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Poverty Lines in Theory and Practice

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The Living Standards Measurement Study

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Poverty Lines in Theory and Practice

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Foreword

Setting poverty lines is often the hardest, and most contentious, step in constructing a poverty profile from household survey data. The methods used in setting poverty lines have implications for policy making in fighting poverty, such as in determining which region of the country should receive attention first, and in assessing how much the poor share in economic growth.

This paper provides a critical overview of the theory and methods of setting poverty lines. It is intended for practicing economists who may not be familiar with the concepts and methods found in this branch of economics. The author tries to point clearly to both the strengths and weaknesses of existing methods, and so guide the choices made in future practice. The paper is part of a larger effort in the Development Research Group to help assure that policy choices in fighting poverty are informed by sound data.

Paul Collier, Director
Development Research Group

Abstract

A poverty line helps focus the attention of governments and civil society on the living conditions of the poor. In practice, there is typically not one monetary poverty line but many, reflecting the fact that poverty lines serve two distinct roles. One role is to determine what the minimum level of living is before a person is no longer deemed to be "poor". The other role is to make interpersonal comparisons; poverty lines for families of different sizes and compositions, living in different places, or for different dates, tell us what expenditures are needed in each set of circumstances to ensure that the minimum level of living needed to escape poverty is reached.

Both roles matter to the credibility of the resulting poverty measures, such as the popular "headcount index", given by the proportion of the population living below the relevant poverty line. Economists have given surprisingly little attention to the first role. While they have studied the problem of how data on the distribution of welfare should be aggregated into a single measure of poverty, given a poverty line (and the weaknesses of the headcount index are becoming well understood), the problem of how one sets a poverty line has been largely ignored. Economists have given a great deal of attention to the second role, in the context of the general issue of welfare measurement, though the lessons learned have often been ignored by practitioners measuring poverty. Experience suggests that the choices made in setting poverty lines can matter greatly to the measures obtained, and to the inferences drawn for policy.

This paper offers a critical overview of alternative approaches to setting poverty lines, keeping both roles in mind. It argues that a "poverty line" can be interpreted within the approaches to welfare measurement found in economics based on the consumer's expenditure function, giving the cost of a reference level of utility. However, the paper also argues that this approach leaves some key questions unanswered, and hence it makes a rather hollow theoretical foundation for applied work. The paper then argues that the methods of setting poverty lines found in practice can be interpreted (implicitly at least) as attempts to address those questions, by drawing on information which is not normally employed in economic analysis. That information includes data on "capabilities", which can be interpreted as a useful intermediate space for making welfare comparisons, between the spaces of "utility" and "commodities" which are more familiar to economists. Measurement practice has sometimes also turned to information on subjective (self-rated) assessments of well-being, often discounted by mainstream approaches to "objective" welfare measurement favored by economists.

In critically reviewing the methods found in practice, the paper tries to throw light on, and go some way toward resolving, ongoing debates about poverty measurement, emphasizing those issues which would appear to have greatest bearing on policy discussions. Some methods found in practice seem to make more sense than others. Some methods work well in one setting but not others. There is no single ideal and generally feasible method, but it does appear to be possible to identify a reasonably defensible subset of the existing methods which should adequately serve the data needs of policy makers.

Acknowledgments

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Introduction

A credible measure of poverty can be a powerful instrument for focusing the attention of policy makers on the living conditions of the poor. Economists have given a great deal of attention to the "functional form" of a poverty measure, such as how the measure should respond to changes in distribution below the poverty line.[1] Less attention has been given to the methods used in drawing the poverty line itself, which is often taken as given. Yet the choices made in setting poverty lines can matter greatly to the policy decisions which are to be guided by poverty data; indeed, they can matter just as much as the functional form issues.

For example, the extent to which the poverty line rises with average income is one determinant of how responsive measured poverty will be to economic growth. Assessments of the effects of economic growth on poverty have often assumed that the poverty line is fixed in real terms (after normalizing by a cost of living index). Some analysts have argued that the real value of the poverty line should shift positively with mean national income, implying lower elasticities of poverty to growth. Indeed, the European Commission sets its poverty lines at one half of the mean in each country (Atkinson, 1997), implying that an equi-proportionate increase in all incomes (including of the poor) would leave measured poverty unchanged. Clearly then, the method of drawing the line matters to assessments of how much economic growth reduces poverty.

To give another example, the ranking of regions or other socio-economic groupings in terms of poverty can inform policy choices, such as decisions as to which regions should be targeted first in attempts to reduce poverty. There are cost of living differences between regions, and other factors such as access to non-market goods, that one would want to incorporate in the structure of poverty lines. But the information for this task may be limited in important ways, such as when some price data are missing. The alternative methods found in practice for dealing with such problems can give radically different results; for example, one study for Indonesia found virtually zero correlation between the regional poverty profiles produced by the two most common methods used for drawing poverty lines (Ravallion and Bidani, 1994).

What principles might usefully guide methods of setting poverty lines in practice? One wants the method of measurement to be consistent with the purpose of measurement. I shall argue that when that purpose is to monitor progress in reducing poverty in terms of a given measure of welfare, or to target limited public resources to better reduce aggregate poverty, then the poverty lines used should have constant value in terms of that welfare measure. This assumes that a Pareto improvement in terms of welfare–whereby at least one person gains, and no one else loses–cannot increase measured poverty. It may not be a serious problem to find that a method of drawing the poverty line fails this test if one is not interested in comparing the resulting poverty measures (such as over time or between regions). But in most applications, and particularly in policy applications, it can be a serious problem.

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[1] The seminal contribution was Sen (1976). A large literature followed, devoted almost solely to identifying an ideal functional form for a single measure defined on the distribution of a welfare indicator; Atkinson (1987) cites a number of examples.

The paper attempts a critical overview of alternative approaches to setting a poverty line, and how they are implemented. The intended audience is applied economists.[2] The paper begins by looking at how a "poverty line" can be interpreted within mainstream approaches to welfare measurement in economics. The sections which follow then look at the main methods found in practice. These can be interpreted as attempts to implement ideas from economics. However, I shall also argue that the methods found in practice are trying to do far more than that; they can be interpreted as attempts to surmount some deep theoretical problems in the economics of welfare measurement, by drawing on ideas from outside mainstream economics. I shall try to throw light on, and go some way toward resolving, the key ongoing debates about poverty measurement (both within and outside economics) with bearing on policy discussions.

[2] The present paper goes into greater depth and adds new material on a number of topics covered in Ravallion (1994a, 1996a). The latter paper provides a less technical, and more "cook-book" like, discussion of poverty lines.

Poverty Lines in Theory

I shall define a poverty line as the monetary cost to a given person, at a given place and time, of a reference level of welfare. People who do not attain that level of welfare are deemed poor, and those who do are not. But how then do we assess "welfare"?

The cost of the poverty level of utility

The most widely used characterization of welfare in economics postulates a utility function defined over consumptions of commodities, such that the function reproduces consumer preferences over alternative consumption bundles. Following this approach, the poverty line can be interpreted as a point on the consumer's expenditure function, giving the minimum cost to a household of attaining a given level of utility at the prevailing prices and for given household characteristics.

