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by Claudia Biancotti

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A DUAL-REGIME UTILITY MODEL FOR POVERTY ANALYSIS

by Claudia Biancotti*

Abstract

This paper offers a micro-founded general definition of poverty set in the context of utility theory. Poverty and non-poverty are described as two structurally different types of local non-satiation: the former entails a strong need for further consumption and social marginalization, the latter is characterized by a weak need for further consumption and satisfactory adjustment to social expectations. Each of the states can be fully described by a separate technology of utility production. The model is tested on data from the Bank of Italy's Survey of Household Income and Wealth; an indicator of self-reported economic satisfaction is regressed on yearly consumption of food and non-food commodities. The predictions of the model are confirmed in the case of food consumption, signalling the existence of physiological minima that are uniformly perceived by individuals. For non-food commodities, no significant change of regimes is found: welfare appears to be connected with needs that are less exposed to structural variation, possibly because they are not as urgent or objective as food-related ones.

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* Bank of Italy, Economic Research Department. Email: claudia.biancotti@bancaditalia.it

1. Introduction[1]

A number of definitions have been proposed in the literature for the state of being commonly known as poverty. Is it simply a failure to achieve a certain level of income in a given time span, or is it a broader condition arising from the concurrence of low consumption, lack of education, bad health and precarious employment (Ravallion, 1994; World Bank, 2000)? Does deprivation correspond to falling short of a minimum level of daily calorie intake, or does it mean being unable to afford what most of the neighbours have (Townsend, 1962; Townsend, 1979; Sen, 1983; Mack and Lansley, 1985)? Does an objective condition of poverty even exist at all, or is it in the eye of the beholder (Garner and de Vos, 1995; Lelkes, 2006; D'Ambrosio and Frick, 2004)?

Each interpretation spawns its own toolbox: a set of poverty lines, i. e. thresholds separating the poor from the non-poor, and an array of poverty indicators. In recent times, the debate has concentrated on how to choose the best among these toolboxes and on the qualities that a good poverty index should have (Ravallion, 1996; Glennerster, 2000; Förster, Tarcali and Till, 2002; Garcia Diaz, 2003; Atkinson, Marlier and Nolan, 2004). This turn towards the existential rather than the ontological might have been driven by the fact that the study of poverty is very close to policy-making: the task of identifying the destitute primarily serves the purpose of outlining a target population for relief programme. The question of the very nature of poverty has thus been largely overlooked, or tackled indirectly by assuming that a particular reading of the concept is correct and then building a measurement strategy upon it.

[1] I would like to thank Tony Atkinson, Andrea Brandolini, Giovanni D'Alessio, Giacomo Ponzetto, Inger Munk, Ivan Faiella, Luigi Federico Signorini, Marco Taboga and three anonymous referees for useful suggestions. All remaining mistakes are mine. This paper reflects only the author's opinions, which should not be attributed to the Bank of Italy.

This paper brings the focus back onto what poverty itself is. It offers a micro-founded general definition set in the context of utility theory. We define poverty and non-poverty as two qualitatively different types of local non-satiation: the former entails a strong need for further consumption[2] and social marginalization, the latter is characterized by a weak need for further consumption and satisfactory adjustment to social expectations. Each of the states is fully described by a separate technology of utility production. A poverty line is a quantity of a good at which there is a structural break in how utility is extracted from consumption of that good.

Our qualification of poverty draws on the one tenet of the literature that does not appear to be in discussion: there is a difference between those who cannot satisfy their basic needs and those who can. It also incorporates two corollaries of this statement that are widely agreed upon: first, meeting fundamental demands is more important than achieving further resources once those are taken care of; second, not meeting them is accompanied by burdens such as social stigma and diffuse feelings of powerlessness. These ideas suggest the existence of a dual-regime technology of utility production: each individual derives utility from each attribute corresponding to a dimension of life we deem relevant for well-being, but the function that transforms the level of the attribute owned by the individual into utility is differently parametrized depending on the state of poverty of the individual with respect to that attribute. In particular, if the poor can be defined as people who experience a special state of need, and if marginal utility can be taken as a proxy of the intensity of need, when a person makes the transition from poor to non-poor the marginal utility of consumption registers a discrete negative change that goes beyond the fall in returns to consumption predicted by standard theory. This reflects a switch between two different utility-production regimes, also marked by the elimination of the moral cost connected with rejection on the part of society. [3]

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[2] When poverty is studied from a multidimensional perspective, it is often emphasized how welfare depends on goods that technically are not "consumed". We will use the term "consumption" throughout the paper for the sake of simplicity, but it should be understood to refer to enjoyment of any good that contributes to the formation of well-being.

[3] Symmetrically, it can be argued that the non-poor reap moral rewards from being well-adjusted to social standards. In order to keep the formalization as simple as possible, this aspect is not discussed in the paper. We choose to consider the condition of those who fit in with social standards as the benchmark, and evaluate the costs of poverty differentially by assuming that the rewards to being non-poor only consist in leaving stigma and rejection behind, with no added bonus.

In our framework, most well-known interpretations of poverty turn out to be specifications of the general definition, in the form of parametrizations of a comprehensive model. The theory is tested in the paper for one such specification. As an accessory, we present a flexible poverty indicator to match, which can also be used to carry out sensitivity analysis with respect to implementation choices.

To our knowledge, at present the literature does not provide a unifying ontology of poverty such as the one proposed here: several of its constituent parts, however, have been explored. Models featuring bilinear or other parameter-switching utility functions are routinely used in finance to describe structural changes in the level of risk aversion (Sharpe, 1998). The idea of implicit levels of utility associated with poverty measures was originally developed in a uni-dimensional, monetary framework by Hagenaars and Van Praag (1985) and Hagenaars (1986), and subsequently extended by many others. The possibility of a dual structure of preferences has been studied in relation to poverty by Eswaran and Kotwal (1993), although they describe a variation in utility-production technologies between food and non-food goods rather than for each good individually. The cost of poverty in terms of social stigma and exclusion has been investigated, among others, by Narayan et al. (2000) and Lister (2004).

Section 2 briefly presents the dual-regime utility model (DRUM) associated with our definition of poverty. Section 3 proposes a test of the model, based on the analysis of subjective poverty in Italy. Section 4 concludes. The Appendix provides a poverty indicator built on the DRUM framework, and proves its compliance with the relevant axiomatic requirements as proposed by Cowell (1988) and extended by Tsui (2002) and Bourguignon and Chakravarty (2003).

