactions and where $\mu_{GS,i}$ stands for the quantile of General Satisfaction , so low that it may be called poverty. Equation (2.5) may be interpreted as an indifference curve. The coefficients presented in Table 7 make it possible to interpret overall-poverty as a weighted sum of domain poverties. It makes also clear that there is a trade-off between the domains. For instance less job satisfaction may be compensated by a higher financial satisfaction.

In a certain sense these satisfaction variables are not tangible. However, we may replace the u – variables in (18) by their conditional expectations, being the structural parts in (11).

Then we may write (18) as

$$u_{GS}(u_n, x_n) = \alpha'_{GS}BX_n + \beta'_1 x_n + C = \mu_{GS,i} \qquad (18)$$

where the (k x q) – matrix B is

$$B = \begin{bmatrix} \beta'_1 \\ . \\ . \\ . \\ . \\ \beta'_6 \end{bmatrix}$$

where *q* equals the number of all explanatory variables used and *X* the corresponding (*q* x *k*)- matrix of explanatory variables that are used in the *k* domain satisfaction equations. Equation (19) is the border- line of overall-poverty.

Especially interesting is of course the trade-off with money. Let us assume that ln(*income*) appears only in the financial satisfaction equation with coefficient $\beta_{1,y}$. Then a change in variables *X*, say by ΔX, has to be compensated by a (relative) income change $\Delta \ln(y)$ where

$$\beta_{1,y} \Delta \ln(y) + \tilde{B}.\Delta X = 0 \qquad (19)$$

where $\tilde{B}$ is the matrix *B* except for the column pertaining to $\ln(y)$, where we assume that income has only effect on financial satisfaction. If income has also an effect on other domains (like health), it is obvious how things have to be changed.

6. Conclusion

In this paper we extended and generalized the subjective poverty concept as originally introduced by Goedhart et al. (1977). In accordance with the ideas on poverty up till recently, there it was assumed that poverty can stand only for *financial* poverty. Using the life domain concept it is clarified in this paper that we may define any kind of subjective poverty, as soon as we have a corresponding satisfaction question. We saw also that we can define various types of poverty, ranging from 'severe' to 'hardly'.

In this paper we then asked the question whether those types of poverty are heavily correlated, in the sense that somebody who may be called poor with respect to one domain *A* is almost

automatically also poor with respect to another domain *B*. If this is the case there is no room for two distinct poverty concepts, but one will suffice. In this paper it is demonstrated, at least for a German data base, that poverties for the main domains are correlated, but not to such an extent, that poverty with respect to domain *A* almost implies poverty with respect to *B* or vice versa. In other words, poverty is a multi-dimensional concept.

We explained poverty with respect to six domains. So it became possible to explain the subjective *feelings* of poverty by measurable objective variables.

Third, we defined an overall poverty concept as an amalgam of domain poverties and we derived trade-off coefficients between various objective explanatory variables. We notice that it is not essential in this analysis to *explain* poverty. If we do not introduce explanatory variables *x*, we can still measure poverty as such. However, in that case we cannot look for objective causes of poverty and from those findings develop instruments to alleviate poverty.

In this paper we did not attempt to measure poverty for a specific country, although we tabulated in table 1 some simple subjective poverty counts for Germany. We reported on the estimation results for one poverty equation. The corresponding equations for the other domains can be found in Van Praag, Frijters, Ferrer-i-Carbonell (2003) or in Van Praag, Ferrer-i-Carbonell (2004).

Finally, the question arises how this new apparatus has to be placed in the present framework of poverty analysis. In our view poverty is a subjective feeling of individuals. Hence, any knowledge and any poverty policy has to rely in the last instance on the gauging of those feelings in the population. If specific objective variables explain the feelings of poverty very well, there is of course no

problem to replace the outcomes of surveys by some synthetic index, but still we should periodically check if that index still represents that what it is assumed to do. In our view it is natural to base any political poverty measures on subjective data.

It is sometimes thought that subjective indicators are themselves subjective and therefore non-scientific. This idea is based on confusion and not true. As we hope this paper demonstrates, analysis of subjective data can be done in the most objective way. We use a calibrated questionnaire and a sample, representative for the population we are interested in, and we apply the method described above. Such a method should be clearly described, and it should be repeatable. It should lack subjective choices by researchers, or if they are unavoidable, they should be well-documented by the researchers.