To see how this works more formally, consider a household with characteristics x (a vector) consuming a bundle of goods in quantities q (also a vector). It is assumed that the household's preferences over all the affordable consumption bundles can be represented by a utility function $u(q, x)$ which assigns a single number to each possible q, given x. The consumer's expenditure function is $e(p, x, u)$ which is the minimum cost to a household with characteristics x of a level of utility u when facing the price vector p.[3] (When evaluated at the actual utility level, $e(p, x, u)$ is simply the actual total expenditure on consumption, $y=pq$, for a utility-maximizing household.) Let u_z denote the reference utility level needed to escape poverty. The poverty line is then:

$$z = e(p, x, u_z) \qquad (1)$$

In words, the poverty line is the minimum cost of the poverty level of utility at prevailing prices and household characteristics. This tells us how to go from poverty in terms of utility to poverty in terms of money; but it does not tell us how to define the poverty level of utility. I will return to this issue.

To measure poverty we need to combine the poverty line with information on the distribution of consumption expenditures. In principle, there are two ways of doing so:

The welfare ratio method: One can deflate all money incomes by z, so that the indicator of welfare is simply y/z where y is total expenditure (pq). The value of y/z is sometimes referred to as a "welfare ratio" (following Blackorby and Donaldson, 1987). Equivalently, one can calculate a "true cost of living index", $e(p, x, u_z)/e(p^r, x^r, u_z)$ for fixed reference prices p^r and reference household characteristics x^r (which define the "base" of the index, such as households with given demographics, at a given location and date). The cost of living index is just the ratio of each person's poverty line to the base poverty line $z^r = e(p^r, x^r, u_z)$. The index can then be used to normalize all money incomes into comparable monetary units, and a single poverty line applied, namely that for the base. This gives what is often termed "real expenditure" or "real income".

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[3] On the properties of the cost function see Varian (1978, Chapter 3) or Deaton and Muellbauer (1980).

The equivalent expenditure method: Alternatively, one can use the cost function to calculate an "equivalent expenditure" (or "money metric utility") measure, given by:

$$y^e = e[p^r, x^r, v(p, x, y)] \tag{2}$$

Since p^r and x^r are fixed, y^e is a strictly increasing function of utility, and it is the same function for everyone. One can then calculate the welfare ratios relative to the base poverty line, z^r, to obtain the "equivalent welfare ratios", y^e/z^r.[4]

From the information obtained on the distribution of real expenditures or equivalent expenditures over all persons, a poverty measure can then be defined. The most common measure used in practice is the headcount index, given by the percentage of the population living below the line. Other measures can be defined which reflect the depth and/or severity of poverty, such as the "poverty gap index" and the "squared poverty gap index" (Foster, Greer and Thorbecke, 1984). The latter measure is one of a number of "distribution-sensitive" measures, which penalize inequality amongst the poor.[5] Almost all poverty measures found in practice are homogeneous of degree zero between expenditures and the poverty line, so they can be written as a function of the distribution of all welfare ratios, $w=y/z$ for $y \leq z$, and $w=1$ for $y>z$ (or in terms of the equivalent welfare ratios and base poverty line, as in the equivalent expenditure method). I confine attention to such measures.

The two methods described above will not, however, give the same poverty measures in general. The special case in which they are equivalent is when preferences are homothetic, meaning that the budget share devoted to a given commodity is independent of utility. Since (by the well-known envelope property) the budget share for a given commodity is given by the log derivative of the cost function with respect to the price of that commodity, homotheticity requires that the cost function is linear in utility (or some stable monotonic increasing function of utility). Then it can be readily verified that:

$$y^e/z^r = v(p, x, y)/u_z = y/z \tag{3}$$

However, homotheticity has often been tested empirically and rarely been accepted (Deaton and Muellbauer, 1980). So the choice of method will matter.

When the poverty measure is distribution sensitive, there is however a problem with the equivalent expenditure method. We presumably want a distribution-sensitive poverty measure to penalize inequality in utility amongst the poor. However, with non-homothetic preferences, the transformation in equation (2) introduces another source of non-linearity, namely of equivalent expenditure with respect to utility. There

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[4] For an example of the equivalent expenditure method in the context of poverty measurement see Ravallion and van de Walle (1991b).

[5] For surveys see Foster (1984) and Atkinson (1987).

is nothing in theory to guarantee that a poverty measure which penalizes inequality amongst the poor with respect to equivalent expenditures (which requires that it is strictly quasi-convex) will then penalize inequality in utilities.[6] This problem is not shared by the welfare ratio method.

"Absolute" versus "relative" poverty?

A distinction is sometimes made between an "absolute poverty line" and a "relative poverty line", whereby the former has fixed "real value" over time and space, while a relative poverty line rises with average expenditure.[7] I will argue that for the purposes of informing anti-poverty policies, a poverty line should always be absolute in the space of welfare. Such a poverty line guarantees that the poverty comparisons made are consistent in the sense that two individuals with the same level of welfare are treated the same way. As long as the objectives of policy are defined in terms of welfare, and policy choices respect the weak Pareto principle that a welfare gain cannot increase poverty, then welfare consistency in poverty comparisons will be called for.

However, absolute poverty lines in terms of welfare do not require that the poverty line is invariant to average expenditure. Fixing the reference utility level over time and space need not entail that it is also fixed in terms of the purchasing power (at given consumer preferences and given prices). This depends on what determines welfare. If welfare also depends on expenditure relative to (say) the mean within some reference group then the real value of the poverty line will also vary with the mean. To see this more clearly, let the utility of a person with expenditure y be:

$$u = u(y, r) \tag{4}$$

where $r = y/m$ is the person's relative expenditure, where m is mean expenditure in an appropriate reference population, such as the fellow citizens of the country in which the person lives.[8] I assume that the function u is smoothly increasing in both arguments. The poverty line is taken to be "absolute" in utility space, but "relative" in consumption space. Then:

$$u_z = u(z,\ z/m) \tag{5}$$

This defines implicitly the function:

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[6] This is an instance of a quite general problem of the money-metric utility function when used for social welfare comparisons; see Blackorby and Donaldson (1988).

[7] Sometimes the term "relative poverty line" is used to refer to a poverty line which is proportional to the mean or median income. I shall treat this as a special case.

[8] If one defines m as average expenditure on certain "basic goods" then the following argument will generate the type of poverty line proposed by Citro and Michael (1995) (though it need not have an elasticity of one to m, as assumed by Citro and Michael). It is not however clear why perceptions of relative deprivation would exclude certain goods, and particularly "non-basic" goods.

$$z = z(m, u_z) \tag{6}$$

which shows how the poverty line should vary with the mean to keep utility constant. Let η denote the elasticity of the poverty line with respect to the mean holding the utility poverty line constant. On differentiating (5) with respect to m holding u_z constant, and solving, one obtains:

$$\eta \equiv \frac{\partial \ln z}{\partial \ln m} = \frac{1}{1 + mMRS} \tag{7}$$

where MRS denotes the marginal rate of substitution between absolute expenditure (y) and relative expenditure (r) i.e., $MRS = (\partial u/\partial y)/(\partial u/\partial r)$. The value of η will be somewhere between zero and one. Later I discuss empirical evidence on η.