2. A dual-regime utility model (DRUM) for poverty analyisis

2.1 The utility-generating process

Let us assume that there exist m goods in the world, all of which produce utility when consumed. The utility function for each individual i is additively separable:

$$u_i = \sum_{k=1}^{m} v_k(q_{ki}, \vartheta_k(q_{ki})) \qquad (1)$$

where v_k is the subutility function (or good-specific utility function) for the k-th good, q_{ki} is the quantity of the k-th good owned by the i-th individual, and ϑ_k is a vector of parameters dependent on q_{ki}.

For each good, there exists a quantity z_k called a poverty line such that

$$v_k = [f_k(q_{ki}, \vartheta_k(q_{ki})) - l_k]\mathrm{I}_k(q_{ki}) + [f_k(q_{ki}, \vartheta_k(q_{ki}))][1 - \mathrm{I}_k(q_{ki})] \tag{2}$$

where

$$\mathrm{I}_k(q_{ki}) = \begin{cases} 1 \ \textit{if} \ q_{ki} < z_k \\ 0 \ \textit{otherwise} \end{cases} \tag{3}$$

$$\vartheta_k(q_{ki}) = \begin{cases} \vartheta_{k1} \ \textit{if} \ q_{ki} < z_k \\ \vartheta_{k2} \ \textit{otherwise} \end{cases} \tag{4}$$

$$l_k > 0 \tag{5}$$

signifying that utility is derived from each good according to a function that exhibits a dual regime, i.e. a function that is differently parametrized depending on whether the consumed quantity of that good lies above or below z_k. Note that the utility curve for the poor is shifted downwards by an intercept l_k.

All f_k (and hence all v_k) show positive and diminishing returns as described by

$$\frac{\partial f_k(q_k, \vartheta_k(q_k))}{\partial q_k} > 0, \ \frac{\partial^2 f_k(q_k, \vartheta_k(q_k))}{\partial {q_k}^2} < 0 \tag{6a-b}$$

for all goods k and all quantities q_k, and meet the Inada conditions

$$\lim_{q_k \longrightarrow 0} \frac{\partial f_k(q_k, \vartheta_k(q_k))}{\partial q_k} = \infty, \ \lim_{q_k \longrightarrow \infty} \frac{\partial f_k(q_k, \vartheta_k(q_k))}{\partial q_k} = 0 \tag{7a-b}$$

for all goods k.

As for continuity, we require

$$\lim_{q_k \longrightarrow x^+} f_k(q_k, \vartheta_{k1}) = \lim_{q_k \longrightarrow x^-} f_k(q_k, \vartheta_{k1}) \text{ for all } x \in (-\infty, z_k] \tag{8a}$$

and

$$\lim_{q_k \longrightarrow x^+} f_k(q_k, \vartheta_{k2}) = \lim_{q_k \longrightarrow x^-} f_k(q_k, \vartheta_{k2}) \text{ for all } x \in [z_k, +\infty) \tag{8b}$$

The core assumption of the model is as follows:

$$\frac{\partial f_k(q_k, \vartheta_{k1})}{\partial q_k}\Big|_{Z_k} > \frac{\partial f_k(q_k, \vartheta_{k2})}{\partial q_k}\Big|_{Z_k} \tag{9}$$

for all goods k. We know from (6a-b) that marginal utility is negatively correlated with consumption for both the poor and the non-poor, consistently with the "absence makes the heart grow fonder" idea of diminishing returns; according to (9), the transition between classes is marked by a specific state-switching fall in its level beyond the one predicted in a single-regime setting. This fall signals that we are moving from a condition where further consumption has the purpose of achieving a decent standard of living to another where it just produces additional pleasure. If the magnitude of the cause of consumption can be measured by the magnitude of its effect, then the poverty lines z_k are the watershed between the situation of strong need for additional consumption of those who struggle to cope and the weak need of those who have already taken care of the basics.

Finally, we ask that

$$f_k(z_k, \vartheta_{k1}) - f_k(z_k, \vartheta_{k2}) = l_k \tag{10}$$

for all goods k: at the poverty line, the distance between the utility curve for the poor and the utility curve for the non-poor is zero. When combined with (8a-8b), this implies that v_k is also continuous for all k.

Two effects are at work here: on the one hand, there exists a penalty term l_k associated with the state of poverty that is positive for all consumption levels below the threshold, representing the fact that the poor incur a loss in utility derived from being outcasts *per se*. On the other hand, the impact of this loss on utility levels grows smaller as the exit from poverty draws nearer, because it is progressively compensated by the mechanism described in (9): for any quantity q_k, the transformation of consumption into

utility yields higher returns in the poverty regime than it would if we applied the non-poverty regime. Assumption (10) requires that this compensation be exact at the poverty line.

The clear-cut separation of these two components is obviously a device that has more to do with the economy of the model than with an idea of completely disjoint processes. In the real world, what can be observed is that an increase in consumption levels not only improves the material conditions of the poor, it also tends to alleviate the degree of marginalization and stigmatization they are subject to. In order to describe the latter phenomenon more accurately, we can define on all $q_k < z_k$ a function quantifying the net moral cost of poverty as

$$c_k(q_k) = f_k(q_k, \vartheta_{k2}) - (f_k(q_k, \vartheta_{k1}) - l_k) \tag{11}$$

i.e. the distance between the level of utility that would be achieved by transforming q_k into utility according to the technology used by the non-poor and the level of utility that is actually achieved by those who consume q_k, considering that the quantity in point is actually below the threshold. From assumptions (5a) through (9) we know that c_k is continuous and strictly decreasing for all goods k and all quantities q_k; it is also zero-valued at the poverty line. In other words, the utility gap between the poor and the non-poor starts at a level l_k, then decreases until it closes at the threshold (Figure 1).

2.2 Representing different concepts of poverty

As anticipated in Section 1, the dual-regime utility function described by (1) through (5) can be adapted to a number of concepts of deprivation, provided that the idea of structurally different states of need is accepted. As far as evaluating which aspects of life are important for well-being is concerned, it is easy to see that if $m = 1$ and the reference good is income or final consumption, we have traditional measures of monetary deprivation; if $m > 1$, the framework is multidimensional. The relative, absolute, subjective or objective nature of poverty lines is clearly dependent on how the value of the parameter(s) z_k is set or estimated. The magnitude of the change in need between the poor and the non-poor, and thus ultimately the emphasis on the problem of deprivation, depends on the value of the parameters ϑ_k (or l_k, if we start by estimating the cost of poverty instead of deducing it from the relationship between different regimes of utility production) and on the functional form

of the f_ks. A situation where poverty is not a problem at all can be re-created by relaxing assumption (9) to allow for $\vartheta_{k1} = \vartheta_{k2}$ for all k, implying $l_k = 0$ for all k. On the other hand, the plight of the destitute should be taken very seriously when $\frac{\partial f_k(q_k, \vartheta_{k1})}{\partial q_k}\Big|_{Z_k}$ is much larger than $\frac{\partial f_k(q_k, \vartheta_{k2})}{\partial q_k}\Big|_{Z_k}$, implying a high cost of poverty.