The main test for a poverty index is whether it reflects reality. That is, whether the index classifies those individuals or households as poor who perceive themselves as poor and the same for the non-poor. In that respect the subjective measures do not score very highly thus far. This is so, because the error term rules mightily. Partly, this is caused by the fact that the analysis has to be refined by choosing better functional specifications and better explanatory variables. But partly it is also due to the fact that there is and there will remain always a large element of randomness involved. In terms of significance of the effects we see that the quality of the estimates is very good. This points to the fact that the structural relations underneath are well-estimated but that there is a random component and an unobservable component involved, which we cannot catch (yet), but which have rather significant effects on poverty feelings. Nevertheless, what is the performance of so-called objective measures, like half-median income or the U.S.A. food

based poverty index (see Orshansky (1965) . There have been only a few attempts to compare those objective measures with the underlying poverty feelings (see e.g. Hagenaars, 1986 and Van Praag, Flik, and Stam, 1997). Those partial comparisons suggest that such measures shoot structurally beyond the mark. This is especially due to the fact that they not use subjective household equivalence scales, but objective definitions like that of the OECD, which are based on intuition of some nutritional experts instead of subjective data analysis Garner and Short (2005).

Summarizing, we believe that the subjective multi-dimensional concept is a needed instrument. It is needed for scientific analysis and socio-economic policy.

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Appendix *A*

Dummies for non-missing variables are not included in the tables.

Health Satisfaction Germany, 1996 west-workers, POLS

	Estim.	t-value
Constant	4.001	2.530
Ln(age)	-2.076	-2.330
Ln(age) ^ 2	0.178	1.430
Turning point	337	
Ln(household income)	0.048	1.590
Ln(years education)	0.292	4.560
Ln(children+1)	0.036	1.350
Male	0.026	1.050
Living together?	0.010	0.300
Self-employed	0.004	0.080
Ln(Savings)	0.026	1.360
Number Observations	5185	
R^2:	0.077	

Job Satisfaction GSOEP, 1996 west-workers, POLS

	Estim.	t-value
Constant	9.516	5.000
Ln(age)	-5.602	-5.360
Ln(age) ^ 2	0.757	5.120
Min Age	*41*	
Male	-0.150	-1.470
Ln(household income)	0.122	3.600
Ln(years education)	-0.111	-0.420
Ln(adults)	0.064	1.800
Ln(children+1)	0.103	3.550
Living together?	-0.038	-1.050
Ln(working income)	0.040	0.350
Ln(working inc.)* Ln(age)	-0.017	-0.850
Ln(work.inc.) *Ln(YrsEdu)	0.032	0.990
Ln(working income)*male	0.010	0.740
Self-employed	0.109	1.580
Ln(working hours)	-0.094	-2.190
Ln(extra money)	0.019	2.580
Ln(extra hours)	-0.007	-0.630
Number of Observations	5098	
R^2:	0.027	

Housing Satisfaction GSOEP, 1996 west-workers, POLS

	Estim.	t-value
Constant	5.428	3.540
Ln(age)	-4.648	-5.300
Ln(age) ^ 2	0.686	5.590
Min. age	*30*	
Ln(household income)	0.293	9.760
Ln(years education)	0.038	0.590
Ln(adults)	-0.100	-3.080
Ln(children+1)	-0.036	-1.380
Male	-0.121	-4.750
Self-employed	0.029	0.620
Number Observations	5171	
R^2:	0.040	

Leisure Satisfaction GSOEP, 1996 west-workers, POLS

	Estim.	t-value
Constant	13.801	8.930
Ln(age)	-7.192	-8.300
Ln(age) ^ 2	1.006	8.290
Min.Age	*36*	
Ln(household income)	0.055	1.340
Ln(years education)	0.073	1.130
Ln(adults)	-0.080	-2.490
Ln(children+1)	-0.113	-4.320
Male	0.134	4.890
Ln(working hours)	-0.315	-10.080
Self-employed	-0.482	-10.290
Ln(leisure time)	0.015	0.120
Ln(leis.time)*ln(hous.income)	0.005	0.350
Number Observations	5177	
R^2:	0.075	

Environmental Satisfaction GSOEP, 1996 west-workers, POLS

	Estim.	t-value
Constant	3.790	2.420
Ln(age)	-2.962	-3.340
Ln(age) ^ 2	0.419	3.380
Min.Age	*34*	
Ln(hous. inc.)	0.161	5.800
Ln(yrs.Edu.)	0.028	0.410
Male	0.130	4.890
Self-employed	-0.094	-1.930
Ln(leisure time)	0.022	2.730
Number Observations	5179	
R^2:	0.0168	