The referencing and identification problems

It is clear from the preceding discussion that one cannot assess the merits of any methodology for drawing the poverty line without first establishing how "utility" is to be assessed. There are essentially two problems, both familiar from other branches of microeconomics:

The referencing problem. In the above discussion, the question is left begging as to what the poverty line should be in utility space – the "reference utility level" which anchors the monetary poverty line in equation (1). It is tempting to say this choice is arbitrary, and to hope that it is innocuous. But that is unlikely. In the practice of poverty measurement, the choice of the reference is far from arbitrary, but is crucial to the resulting poverty measure. It influences the measured magnitude of the poverty problem in a given setting, and the magnitude of the resources devoted to that problem. The choice may also alter the qualitative comparisons one makes of poverty in (say) different regions, and hence the priorities for geographically targeted public programs. A degree of consensus about the choice of the reference utility level in a specific society may well be crucial to mobilizing resources for fighting poverty.

The identification problem. Even if we can readily agree on what the poverty line is in welfare space, there is a further problem in identifying the cost function in equation (1). Standard practice is to calibrate the parameters of the cost function from consumer demand behavior. The problem is that households vary in characteristics such as their size and demographic composition which influence welfare in ways which may not be evident in consumer demand behavior. Then there is a fundamental problem of identification.[9] For suppose that we find that an indirect utility function $v(p, y, x)$ supports observed demands:

$$q(p, y, x) = v_p(p, y, x)/v_y(p, y, x) \tag{8}$$

as an optimum, for a household with characteristics x. The indirect utility function then implies a cost

[9] On this identification problem see Pollak and Wales (1979) and Pollak (1991).

function $c(p, x, u)$, such that $y=c[p, x, v(p, y, x)]$. We seem to have the problem nailed. However, if $v(p, y, x)$ implies the demands $q(p, y, x)$ then so does every other indirect utility function $V[v(p, y, x), x]$.[10] There is thus a fundamental problem of identifying the consumer's cost function from demand behavior when household attributes vary.

To answer that "utility is just whatever people maximize" will not get us far if we cannot determine what in fact they maximize. The view that we can measure welfare by looking solely at demand behavior is untenable. External information, including normative judgements by third parties, will have to be introduced if we are to determine which of two persons is poorer.

The various methods of drawing poverty lines found in practice can be interpreted as ways of addressing the two problems identified above. The goal of practice in this area extends beyond an effort to "approximate" the theoretical idea. Practice also recognizes (often implicitly) the referencing problem and the identification problem as fundamental issues in implementing the type of ideal measurements that theory would strive for. The means used can be interpreted as ways of extending the informational base of conventional welfare measurements in applied economics. More information is sought to anchor the reference utility level. And more information is sought for making inter-personal comparisons of welfare when demand behavior alone is clearly insufficient.

That information is sought in two main areas:

(i) Objective information on requirements for attaining certain capabilities. There is a long tradition in poverty measurement of anchoring the poverty line to the attainment of certain basic capabilities, such as being able to lead a healthy and active life, including participating fully in the society around one. Consistently with this tradition, Sen (1883, 1985, 1987) has defined poverty in terms of absolute standards of minimum material capabilities, recognizing that "an absolute approach in the space of capabilities translates into a relative approach in the space of commodities" (Sen, 1983, p. 168).

(ii) Subjective information on perceptions of welfare. Economists have traditionally been shy about asking people themselves about how they perceive their own welfare, in absolute terms, or relative to others. The last two decades have seen a number of attempts to broaden the information base for interpersonal welfare comparisons so as to include this type of information in a systematic way.

The following discussion will turn to the main methods found in practice. I will first examine the "objective methods", which do not use information on individual perceptions of welfare. After that, the discussion turns to "subjective methods" which do use such information. I will argue that, by both approaches, one can still interpret the poverty line as the cost of a given level of "utility". The definition of a poverty line that I started off with is sufficiently broad to encompass these approaches as well as the consumer-demand based methods of welfare measurement that economists have traditionally favored. The difference does not lie there, but rather in the nature of the information one employs in attempting to solve both the referencing problem and the identification problem.

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[10] This follows immediately from the fact that

$$[\partial V(p, y, x)/\partial p]/[\partial V(p, y, x)/\partial y] = v_p(p, y, x)/v_y(p, y, x)$$

Objective Poverty Lines

Objective approaches can be interpreted as attempts to anchor the reference utility level in equation (1) to attainments of certain basic capabilities, of which the most commonly identified relate to the adequacy of consumption for leading a healthy and active life, including participating fully in the society around one. Sen (1985, 1987) and others have argued that poverty should be defined in terms of a fixed set of "capabilities"—the activities a person is able to perform. By this view, the commodities needed to attain those capabilities may vary, but the capabilities do not.

I shall first attempt to clarify how the idea of "capabilities" relates to the more conventional approaches to welfare measurement found in economics, as discussed in the last section. I will then examine the two main methods found in practice for setting capability-based poverty lines.

"Capabilities" versus "incomes"?

Capability-based concepts of welfare are sometimes seen as fundamentally distinct from, and (by their supporters) greatly preferable to, the more conventional money metrics of welfare popular in economics.[11] The following discussion will attempt to clarify how the theoretical idea of "capabilities" relates to the "real income" or "money-metric-utility" formulations of the idea of "income" discussed above.

A simple theoretical model linking these concepts can be formulated as follows. Assume that the household's capabilities–denoted by the vector c–are a (vector valued) function of the quantities of goods consumed by the household (q, as before) and its characteristics (x). (Relative consumptions may also matter.) Let the "capabilities function" be

$$c = c(q, x) \tag{9}$$

Utility can then be thought of as a (single valued) function of the various capabilities,

$$u = w(c) \tag{10}$$

Substituting (9) into (10) one can then "solve out" capabilities to get back to the original utility function $u(q, x)$ and corresponding expenditure function $e(p, x, u)$. A person's capabilities are thus implicit in demand behavior and the corresponding money-metric representations of utility.

For many purposes of applied welfare economics, capabilities need not be identified explicitly. However, the idea has had an important role in some applications, including poverty measurement. In deciding on what utility level is needed to escape poverty it can help greatly to consider what normative capabilities must be met to do so. It is more transparent, and likely to be more readily accepted in society at large, to define "poverty" in terms of people's abilities to lead a healthy and active life and to

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[11] See, for example, the discussions of alternative approaches to measuring poverty in the 1997 *Human Development Report* (UNDP, 1997, Chapter 1).

participate fully in the society around them, than as an abstract concept of "utility". Let c_z be the value of the capabilities needed to escape poverty. The poverty level of utility in equation (1) can then be obtained as:

$$u_z = w(c_z) \tag{11}$$

Having found u_z we can proceed as in the last section.

To make the above framework more concrete, consider nutrition-based poverty lines. Objective methods of setting poverty lines have often identified activity levels for maintaining bodily functions at rest and for supporting work. Nutritional requirements are then determined appropriate to these activity levels, and the cost of meeting those requirements in a specific setting is estimated.

Such nutrition-based poverty lines can be interpreted within the broad framework outlined above. Activity levels are the "capabilities". They depend on the quantities of various foods consumed and the characteristics of the individual, such as age, weight, and occupation, as in equation (9). The normative activity levels underlying the stipulated food energy requirements are the values of c_z in equation (11). They imply some reference utility level, u_z, though for practical purposes this need not be identified explicitly. One then tries to determine the cost of that (implicit) reference utility level, as in question (1). As we will also see later, the specifics of how this last step is done in practice will matter greatly to whether the resulting estimates of the cost of utility are believable.