In the multidimensional case, the relative importance of each good in producing utility and how it varies depending on the state of poverty is, again, embodied in the value of the parameters ϑ_k (or c_k, depending on where the reasoning starts) and the functional form of the f_ks. This part of the empirical specification has the most visible impact on the type of consumption patterns predicted by the model under rationality.

While the number of dimensions relevant to welfare, the nature of thresholds (absolute or relative) and the point of view from which they are set (subjective or objective) are normally decided beforehand along with the transformation rule that goes from ownership or consumption to utility (the functional form of the f_ks), the parameters ϑ_k can be either assumed in order to conduct a poverty assessment based on a normative theory or estimated positively. The former exercise assumes the DRUM scenario to be correct, while the latter doubles as a test of the model and a way to derive information about the process of utility generation from data. In the following, we proceed down the inductive route.

3. A test of the model: subjective poverty in Italy

The abstract nature of the DRUM approach, while ensuring the flexibility discussed in Section 2.2, prevents us from building a catch-all experiment able to validate all possible adaptations of the framework. When translating the theory into empirics we need to decide what utility is, how it can be measured, which goods produce it and in which way. This set of choices identifies a specification of our general definition: as a consequence, the test will not tell us whether poverty as a noumenon exists or not, but rather whether, say, the phenomenon of subjective income poverty does indeed emerge in a given time and location in the sense put forward by the paper. Once the reference implementation is chosen, it must be ascertained whether there exists, for each of the welfare-generating goods, a threshold

able to tell apart two groups of agents with utility functions that are differently parametrized consistently with conditions (6a) through (10).

For the sake of brevity, in this paragraph we will present only one possible test. The first dychotomy we are faced with is the following: should we rely on direct elicitation of (cardinal) utility, i.e. on self-reported welfare with all the subjectivity biases that such a measure entails, or rather embrace the objectivist approach? We choose the former option following Frey and Stutzer (2002): "[S]ubjective well-being is a much broader concept than decision utility […]. People are reckoned to be the best judges of the overall qualities of their lives, and it is a straightforward strategy to ask them about their well-being. […] Measures of subjective well-being can thus serve as proxies for 'utility'". One appealing alternative would entail following the revealed-preference path: (ordinal) utility can be derived by assuming that agents are rational and allocate income according to an optimization strategy, which is reconstructed based on actual choice. A test of the model conducted in this direction could prove interesting in two different ways: one, as a means of cross-validating the results based on self-assessments of welfare; two, as a means of playing the subjectivist approach against the objectivist approach using DRUM as a yardstick. The SHIW data are, however, not ideal for this purpose because of difficulties in estimating the budget constraints connected with incomplete information on variations in assets during the reference year.

We assume utility to arise from the consumption of two goods, and we pick a functional form for the utility-production process described in (2) among the simplest possible options consistent with conditions (6a) through (8b). A simulation is subsequently run: the parameters of the utility function are estimated under different hypotheses on the location of the poverty lines. If the features predicted by the theory emerge in the parameter estimates for at least one of the pairs of poverty lines fed into the simulation, and if statistical tests do not reject the hypothesis of a regime change at these lines, then it makes sense to define subjective poverty with respect to each of our two goods as one of two possible states of non-satiation, with the characteristics described in Sections 1 and 2. If, on the other hand, the parameter estimates are invariant across all partitions established by all poverty lines, or if their changes are not statistically significant, then we must conclude that either poverty is what we say it is but it does not exist in this particular case, or that the DRUM scenario, and especially the definition of poverty at its core, is not valid.

3.1 The data

Every two years, the Bank of Italy carries out a Survey of Household Income and Wealth (SHIW) on a representative sample of about 8,000 Italian households with the purpose of gathering information on several aspects of economic life. In 2002, the survey included for the first time the following question:

> Is your household's disposable income enough to get you through the end of the month?
>
> - With a great deal of difficulty 1
> - With difficulty 2
> - With a little difficulty 3
> - Fairly easily..... 4
> - Easily..... 5
> - Very easily 6

The answer is coded as a multinomial variable taking ordered values 1 through 6. Following the principles of prospect theory (Kahneman and Tversky, 1979), we believe it can be considered a good proxy of subjective utility. Kahneman (2003) states that "Perception is reference-dependent: the perceived attributes of a focal stimulus reflect the contrast between that stimulus and a context of prior and concurrent stimuli". In other words, people naturally evaluate the situation they are in against a benchmark: Stutzer (2004) indicates desires and expectations as natural candidates for this role. As an assessment of the stringency of a budget constraint, the answer to the SHIW question measures the ability of people to afford the lifestyle they desire; this seems to be an acceptable indicator of well-being.

The formulation of the question offers another advantage: it suggests quite precisely which variables should be considered as arguments of the utility function, contrary to other possible proxies such as self-reported happiness. Since it refers specifically to the relationship between disposable income and the ability to satisfy a household's needs, we should not expect it to measure the well-being derived from aspects of life, such as health or education, that are mentioned in the literature on multidimensional welfare but do not relate directly to earnings. This does not necessarily confine us to univariate analysis of income utility and, consequently, monetary poverty in the traditional sense. A higher level of insight into the problem can be attained by considering that "reaching the end of the month" comfortably means that income is commensurate to the desired level of consumption, both of

vital and leisure goods. We can obtain a bidimensional measure by focusing on how utility is derived from the consumption of two aggregate goods, food and non-food commodities.

Consumption of food at the household level is recorded directly, by way of the following question:

> What is the average monthly figure spent on food? Consider spending on food in supermarkets and the like and spending on meals eaten regularly outside the home. [4]

Consumption of non-food commodities, on the other hand, needs to be estimated as the sum of several items that are surveyed independently. A question is asked on the bulk value of non-durables bought in a month: food is included, but can easily be subtracted based on the information above. We supplement the answer with a measure of yearly expenditure on durable goods, which is the object of three separate questions concerning, respectively, precious objects, means of transport, and furniture and appliances. Respondents are required to declare the value of the goods acquired regardless of whether they were paid for completely during the reference year.[5] Finally, we also categorize mortgage payments as non-food consumption expenditure, even if accounting standards define them as saving/investment: they do impact on a household's budget constraint in a fashion similar to rent payments.

Several other survey variables are featured in our application as controls. They can be assumed to influence the subjective evaluation of welfare even if they do not refer directly to consumption of utility-producing goods. These are: the income-to-consumption ratio, which is directly related to the idea of tightness of the budget constraint embedded in the question; financial wealth owned by the household at the end of the reference year, which may contribute to a general sense of security and ability to meet unforeseen needs; and a set of dummies referring to location and demographic size of the place of residence, home

[4] Even though the information on food consumption is not collected with a booklet method, it has been shown to be fairly robust. Biancotti, D'Alessio and Neri (2004) estimate the Heise index, a reliability measure ranging from 0 (totally unreliable) to 1 (totally reliable) used in statistical literature on data quality, for several SHIW variables: food consumption has a score of 0.8.

[5] While in some cases this might distort the evaluation of the income-to-consumption ratio, it serves the purpose of our analysis. We want to explain a general level of ease in making ends meet, and households are very likely to incorporate in the evaluation of their constraints the fact that they have purchased a car, regardless of whether they paid for it in a single solution or in instalments: they probably have to cut back on other items for a while anyway.

ownership, and job status of the head of household. The location dummy reflects the expectation of lower private costs derived from the higher quality and wider availability of public goods found in the northern regions of the country; the demographic size dummy is supposed to embody the differences in the cost of living between big cities and small towns. The information about home ownership and job status is included for the same reason as financial wealth.

3.2 The empirical model

Since food and non-food consumption are measured in currency, each of the aggregate goods has a unit price. The theoretical subutility functions can be written as follows:

$$v_{Fi} = [L_F + \alpha_1 \log(F_i)]\mathrm{I}_F(F_i) + \alpha_2 \log(F_i)[1 - \mathrm{I}_F(F_i)] \tag{12}$$

$$v_{NFi} = [L_{NF} + \beta_1 \log(NF_i)]\mathrm{I}_{NF}(NF_i) + \beta_2 \log(NF_i)[1 - \mathrm{I}_{NF}(NF_i)] \tag{13}$$

$$v_{Ri} = f(R_i) \tag{14}$$

where F indicates consumption of food, NF indicates consumption of non-food commodities, and $R \in \Re^w$ is a vector of w factors different from current consumption as represented in (12) and (13) and contributing to the determination of perceived welfare. We assume f to be linear.

The individual utility function results from

$$u_i = v_{Fi} + v_{NFi} + v_{Ri} \tag{15}$$

Our goal is the estimation of the following model:

$$u = D_F\alpha_1 \log(F) + (1 - D_F)\alpha_2 \log(F) + D_{NF}\beta_1 \log(NF) + (1 - D_{NF})\beta_2 \log(NF) + \gamma D_F + \delta D_{NF} + \phi R + \varepsilon \tag{16}$$

where all the variables are vectors in $\Re^n$, except for the matrix of controls $\mathbf{R} \in \Re^n \times \Re^w$; n is the number of individuals in the sample; ε is white noise, and D_F and D_{NF} are two dummy variables that take the value 1 when F_i and NF_i respectively lie below the given quantities $\hat{z}_F$ and $\hat{z}_{NF}$. For the sake of simplicity, we only estimate the initial moral loss connected with poverty L_F and L_{NF} rather than reconstruct the respective net cost functions. However, those can be easily obtained based on the setup of the empirical model and its results.

A simulation is conducted in order to find poverty lines: the model is estimated for 190 possible sets of thresholds $\hat{z}_F$ and $\hat{z}_{NF}$, corresponding to all combinations of a fraction

of the median for food consumption and a fraction of the median for non-food consumption. Eligible fractions for both goods range from 0.05 to 1 in increments of 0.05. Each specification of equation (16) is estimated with a standard ordered probit model (for details see, for example, Maddala, 1983); the likelihood is maximized by way of a ridge-stabilized Newton-Raphson algorithm. Estimates are screened for compliance with the theoretical predictions as expressed by (5) and (9); if they match the requirements $0<\alpha_2<\alpha_1$, $0<\beta_2<\beta_1$, $\gamma<0$, and $\delta<0$ they are subjected to three statistical tests.[6] First of all, a standard likelihood ratio test is run for the hypothesis that a single-regime model, with no changes in regression coefficients and no costs of destitution, is nested in the dual-regime model. This is done in order to obtain a broad indication that the DRUM framework tells a different story from a standard utility function; it allows us to consider jointly all of its defining traits, namely the switch in parameters and the existence of fixed penalty terms. Individual tests for equality of the coefficients above and below the poverty line are then run on food and non-food consumption. On account of the use of dummy variables for food and non-food poverty in (16) the dataset is partitioned in four cells from the start; in this setting, equality tests are equivalent to structural break tests run on points selected *ex ante* based on a model. These tests are not optimal, because the theory is silent on the position of the break points and the only requirement that we can posit intuitively is that they should not be above the median. A proper structural break test should be run for the empirical model for which the maximum difference in coefficients is observed. To our knowledge, however, the literature does not offer such a procedure for ordered probit estimation, and it is not the goal of this paper to propose one; we therefore treat the simulation results much as we would a prior probability distribution for the location of breaks. No joint test is run either; we want to look at each different dimension of poverty separately, and the additive utility framework allows us to do that without compromising the validity of the test statistics.

[6] We do not test for (10) beyond a qualitative assessment of the magnitude of δ and γ, nor do we estimate a restricted model, because we expect measurement error in the micro data to prevent the generation of a result exactly compliant with such a strict requirement.

3.3 Results

Several specifications of the dual-regime model pass the preliminary screening procedures. All of them are characterized by a poverty line for food in the neighbourhood of 40 per cent of the median per equivalent adult, and a poverty line for non-food commodities in the neighbourhood of the median itself. Since the results for these models are very similar, which incidentally may give evidence in favour of a fuzzy sets approach to the problem, we will only discuss the case of $\tilde{z}_F$ = 1,200 euros (exactly 0.4 times the median for food consumption) and $\tilde{z}_{NF}$ = 7,200 euros (exactly the median for non-food consumption). The results yielded by ordered probit estimation for this specification of (16) are presented in Table 1; Table 2 offers descriptive statistics on income, consumption and poverty incidence, organized by level of self-assessed welfare. Figure 2 portrays the two subutility functions.