In principle, the set of activity levels underlying nutritional requirements is only an example of this approach, though it is an example which has dominated practice (in both developing and developed countries). There is no reason why one would restrict attention to this specific set of capabilities; one could imagine extending the approach to a broader set of capabilities, including (for example) the capability of participating in cultural and/or political activities. How do this convincingly remains unclear, however. In practice, it may be better to monitor indicators of these other capabilities side by side with conventional poverty measures (Ravallion, 1996b).

The above discussion suggests that focusing on capabilities for defining poverty does not require that we abandon monetary, utility-based, characterizations of welfare. In terms of the discussion in the last section, the concept of "capabilities"–as an intermediate level between utility and commodities consumed–is a way of dealing with the referencing problem in defining who is poor. "Utility", as a representation of preferences over the set of capabilities, remains the welfare indicator. The idea of "capabilities" does not substitute for utility (or some money metric of utility) as the individual welfare indicator but complements it, by introducing more information into assessments of poverty, information that would otherwise be hidden from view. Attempts to present the two approaches as fundamentally different and to debate their relative merits can thus be misleading.

There is nonetheless plenty of scope for debate. Two main issues can be identified. Firstly, there are potential disagreements about what exactly the normative capabilities are; what activity levels, for example, are deemed necessary in defining "nutritional requirements"? Secondly, there is the issue of how one goes from any specification of what those capabilities are to the consumption or income

space. I will argue below that the second problem is probably the more worrying for many of the purposes of poverty measurement, notably informing anti-poverty policies.

The food-energy intake method

A popular practical method of setting poverty lines proceeds by finding the consumption expenditure or income level at which food energy intake is just sufficient to meet pre-determined food energy requirements. Setting food-energy requirements can be a difficult step. Requirements vary across individuals and over time for a given individual. An assumption must also be made about activity levels which determine energy requirements beyond those needed to maintain the human body's metabolic rate at rest. Here I shall follow common practice in assuming that a single nutritional requirement for a typical person is already set.[12] For the present, the key difference between methods is in how food energy requirements are mapped into the expenditure space.

Food energy intakes will naturally vary at a given expenditure level, y. Recognizing this fact, the method typically calculates an expected value of intake. Let k denote food-energy intake, which is a random variable. The requirement level is k^r which is taken to be fixed (this can be readily relaxed). As long as the expected value of food-energy intake conditional on total consumption expenditure, $E(k|y)$, is strictly increasing in y over an interval which includes k^r then there will exist a poverty line z such that

$$E(k|z) = k^r \tag{12}$$

This can be termed the "food-energy-intake" (FEI) method (Ravallion, 1994a). The method has been used in numerous countries; for example see Dandekar and Rath (1971), Osmani (1982), Greer and Thorbecke (1986), and Paul (1989).

Notice that the FEI method is still aiming to measure consumption poverty, rather than undernutrition. If one wanted to measure undernutrition, one would look at nutrient intakes relative to requirements, and not incomes or consumption expenditures. What the FEI method is aiming to do is find a monetary value of the poverty line at which "basic needs" are met.

Figure 1 illustrates the method. The vertical axis is food-energy intake, plotted against total income or expenditure on the horizontal axis. A line of "best fit" is indicated; this is the expected value of caloric intake at a given value of total consumption. By simply inverting this line, one then finds the expenditure z at which a person typically attains the stipulated food-energy requirement.[13]

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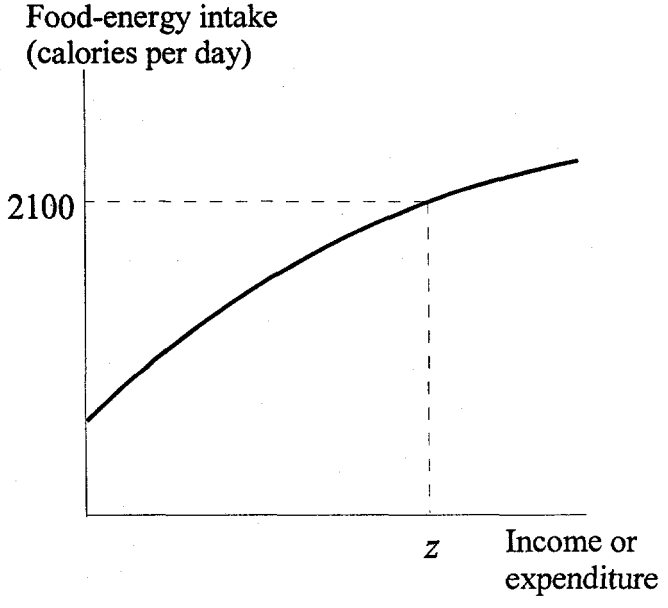
[12] For an attempt to deal explicitly with the implications of un-observed variability in nutritional requirements see Ravallion (1992).

[13] Some versions of the FEI method regress (or graph) nutritional intake against consumption expenditure and invert the estimated function, while others avoid this step by simply regressing consumption expenditure on nutritional intake. These two methods need not give the same answer, though the difference is not germane to our present interest; either way the following points apply.

Figure 1: The Food-Energy Intake Method



Once food-energy requirements are set, the FEI method is computationally simple. A common practice is simply to calculate the mean income or expenditure of a sub-sample of households whose estimated caloric intakes are approximately equal to the stipulated requirements. More sophisticated versions of the method use regressions of the empirical relationship between food energy intakes and consumption expenditure. These can be readily used (numerically or explicitly) to calculate the FEI poverty line.

Notice too that the method automatically includes an allowance for both food and non-food consumption as long as one locates the total consumption expenditure at which a person typically attains the caloric requirement. It also avoids the need for price data; in fact, no explicit valuations are required. Thus the method has a number of practical advantages, as proponents have noted (Osmani, 1982; Greer and Thorbecke, 1986; Paul, 1989). Ostensibly then, the FEI method offers hope of constructing a poverty profile consistent with the attainment of basic food needs, and of doing so with relatively modest data requirements.

Can the FEI method assure consistency in terms of real expenditure, or some other agreed measure of welfare? Concerns about the FEI method have arisen from the fact that the relationship between food energy intake and income will shift according to differences in tastes, activity levels, relative prices, publicly-provided goods or other determinants of affluence besides consumption expenditure. And there is nothing in the FEI method to guarantee that these differences are ones which would normally be considered relevant to assessing welfare (Ravallion, 1994a).

For example, to the extent that prices differ between urban and rural areas (due, say, to transport costs for food produced in rural areas) one will want to use different nominal poverty lines. However,

relative prices can also differ and (in general) this will alter demand behavior at given real expenditure levels (nominal expenditures deflated by a suitable cost-of-living index). The prices of certain non-food goods tend to be lower relative to foods in urban areas than rural areas.[14] And their retail outlets also tend to be more accessible (so the full-cost, including time is even lower) in urban areas. This may mean that the demand for food and (hence) food energy intake will be lower in urban areas than rural areas, at any given real income. But this does not, of course, mean that urban households are poorer at a given expenditure level.

To give another example, activity levels in typical urban jobs tend also to require fewer calories to maintain body weight than do rural activities. (Compare the stipulated food-energy requirements for activities such as agricultural labor with factory work, as given in WHO, 1985.) Again food intakes will tend to be lower at a given income, but this should clearly not be taken as a sign of poverty.