The parameter values, together with the chosen functional form, ensure that requirements (6a) through (8b) are complied with; (9) is also heeded, at least at first blush. The general likelihood ratio test rejects the hypothesis that the single-regime model is nested in the DRUM representation. However, in the case of food the parameter estimate falls by 44 per cent and the difference is statistically significant; for non-food commodities, the switch is negligible in magnitude, the initial utility loss associated with poverty is of the expected sign but not significant and, more importantly, the p-value for a test of equality of the coefficients below and above $\tilde{z}_{NF}$ is quite high at 0.697. This result is eloquent on the nature of poverty as a structurally specific condition of non-satiation; it hints at the fact that two different states of being, separated on the basis of consumption levels, can be observed only with respect to goods that fuel a minimum ability to survive.[7]

The 3 per cent share of Italian households spending less than 100 euros per adult equivalent on food each month appear to perceive the utility of such consumption differently from everyone else. In other words, the self-assessment of welfare incorporates the idea that life is very different depending on whether one has to struggle to eat regularly or not,

[7] The same argument should apply to basic shelter and clothing. Unfortunately, it is quite difficult to estimate the actual consumption of housing services, which might be very different from the rent or mortgage paid by a household; and we do not have detailed data concerning expenditure on clothing.

signalling the existence of physiological minima and of a common perception thereof.[8] No such structural change emerges for non-food commodities: judging from the fact that a weak hint at a break can be found around the median, imitation stimuli known in the literature as the "keeping up with the Joneses" effect might be predominant in this case. The line $\tilde{z}_{NF}$ does not separate two qualitatively different states of need, but rather illustrates the fact that people might or might not feel a slight variation in the intensity of their wants depending on what everyone else has.

The coefficients on the control variables have the expected sign: self-reported utility is affected negatively by living in the South or being unemployed, while living in a small town, owning a house and managing to save a good fraction of income improve the situation. Financial wealth also seems to have a positive effect, although it is very small.

It is interesting to note that being self-employed boosts welfare, consistently with SHIW-based evidence about income dynamics showing that the self-employed in Italy have recently enjoyed income growth rates higher than those of employees (Boeri and Brandolini, 2005). This result seems to support a particular facet of the idea, recalled in Section 3.1, that subjective judgements about well-being tend to include a relative element; in this case we are looking at interpersonal comparisons rather than at consistency between desires and achievements. The position of a household in the distribution of income has an effect on reported utility that goes above and beyond the mere increase in consumption and/or savings, because people evaluate their own conditions with reference to the prevailing community standards (Clark and Oswald, 1996; Easterlin, 2002).

4. Conclusions

This paper offers a micro-founded general definition of poverty set in the context of utility theory. Poverty and non-poverty are described as two structurally different types of local non-satiation: the former entails a strong need for further consumption and social

[8] Famine is an unknown phenomenon in Italy, barring rare and extreme situations experienced by the homeless or by illegal immigrants, who would not appear in our regressions anyway as they are not part of the SHIW reference population. Such a low level of expenditure, however, can not grant proper nutrition. Probably, it is also associated with very strong uncertainty about the possibility of having a meal on the table every day.

marginalization, the latter is characterized by a weak need for further consumption and satisfactory adjustment to social expectations. Each of the states can be fully described by a separate technology of utility production: a poverty line is defined as a quantity of a good for which there is a structural break in how utility is extracted from consumption of that good.

The model is tested on data from the Survey of Household Income and Wealth conducted by the Bank of Italy. We look at how self-assessed welfare, or perceived utility, relates to consumption of food and non-food commodities. The main predictions of the model are confirmed for food consumption: a threshold can be found such that two different technologies of utility production are observed, and it corresponds to 40 per cent of the median, probably signalling physiological minima. The parameter governing marginal utility falls by 44 per cent at this threshold. For non-food commodities, no significant change of regimes is found. Subjective welfare, where non-food commodities are concerned, appears to be connected with needs that are less exposed to structural change, possibly because they are not as urgent or objective as the food-related ones.

Tables and Figures

Table 1

SUBJECTIVE UTILITY FUNCTION, ITALY, 2002
(ordered probit model)

	Estimate	Standard error	P-value
Log of food consumption: below the poverty line (α_1)	0.913	0.247	0.000
Log of food consumption: above the poverty line (α_2)	0.511	0.032	0.000
Log of non-food consumption: below the poverty line (β_1)	0.861	0.049	0.000
Log of non-food consumption: above the poverty line (β_2)	0.836	0.047	0.000
Intangible costs of poverty: food (γ)	-2.415	1.263	0.091
Intangible costs of poverty: non-food (δ)	-0.267	0.571	0.641
Income to consumption ratio	0.593	0.019	0.000
Financial wealth	0.001	0.000	0.000
Dummies			
Southern Italy	-0.171	0.029	0.000
Self-employed	0.218	0.042	0.000
Not in the labor force/unemployed	-0.063	0.027	0.019
Home ownership	0.130	0.028	0.000
Population of town of residence: 20,000 to 40,000	-0.053	0.036	0.142
Population of town of residence: 40,000 to 500,000	-0.095	0.029	0.001
Population of town of residence: above 500,000	-0.162	0.048	0.001
Ordinal response cut-offs			
1	10.869	0.498	
2	11.554	0.499	
3	12.625	0.501	
4	13.961	0.504	
5	15.032	0.508	
P-value for the likelihood ratio test: single-regime nested in dual-regime		0.018	
Dual-regime model: p-value for $\alpha_1=\alpha_2$		0.047	
Dual-regime model: p-value for $\beta_1=\beta_2$		0.697	
Pseudo-R^2		0.123	

Table 1 (continued)

Pearson correlation statistics for regressors and associated p-values	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Food consumption (1)	1.000	0.286	0.257	-0.077	-0.257	0.101	0.097
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Non-food consumption (2)		1.0000	0.476	-0.173	-0.292	0.134	0.103
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
Financial wealth (3)			1.000	0.139	-0.151	0.329	0.032
			<.0001	<.0001	<.0001	0.0039	<.0001
Income-to-consumption ratio (4)				1.000	-0.054	0.124	0.004
				<.0001	<.0001	0.349	<.0001
Residence in southern Italy (5)					1.000	-0.023	-0.056
						<.0001	<.0001
Home ownership (6)						1.000	-0.114
							<.0001
Population of town of residence (7)							1.000
							<.0001

The dependent variable is the six-level subjective evaluation of utility described in Section 3. Variables are per equivalent adult where applicable; the standard OECD equivalence scale was employed (head of household=1, other household members older than 14=0.5, household members younger than 14=0.3). Dummy variables for home ownership and residence in Southern Italy are at the household level, while dummy variables for job status refer to the head of household, i.e. the main contributor to household expenses. The poverty line used for food consumption is of 1,200 euro per year (2002 prices), corresponding to 40 per cent of the weighted median; for non-food consumption, it is of 7,200 euro (2002 prices), corresponding to the weighted median. The baseline for the employment dummy is "Employee". The baseline for the demographic size dummy is "Population of town of residence: less than 20,000 inhabitants". The sample weights are provided in the SHIW dataset.

Table 2

INCOME, CONSUMPTION AND POVERTY STATISTICS BY LEVEL OF SELF-REPORTED WELFARE, ITALY, 2002

(euros per equivalent adult per year, percentages*)

Self-reported welfare	Food consumption		Non-food consumption		Income	
	Mean	Median	Mean	Median	Mean	Median
1 (Lowest)	2,370.32	2,400.00	4,966.43	4,285.71	8,132.38	7,405.41
2	2,827.74	2,640.00	6,474.08	5,600.00	10,805.07	9,992.12
3	3,099.11	3,000.00	7,649.62	6,580.65	13,896.61	12,843.76
4	3,618.17	3,360.00	10,369.82	8,824.76	19,584.81	17,887.36
5	3,873.89	3,600.00	13,972.28	11,803.23	26,956.45	23,194.61
6 (Highest)	4,464.24	3,840.00	18,490.64	14,300.00	38,388.15	30,884.51
All	3,216.77	3,000.00	8,723.14	7,200.00	16,051.72	13,958.40

Self-reported welfare	Distance from poverty line: food		Distance from poverty line: non-food		Poverty incidence	
	Mean	Median	Mean	Median	Food	Non-food
1 (Lowest)	1,170.32	1,200.00	-1,985.95	-2,666.67	0.09	0.81
2	1,627.74	1,440.00	-478.30	-1,352.38	0.04	0.66
3	1,899.11	1,800.00	697.23	-371.74	0.02	0.55
4	2,418.17	2,160.00	3,417.44	1,872.38	0.01	0.30
5	2,673.89	2,400.00	7,019.90	4,850.84	0.02	0.21
6 (Highest)	3,264.24	2,640.00	11,538.26	7,347.62	0.01	0.10
All	2,016.77	1,800.00	1,770.76	247.62	0.03	0.49

*See Table 1 for details about the equivalence scale and the poverty lines employed in the calculations.

Figure 1

THE DUAL-REGIME UTILITY MODEL: A SINGLE-GOOD ILLUSTRATION

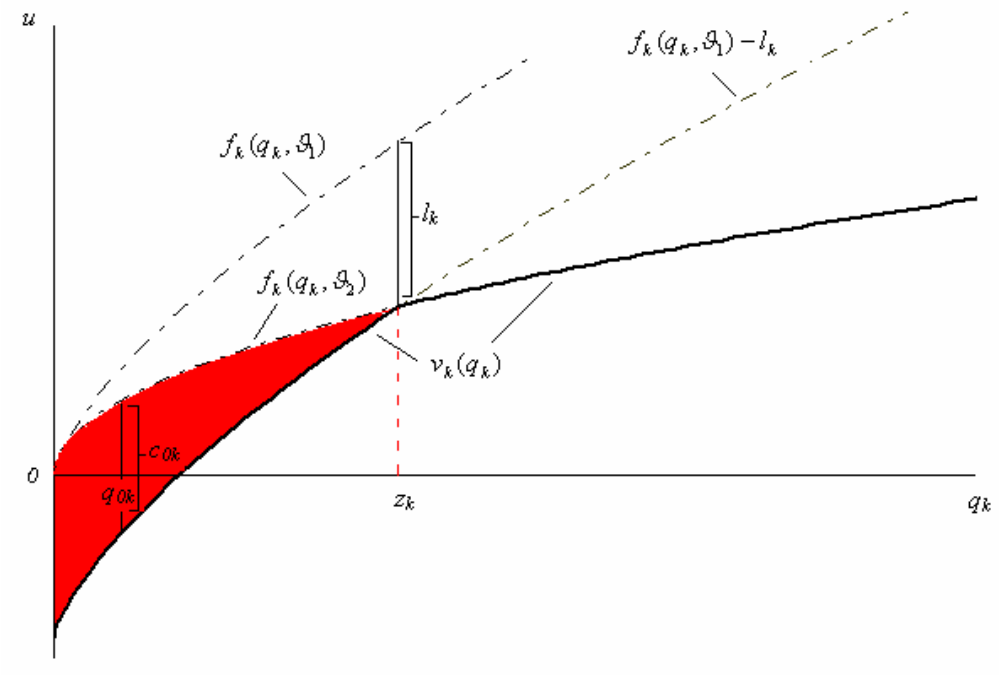
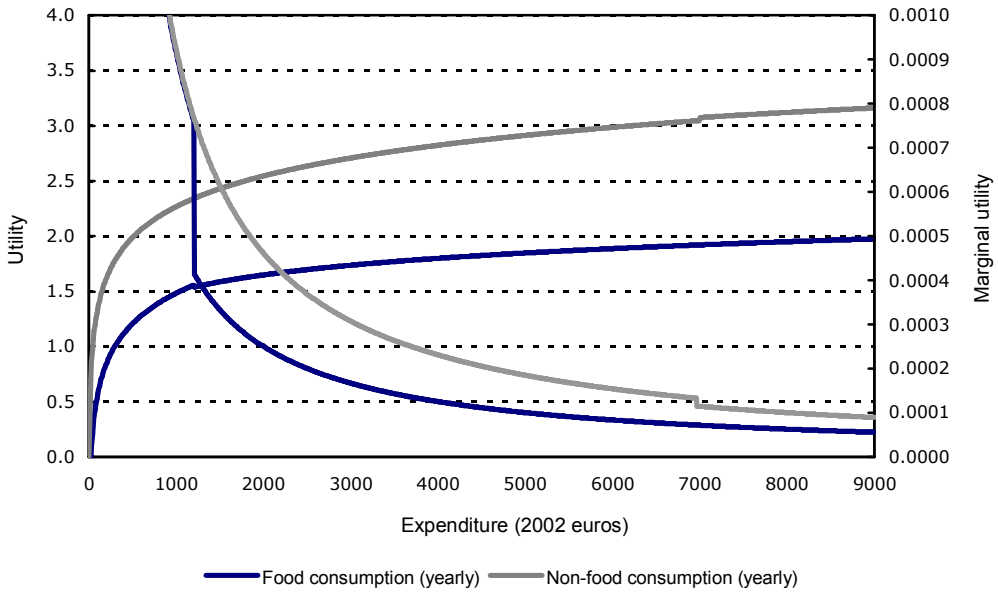