Tastes may also differ systematically. At given relative prices and real total expenditure, urban households may simply have more expensive food tastes; they eat more rice and less cassava, more animal protein and less foodgrain, or simply eat out more often. Thus they pay more for each calorie, or (equivalently) food energy intake will be lower at any given real expenditure level. Again, it is unclear why we would deem a person who chooses to buy fewer and more expensive calories as poorer than another person at the same real expenditure level.

For these reasons, the real income at which an urban resident typically attains any given caloric requirement will tend to be higher than in rural areas. And this can hold even if the cost of basic consumption needs is no different between urban and rural areas. The FEI method may thus build-in differences between the poverty lines which are not related to the standard of living defined in terms of command over commodities.

Consider Figure 2, which gives a stylized food energy-income relationship for "urban" and "rural" areas. The urban poverty line is z_u while the rural line is z_r. However, there is nothing in the method to guarantee that the differential z_u/z_r equals the differential in the cost-of-basic needs between urban and rural areas. The distribution of caloric intakes can readily vary between groups such that the regression function $E(k|\ y)$ also varies with the characteristics of those groups, and there is no reason to assume that $E(k|\ y)$ ranks welfare levels correctly at a given value of y. An unwarranted differential in poverty lines may then appear, and the poverty profile will be inconsistent in terms of command over basic consumption needs.

One should then be wary of the poverty lines generated by this method, in that people at the poverty line in different sectors or dates could well have very different levels of living by almost any agreed measure. Indeed, depending on how these factors vary, it is quite possible to find that the "richer" sector (by the agreed metric of welfare) tends to spend so much more on each calorie that it is deemed to be the "poorer" sector. For example, a case study for Indonesia found virtually zero rank

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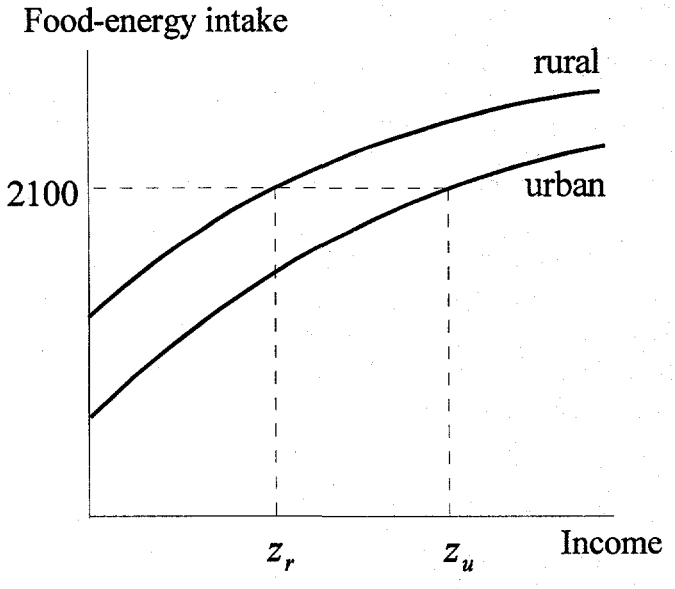
[14] One might argue that the relative price of food is higher in urban areas (assuming that food energy has a price elasticity less than unity, as is plausible), though this is questionable, given the high non-food prices of, for example, housing in urban areas. See, for example, Ravallion and van de Walle (1991a).

correlation between regional poverty measures implied by FEI-based poverty lines and those which attempted to hold constant purchasing power over basic consumption needs (Ravallion and Bidani, 1994).[15]

Figure 2: Multiple poverty lines with the FEI method



The same point holds over time. Suppose that all prices increase, so the cost of a given standard of living must rise. There is nothing to guarantee that the FEI-based poverty line will increase. That will depend on how relative prices and tastes change; the price changes may well encourage people to consume cheaper calories, and so the FEI poverty line will fall.[16] Indeed, there is nothing to guarantee that a measure of poverty based on FEI poverty lines will increase when all real incomes fall.

Notice that there is a sense in which the poverty lines based on this method are "consistent", namely that (on average) people at the poverty line will have the same food-energy intakes (relative to requirements). The issue is whether that constitutes a good basis for poverty comparisons. It might be if one deemed food-energy intake to be a valid welfare indicator on its own. But there appears to be wide agreement that it is not, even among exponents of the FEI method of setting poverty lines (for if one deemed calories to be sufficient, none of this extra work would be necessary—all one would do is measure caloric shortfalls relative to requirements, all of which are already needed as data to implement this method of setting poverty lines.) The method acknowledges (at least implicitly) that total consumption of goods and services is a better welfare indicator than food-energy intake per se.

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[15] Also see Ravallion and Sen (1996) and Wodon (1997).

[16] Wodon (1997) gives an example of this problem in data for Bangladesh. The FEI poverty line fell over time (in urban areas between 1985 and 1988) even though prices generally increased.

An argument sometimes made in favor of the FEI method is that it reflects differences in preferences between sub-groups.[17] Certainly differences in preferences will affect the poverty lines so derived. But it is not clear what status one should give those differences when making poverty comparisons. If one group—the urban sector, say—prefers to consume less food and more clothing at given prices and real incomes should one then say they are poorer?

It might also be argued that the FEI method is able to reflect other determinants of welfare, such as access to publicly provided goods. But again it is unclear that the method will do so in a way which is consistent with defensible normative judgements in making inter-personal welfare comparisons. For example, access to better health care and schooling in urban areas may mean that one tends to consume a diet which is nutritionally better balanced—with relatively fewer calories and more micro-nutrients. But then the FEI method will entail a higher poverty line, and more people will be deemed poor in urban areas than otherwise. This makes little sense.

In principle, it is always possible to use a higher food-energy requirement for rural areas than urban areas and this will go some way toward avoiding the "urban bias" in the FEI method. That depends on how requirements are set, including the (normative) judgement as to what activity levels are deemed appropriate. In practice, prevailing methods of setting requirements based on the demographic composition and activity levels of the population may or may not entail higher requirements in rural areas.[18] And there can be no presumption that such refinements to the FEI method will achieve a consistent poverty ranking in terms of command over consumption needs.

These issues are quite worrying when there is mobility across the subgroups of the poverty profile, such as migration from rural to urban areas. Suppose that–as the above discussion has suggested may well happen–the FEI poverty line has higher purchasing power in terms of basic needs in urban areas than rural areas. Consider someone just above the FEI poverty line in the rural sector who moves to the urban sector and obtains a job there generating a real gain less than the difference in poverty lines across the two sectors. Though that person is better off–in that she can buy more of all basic needs, including food–the aggregate measure of poverty across the sectors will show an increase, as the migrant will now be deemed poor in the urban sector. Indeed, it is possible that a process of economic development through urban sector enlargement, in which none of the poor are any worse off, and at least some are better off, would result in a measured increase in poverty. Similar points can be made concerning the use of the FEI method in making poverty comparisons over time; it is entirely possible that the method will show rising poverty rates over time even if all households have higher real incomes.

In summary, a priori considerations lead one to suspect that a FEI-based poverty profile could deviate from one which is consistent in terms of the household's command over commodities. By anchoring poverty lines to the observed empirical relationship between food-energy intake and total

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[17] See, for example, Greer and Thorbecke (1986).

[18] Some activities in the urban informal sector may actually entail higher energy requirements compared to rural areas. Activities such as rickshaw pulling and brick-breaking, which represent a major source of the urban poor's employment, would entail similarly high energy expenditures to agricultural labor.

consumption expenditure within each subgroup, the FEI method can estimate poverty lines without data on prices. However, this particular anchor is going to shift across the poverty profile in ways which have little or nothing to do with differences in command over basic consumption needs.

The cost-of-basic-needs method

This method stipulates a consumption bundle deemed to be adequate for basic consumption needs, and then estimates its cost for each of the subgroups being compared in the poverty profile; this is the approach of Rowntree in his seminal study of poverty in York in 1899, and it has been followed since in enumerable studies for both developed and developing countries. I shall call this the "cost-of-basic-needs" (CBN) method.

One can interpret this method in two quite distinct ways. It can be interpreted as the "cost-of-utility", though under quite special assumptions about preferences. If one uses the cost of a given basic-needs bundle then one must assume that utility-compensated substitution effects are zero. That is a restrictive assumption, though possibly less so for the poor. If it holds then the estimated CBN - normalized by its value for some reference - is a utility-consistent cost-of-living index.

By the second interpretation, the definition of "basic needs" is deemed to be a socially-determined normative minimum for avoiding poverty, and the cost-of-basic-needs is then closely analogous to the idea of a statutory minimum wage rate. No attempt is made to assure that utility rankings and poverty rankings coincide under this interpretation; a person might (for example) be deemed "poorer" in state A than state B even if she prefers A to B.

However, in practice the idea of respecting consumer choice has still influenced the second interpretation of the CBN approach in important ways. The criterion for defining poverty is rarely that one attains too little of <u>each</u> basic need. (Again we see that "undernutrition" is viewed as a distinct concept to "poverty".) Rather, it is that one cannot "afford" the cost of a given vector of basic needs. Early attempts to determine the minimum cost of achieving the basic-needs vector at given prices ignored preferences. However, the resulting poverty lines may well be so alien to consumer behavior that their relevance as a basis for policy is doubtful. Instead, current practices aim to anchor the choice more firmly to existing demand behavior. Amongst the (infinite number of) consumption vectors which could yield any given set of basic needs, a vector is chosen which is consistent with choices actually made by some relevant reference group. Poverty is then measured by comparing actual expenditures to the CBN. A person is not deemed poor who consumes less food (say) than the stipulated basic needs, but <u>could</u> consume it on rearranging her budget allocation.

The food component

The food component of the poverty line is almost universally anchored to nutritional requirements for good health. This does not generate a unique monetary poverty line, since many bundles of food goods yield the same nutrition. In practice, a diet is chosen which accords with prevailing consumption patterns, about which one might expect to arrive at a consensus in most settings.

If one knows the (utility-consistent) demand model then one can set a different bundle of goods in different regions to reflect differences in relative prices (keeping on the same indifference curve). But then if one knows the demand model, one could equally well calculate a true cost of living index. The problem in practice is that the demand model is unknown. And there is then a real risk that the ad hoc methods used to adjust the bundle of goods for differences in relative prices will become contaminated by differences in real incomes, as in the case with the food-energy intake method discussed earlier in this paper.

When – as is the norm – one does not know the whole demand model, there are still ways of assuring consistency with available data on consumer behavior. A simple method of allowing for substitution is to set a bundle of goods in each region (say) which is the average consumption of a reference group fixed nationally in terms of their income or expenditure (Ravallion, 1994a, Appendix 1). For example, one might pick those people in the third poorest decile nationally, when ranked in terms of (unadjusted) expenditure per person and then find what the average consumption bundle is of that reference group in each region. Thus one is not using the same food bundle in each region, but rather one is using the bundle which is typical of those within a pre-determined interval of total consumption expenditure nationally. The initial choice of the reference group is interpretable as a "first-guess" of the region in which the poverty line is located. If (in the example in which one picked people in the third poorest decile as the reference group) the final poverty rate is *not* between 20 and 30%, then one can then repeat the calculations, iterating until there is convergence. The bundle of goods used in each region is then the average consumption of the poor in that region, where the poor are defined in terms of real expenditure, deflated by the same set of region-specific poverty lines.

Convergence for this method is not guaranteed, but appears likely. As long as the poverty bundle of goods corresponds to the point on the ordinary demand function at which total expenditure is equal to the poverty line (given local prices) then the budget constraint will also hold, which assures that the cost at local prices of that bundle of goods equals the poverty line. Convergence problems may arise when one considers a large segment of the distribution as the reference, for then the properties of the distribution of expenditure will also play a role, and one cannot rule out multiple solutions.

As a check on this method, one can calculate the implied utility-compensated substitution elasticities (by dividing the proportionate differences in quantities in the poverty bundles by the proportionate differences in prices), and see if these accord with any a priori information from demand studies in similar settings.

The non-food component

The scope for disagreement appears to be far greater with respect to the non-food component. A common practice is to divide the food component of the poverty line by some estimate of the budget share devoted to food. For example, the widely used poverty line for the U.S. developed by Orshansky (1963) assumes a food share of one third, which was the average food share in the U.S. at the time. So the total poverty line is set at three times the food poverty line. But the basis for choosing a food share is rarely transparent, and very different poverty lines can result, depending on the choice made. Why use the average food share, as in the Orshansky line? Whose food share should be used? In what sense

are "basic non-food needs" then assured? How should it be adjusted over time and place.[19]

Again we can appeal to welfare consistency, and require that people with the same standard of living are treated the same way by the poverty measure. But how should the "standard of living" be defined, and how can its cost be identified from available data? This is another instance of the identification problem in applied welfare analysis discussed earlier in this paper. One might write down a bundle of non-food goods. But it is unclear whether a fixed bundle of non-food goods would gain wide acceptance, or maintain its relevance over time, such as with rising average standards of living. (There are also practical problems of consistently measuring non-food prices.) Of all the data that go into measuring poverty, setting the non-food component of the poverty line is probably the most contentious.

Setting an upper bound

The following discussion outlines seemingly defensible assumptions which allow one to set an upper bound for a poverty line anchored to certain basic capabilities. The food share for scaling up the food poverty line to determine this upper bound is the food share of households whose actual food spending equals the food poverty line. The value of this can be readily estimated with the data normally available for this task. In addition to allowing a check on any proposed poverty line, setting an upper bound to the range of admissible poverty lines can help in making qualitative comparisons of poverty over time or space, when one wants to know whether the answer depends on the precise choice of poverty line or poverty measure up to some maximum admissible poverty line.[20]

The human body requires an absolute minimum food-energy intake to maintain bodily functions at rest. These needs must take precedence over all else if one is to survive for more than a relatively short period. Beyond that, food-energy intakes will determine what activity levels can be sustained biologically; the greater the intake, the greater the energy expenditure which is possible i.e., the greater one's activity level. Setting the food component of a poverty line is then a matter of the normative judgement one makes about what activity levels should be attainable.[21]

That judgement also has implications for the non-food component of the poverty line. Good health is essential for most activities, and in most societies — including the poorest — being healthy requires spending on clothing, shelter and health care. Also, many activities one would readily deem essential to escaping poverty cannot be performed without participation in society; for example, this is true of employment, schooling, and health care, even in under-developed rural societies. Social norms or sanctions prohibit that participation without acquiring certain non-food goods—such as a home and socially acceptable dress. Since a set of such non-food goods is required before one participates in

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[19] For a discussion of these issues in the context of the U.S. poverty line see Citro and Michael (1995).