Figure 2

SUBJECTIVE UTILITY LEVELS AND MARGINAL SUBJECTIVE UTILITY FOR FOOD AND NON-FOOD CONSUMPTION, ITALY, 2002



Technical Appendix

A.1 *A poverty indicator for the dual-regime utility model*

Once utility is evaluated for each individual, a way to measure poverty must be found. The primary problem consists in identifying the destitute (Sen, 1976); then we have to devise an indicator of personal deprivation, and finally we need to decide how to compound the individual figures in order to quantify how poor a community is.

With respect to the former issue, we adopt the so-called union approach (Atkinson, 2003): someone is poor, in the sense that their conditions are directly relevant to the value of our measure, if they fail to reach the threshold for at least one commodity. This choice seems to be better suited to the idea of additively separable utility, i.e. of distinct, non-interacting states of need and independent contributions of specific aspects of life to the overall level of welfare, than the intersection approach, according to which only people who fall below all poverty lines should be considered poor.

As for the form of the indicator, the basic idea is quite straightforward: poverty may be measured in terms of distance from the thresholds that divide the poor from the non-poor, taking into account the different relevance of each good in determining welfare. As a metric, we can use distance in utilities: in other words, we propose a generalized, utility-based version of the poverty gap. While it is not the only possible choice consistent with the dual-regime utility framework, it has the advantage of symmetry with a well-known and often used monetary measure. In particular, we define the individual poverty level as

$$p_i = \sum_{k=1}^{m} [f_k(z_k, \vartheta_{k2}) - (f_k(q_{ki}, \vartheta_{k1}) - l_k)]\mathrm{I}_k(q_{ki}) \qquad (1.\mathrm{A})$$

i.e. the sum over all goods of differences between the utility enjoyed from the consumption of a good at the poverty line, $f_k(z_k, \vartheta_{k2})$, and the actual utility derived from good k by individual i, who is below the poverty line; the presence of $\mathrm{I_k}$ ensures that p_i is zero-valued only in the case of agents not falling short of any threshold. Note that the indicator does not necessarily attain higher values for those who are poor in a larger number of dimensions: it all depends on the form of the f_ks, and how they are parametrized.

The aggregation strategy is the simplest possible. We propose a simple average of individual poverty levels:

$$P = \frac{1}{n}\sum_{i=1}^{n} p_i \qquad (2.A)$$

where n is the demographic dimension of the sample we are studying. While this might not seem consistent with the spirit of not wanting to adhere to any specific *a priori*, it is necessary that we choose an assumption, and the trivial one of invariant weights seems to be as non-judgemental as possible. [9]

A.2 *Proof of compliance of the indicator with axiomatic requirements for multidimensional poverty measures*

Let $\mathbf{D} = \{d_1, d_2 \ldots d_n\}$ be a set of n individuals, corresponding to our reference population. Let $\mathbf{K} = \{k_1, k_2 \ldots k_m\}$ be a set of m attributes that we consider important for well-being. We define a matrix $\mathbf{Q} \in \Re^n \times \Re^m$ whose elements q_{dk} correspond to the quantity of attribute $k \in \mathbf{K}$ owned by individual $d \in \mathbf{D}$. Each row is therefore a vector $\mathbf{q_d} \in \Re^m$ of quantities of each attribute owned by individual d, while each column is a vector $\mathbf{q_k} \in \Re^n$ of quantities of attribute k owned by each individual. We also define a vector $\mathbf{z} \in \Re^m$ as the collection of poverty lines for each of the attributes.

Let $\mathbf{I} \in \Re^n \times \Re^m$ be a matrix of poverty dummies, where element i_{dk} corresponds to the value that the indicator function (3) has for individual d and attribute k. It is easily seen that the vector of column sums for $\mathbf{I}$ contains poverty headcounts for each of the m attributes, while the vector of row sums contains an indicator that tells us in how many dimensions the individual d is poor.

Let $\boldsymbol{\vartheta_1} \in \Re^m$ be the vector of parameters that transform attribute levels into utility levels for the poor with respect to each good, and $\boldsymbol{\vartheta_2} \in \Re^m$ the same for the non-poor.

[9] Different choices lead to placement of greater emphasis on specific groups, such as the very poor, the working poor and so on. The dual-regime utility framework can be applied irrespective of how one chooses to construct the measure in (1.A).

We define the two matrices $\boldsymbol{\Theta_1} \in \Re^n \times \Re^m = \boldsymbol{\vartheta_1}'^n$ and $\boldsymbol{\Theta_2} \in \Re^n \times \Re^m = \boldsymbol{\vartheta_2}'^n$, where the superscript n indicates an n-fold replication of a vector or matrix; in other words, all rows of $\boldsymbol{\Theta_1}$ are identical and correspond to $\boldsymbol{\vartheta_1}'$, while all rows of $\boldsymbol{\Theta_2}$ are identical and correspond to $\boldsymbol{\vartheta_2}'$.

The matrix $\boldsymbol{\Theta} \in \Re^n \times \Re^m = (\mathbf{I} \circ \boldsymbol{\Theta_1}) + [(\mathbf{1_{nxm}} - \mathbf{I}) \circ \boldsymbol{\Theta_2}]$, where $\mathbf{1_{nxm}} \in \Re^n \times \Re^m$ is the unit matrix conformable for summation with $\mathbf{I}$ and the symbol $\circ$ refers to the Hadamard product operator,[10] is such that element ϑ_{dk} indicates the parameter used to transform the quantity of attribute k owned by individual d into utility, according to his state of poverty with respect to that good. Each row gives the vector of parameters corresponding to each individual.