[20] See Atkinson (1987) on the conditions under which unambiguous rankings are possible if the poverty line is within a known interval. For an overview of this approach and further references see Ravallion (1994a).

[21] This is well recognized; see Osmani (1992), Anand and Harris (1992), and Payne and Lipton (1993).

society, these must naturally take precedence over even quite basic food requirements beyond survival needs. This appears to be why even people who are well short of meeting food-energy requirements spend on non-food goods. A plausible hierarchy of "basic needs" would then begin with survival food needs, basic non-food needs, and then basic food needs for economic and social activity.

To formalize these arguments, let us make the following assumptions:

Assumption 1: Once survival food needs are satisfied, as total expenditure rises, basic non-food needs will have to be satisfied before basic food needs.

Assumption 2: Both food and non-food are normal goods once survival needs are satisfied.

These assumptions imply that the poverty line cannot exceed the total spending of those whose actual food spending achieves basic food needs. For consider a person whose food spending equals basic food needs. This person has reached the normative activity level underlying the food energy requirement. To have done so she must have already acquired the non-food goods which are a necessary prerequisite to that activity level in a given society. So whatever that person spends on non-food goods must exceed basic non-food needs.

To see this more formally, let b^f be expenditure on basic food needs, while b^n is spending on basic non-food needs, and y is total expenditure, of which $f(y)$ is food spending (or the expected value of food spending conditional on total spending); both x and $f(y)$ are continuous. The poverty line is $z = b^f + b^n$. By Assumption 2, $0 < f'(y) < 1$ (noting that non-food spending is also assumed to be normal). Suppose that $b^n > f^{-1}(b^f) - b^f$, and consider any $x > f^{-1}(b^f)$ such that $x - f(x) = b^n$ (using Assumption 2). Then $f(x) > b^f$ using Assumption 2. However, if $x - f(x) = b^n$ then $f(x) < b^f$ using Assumption 1, implying a contradiction. Thus it must be the case that $z \leq f^{-1}(b^f)$.

Figure 3 illustrates this method of setting an upper bound to non-food spending.

Can we set a reasonable lower bound? At total expenditures below the food poverty line, one can assume that neither basic food nor basic non-food needs will be met. Consider a person for whom total expenditure is just enough to reach the food poverty line, $y = b^f$. Anything that this person spends on non-food goods can be considered a minimum allowance for "basic non-food needs", since the person gave up basic food needs. So it can be argued that a minimum allowance for non-food basic needs is $b^f - f(b^f)$ giving a (total) poverty line of $2b^f - f(b^f)$ (Ravallion, 1994a). This is the lower poverty line in Figure 3.

These poverty lines can be readily estimated using a food-share Engel curve of the form:

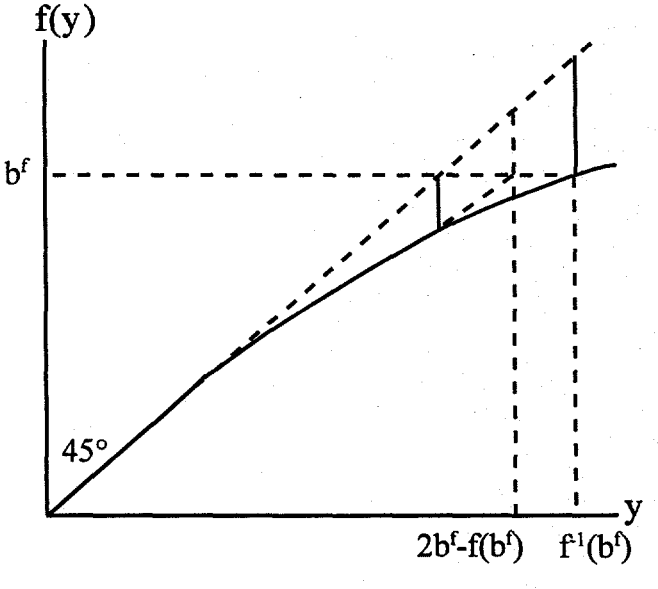
$$f(y_i)/y_i = \alpha + \beta_1 \log(y_i/b^f) + \beta_2 [\log(y_i/b^f)]^2 + \gamma'(d_i - \bar{d}) + residual_i \qquad (13)$$

for sampled household i, where d is a vector of demographic variables, with means $\bar{d}$, and α, β_1, β_2 and γ are parameters to be estimated. The value of α estimates the average food share of those households who can just afford basic food needs. The lower poverty line in Figure 3 is then given by $(2-\alpha)b^f$, while the upper line is b^f/α^*, where α^* is defined implicitly by:

$$\alpha^* = \alpha + \beta_1 \log(1/\alpha^*) + \beta_2 [\log(1/\alpha^*)]^2 \qquad (14)$$

This can be readily solved numerically. Alternatively one can use non-parametric methods which do not impose a functional form on the Engel curve. To give a simple example for the upper poverty line, one can calculate the mean total expenditure of the sampled households whose food spending lies within a small interval around the food poverty line; let that interval be (say) $0.99b^f$ to $1.01b^f$ (i.e., plus or minus one percent of b^f). Repeat this for an interval $0.98b^f$ to $1.02b^f$, then $0.97b^f$ to $1.03b^f$ and so on up to (say) $0.90b^f$ to $1.10b^f$. Then take an average of all these mean total expenditures. This gives a weighted non-parametric estimate of $f^{-1}(b^f)$ with highest weight on the sample points closest to b^f (with weights declining linearly around this point). One can apply the same approach to estimating the lower poverty line described above, with the difference that one calculates the non-food spending of sampled households in the neighborhood of the point where total spending equals the food poverty line.

Figure 3: Methods of Setting the Non-Food Allowance



One should be clear about the role of data on nutritional or other capabilities in these various versions of the cost-of-basic-needs methods. That role is essentially to provide an anchor for setting the reference utility level. Nutritional status is not itself the welfare indicator. Thus there is nothing to guarantee that someone who can afford the resulting poverty line at every place or date will actually reach the nutritional requirement.

Updating over time

Having set the poverty line for one date, how should this be up-dated over time? There are two methods found in practice. The first is to use a consumer price index, preferably re-weighted to conform with the spending behavior of people at the poverty line, or somewhere below the line. The second is to re-do the poverty lines. The choice between the two methods will depend in part on the data available and its quality.

However, aside from data problems, there is another consideration influencing the choice of method for up-dating the poverty line. Lanjouw and Lanjouw (1997) have shown that re-calculating the poverty lines the same way as before can make the resulting poverty measures robust to underlying comparability problems in the survey data being used. Such problems are common; changes in survey design can mean that conventional measures of poverty (and inequality) can change even if there is no real change in the economy. Lanjouw and Lanjouw recommend that a common set of food items be identified (common to the two surveys available) and that the non-food components for both poverty lines be up-dated the same basic way described above for the upper bound of the poverty line. Then the estimated poverty rate (headcount index) will be robust to the changes in survey design.[22] Their theoretical results assume, however, that the food Engel curve is stable over time–meaning that neither relative prices nor tastes change. Any changes in relative prices or tastes which shift the food demand function at given total expenditures will create errors due to changes in survey design.