We can define the felicity matrix $\mathbf{V} \in \Re^n \times \Re^m = F(\mathbf{Q}, \boldsymbol{\Theta}) + \mathbf{Ic}$, where F is a matrix function F: $\Re^n \times \Re^m \rightarrow \Re^n \times \Re^m$, evaluated elementwise, and $\mathbf{c} \in \Re^m$ is the vector of good-specific costs of poverty. Each element v_{dk} indicates the utility level yielded by good k for individual d. While the vector of individual utilities is simply $\mathbf{u} \in \Re^n = \mathbf{V} \cdot \mathbf{1_m}$, where $\mathbf{1_m} \in \Re^m$ is the unit vector of m elements, the vector of individual poverty measures is $\mathbf{p} \in \Re^n = G[\mathbf{I} \circ (\mathbf{V} - F(\mathbf{Z}, \boldsymbol{\Theta_2}))]\mathbf{1_m}$, where G is a matrix function G: $\Re^n \times \Re^m \rightarrow \Re^n \times \Re^m$, evaluated element-wise, and $\mathbf{Z} \in \Re^n \times \Re^m = \mathbf{z}'^n$.

The poverty measure P can therefore be obtained as a scalar function P of the vector $\mathbf{p}$, P: $\Re^n \rightarrow \Re$; indirectly, it can be represented as a scalar function of the attribute matrix and the vector of poverty lines $H(\mathbf{Q}, \mathbf{z})$, allowing us to prove its compliance with axioms for poverty measures, as formally enunciated in Bourguignon and Chakravarty (2003). We will discuss the multidimensional case for generality purposes.

Axiom 1: Strong focus. For any attribute matrix $\mathbf{Q}$ and any threshold vector $\mathbf{z}$, and for any attribute matrix $\mathbf{M}$ such that for an individual d and attribute k, $m_{dk} > q_{dk} > z_k$, if

(i) $m_{ek} = q_{ek}$ for all $e \neq d$

(ii) $m_{dh} = q_{dh}$ for all $h \neq k$

[10] The Hadamard product of two nxm matrices $\mathbf{A}$ and $\mathbf{B}$ is an nxm matrix $\mathbf{C}$ such that $c_{ij} = a_{ij} b_{ij}$.

then P(**M**,**z**) = P(**Q**,**z**). This equates to stating that changes in the level of any attribute owned by an individual who is not poor with respect to that attribute do not change the value of the poverty measure P. It applies to P in (2.A) as a direct consequence of the presence of the indicator term in (1.A): utility generated by attributes with respect to which one is not poor does not enter the evaluation of individual (and therefore aggregate) poverty at all; its changes do not, either. If the strong focus axiom is satisfied, then the weak focus axiom, stating that changes in attributes owned by persons that are not poor in any dimension do not affect the poverty measure, is satisfied as well. The weak focus axiom is conceptually different from the strong focus one because it allows the poverty measure to decrease (increase) if someone who is poor in one or more dimensions consumes more (less) of a good with respect to which he/she is not poor. Given our interpretation of poverty as a sum of good-specific distinct states of need, each of which has a meaning in its own right, we choose the strong version.

Axiom 2: Monotonicity. For any attribute matrices **Q** and **M** and any threshold vector **z**, if **M** is derived from **Q** by increasing the level owned of an attribute for a person who is poor with respect to that attribute then P(**M**,**z**) ≤ P(**Q**,**z**). It applies to P in (2.A) as a consequence of positive marginal utility in (5a) if the increase of the level owned does not go beyond the poverty line; otherwise, it applies because one of the terms in the summation for (1.A) disappears; since all the terms must be greater than zero for (8), the value of (1.A) and hence (2.A) will be lower.

Axiom 3: Symmetry. For any attribute matrix **Q**, any threshold vector **z** and any permutation matrix $\mathbf{\Pi} \in \Re^n \times \Re^m$, P(**ΠQ**,**z**) = P(**Q**,**z**). Since (1.A) is computed from individual poverty levels as described in (2.A), permutation of rows has no effect; since utility is additively separable, permutation of columns has no effect. In both cases, we are just permuting elements of a sum.

Axiom 4: Subgroup consistency. For any attribute matrix $\mathbf{Q} \in \Re^n \times \Re^m$ partitioned into t matrices $\mathbf{Q_1}$, $\mathbf{Q_2}$… $\mathbf{Q_t}$ of column dimension m and row dimension n_1, n_2…n_t and for any threshold vector **z,** P(**Q**,**z**) = $\sum_{s=1}^{t} \frac{n_s}{n}$ P($\mathbf{Q_s}$,**z**). This is especially relevant for policy-making purposes: poverty must be easily traced back to different social groups in order to select

relief programme targets. The property is ensured by the fact that (2.A) is a simple average of individual poverty indicators.

Axiom 5: Continuity. For any threshold vector **z**, P(**Q**,**z**) is continuous on $\Re^n \times \Re^m$. This holds because *P* is a sum of the individual p_is, which are are continuous; for any good *k* and $q_{ki} <> z_k$ this is ensured respectively by the fact that p_i is a distance between two vectors below the threshold, and constant at zero above. The function is also continuous at $q_{ki} = z_k$: $\lim_{q_k \longrightarrow z^-} f_k(z_k, \vartheta_{k2}) - (f_k(q_{ki}, \vartheta_{k1}) - l_k) = \lim_{q_k \longrightarrow z^+} p_{ki} = 0$ for any good *k* due to (8) and (7a).

Axiom 6: Replication invariance. For any attribute matrix **Q**, any threshold vector **z** and any scalar **r**, P($\mathbf{Q}^{\mathbf{r}}$,**z**) = P(**Q**,**z**), where $\mathbf{Q}^{\mathbf{r}}$ is the *r*-fold replication of **Q**. This ensures that the value of P does not depend on population size, and it is ensured by the fact that (2.A) is a simple average of individual poverty indicators. Note that this is only a very basic set of axioms, constructed to ward off macroscopic problems such as excessive influence of measurement error on poverty indicators, results that depend on the demographic size of a country, and assessments of destitution that incorporate the evaluation of how the non-poor live to a greater extent than the possible adoption of a relative poverty line. They are valid for (2.A) no matter the parametrization of the problem.

Further requirements of a distributional nature are often imposed on poverty measures. While the Pigou-Dalton transfer principle, stating that poverty cannot increase (decrease) if there is a progressive (regressive) transfer of resources between the poor, holds in the general formulation as well as for each single good, subtler properties such as the multidimensional transfer principle, scale invariance, translation invariance, non-decreasing poverty under correlation increasing rearrangement all depend on the specific choice of functional forms and parameters.

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