Measurement errors in the welfare indicator further strengthen the case for considering a wide range of potential poverty lines. If random and identically distributed determinants of welfare are omitted in the two distributions being compared (such as urban and rural areas) then a robust ranking over all possible poverty lines will still be correct; however, heterogeneity in the distribution of measurement errors weakens this result (Ravallion, 1994b).

[22] This is not true of other "higher-order" measures; see Lanjouw and Lanjouw (1997) for details.

Subjective Poverty Lines

There is an inherent subjectivity and social specificity to any notion of "basic needs", including nutritional requirements. Psychologists, sociologists and others have argued that the circumstances of the individual relative to others in some reference group influence perceptions of well-being at any given level of individual command over commodities.[23] By this view, "the dividing line ...between necessities and luxuries turns out to be not objective and immutable, but socially determined and ever changing" (Scitovsky, 1978, p.108). Some have taken this view so far as to abandon any attempt to rigorously quantify "poverty". Poverty analysis (particularly, but not only, for developing countries) has become polarized between the "objective-quantitative" schools and "subjective-qualitative" schools, with rather little effort at cross-fertilization. An intermediate approach has emerged in some of the developed country literature. This section discusses this approach, and how it can be adapted to a developing country setting.

The minimum income question

"Subjective poverty lines" have been based on answers to the "minimum income question" (MIQ), such as the following (paraphrased from Kapteyn et al 1988): "What income level do you personally consider to be absolutely minimal? That is to say that with less you could not make ends meet". One might define as poor everyone whose actual income is less than the amount they give as an answer to this question. However, this would almost certainly lead to inconsistencies in the resulting poverty measures, in that people with the same income, or some other agreed measure of economic welfare, will be treated differently. Clearly an allowance must be made for heterogeneity, such that people at the same standard of living may well give different answers to the MIQ, but must be considered equally "poor" for consistency. Past empirical work has found that the expected value of the answer to the MIQ conditional on actual income tends to be an increasing function of actual income.[24] Furthermore past studies have tended to find a relationship such as that depicted in Figure 4, which gives a stylized representation of the regression function on income for answers to the MIQ. The point z^* in the figure is an obvious candidate for a poverty line; people with income above z^* tend to feel that their income is adequate, while those below z^* tend to feel that it is not. In keeping with the literature, we term z^* the "subjective poverty line" (SPL).[25]

It is also recognized in the literature that there are other determinants of economic welfare which should shift the SPL, such as family size and demographic composition. Indeed, the answers to the MIQ

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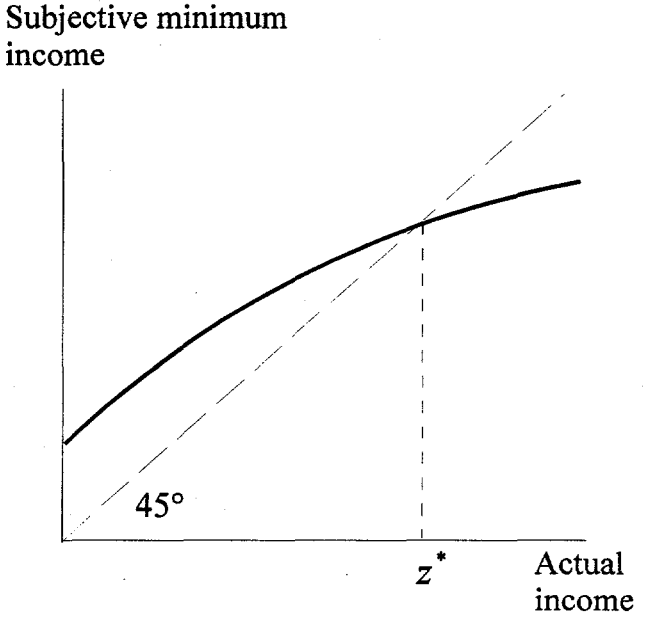
[23] Runciman (1966) provided an influential exposition, and supportive evidence. Also see the discussions in van de Stadt et al., (1985), Easterlin (1995) and Oswald (1997).

[24] Contributions include Groedhart et al., (1977), Danziger et al., (1985), Kapteyn et al., (1988) and Kapteyn (1994).

[25] The term "social subjective poverty line" might be preferable, to distinguish it from the individual subjective poverty lines. However, the meaning will be clear from the context, and so we will stick to the simpler usage.

are sometimes interpreted as points on the consumer's cost function (giving the minimum expenditure needed to assure a given level of utility) at a point of "minimum utility", interpreted as the poverty line in utility space. Under this interpretation, subjective welfare assessments provide a means of overcoming the well-known problem of identifying utility from demand behavior alone when household attributes vary.[26]

Figure 4: The subjective poverty line (z^*)



A Developing country setting

While the MIQ has been applied in a number of OECD countries, there have been few attempts to apply it in a developing country. There are a number of potential pitfalls. "Income" is not a well-defined concept in most developing countries, particularly (but not only) in rural areas. It is not at all clear whether or not one could get sensible answers to the MIQ. The qualitative idea of the "adequacy" of consumption is a more promising one in a developing country setting.

Pradhan and Ravallion (1997) propose a method for estimating the SPL based on qualitative data on consumption adequacy. The method assumes that each individual has his or her own reasonably well-defined consumption norms at the time of being surveyed. At the prevailing incomes and prices, there can be no presumption that these needs will be met at the consumer's utility maximizing consumption vector. Let the consumption vector of a given individual be denoted y, and let z denote the matching vector of consumption norms for that individual. The subjective basic need for good k and household i is given by:

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[26] On the use of subjective welfare assessments to identify cost and utility functions see Kapteyn (1994).

$$z_{ki} = \varphi_k(y_i, x_i) + \varepsilon_{ki} \quad (k=1,..,m; i=1,..,n) \tag{14}$$

where φ_k $(k=1,..,m)$ are continuous functions, and x is a vector of indicators of welfare at a given consumption vector (such as household size and demographics). I assume that each φ_k has a positive lower bound as actual consumptions approach zero, and that the function is bounded above as consumptions approach infinity. The error terms, ε_{ki}, are assumed to have zero mean, and be independently and identically normally distributed with variance σ_k^2. The cumulative distribution functions of the standard normal error terms $(\varepsilon_{ki}/\sigma_k)$ are denoted F_k $(k=1,..,m)$.

Consistently with the literature on the MIQ, we define the subjective poverty line as the expenditure level at which the subjective minimums for all k are reached in expectation, for a given x. A household is poor if and only if its total expenditure is less than the appropriate SPL for a household with its characteristics. Thus the SPL satisfies:

$$z^*(x) = \sum_{k=1}^{m} z_k^*(x) \tag{15}$$

where $z_k^*(x)$ is defined implicitly by the fixed point relationship:

$$z_k^*(x) = \varphi_k(z_1^*(x),...,z_m^*(x), x) \quad (k=1,..,m) \tag{16}$$

A solution of this equation will exist as long as the functions φ_k are continuous for all k.[27]

This provides a multidimensional extension to the one dimensional case based on the MIQ, as illustrated in Figure 4. The SPL is the level of total spending above which respondents say (on average) that their expenditures are adequate for their needs. However, we do not assume that the MIQ is answerable, and so we cannot observe z_{ki} directly. Rather we know from a purely qualitative survey question whether actual expenditure on good k by the i'th sampled household (y_{ki}) is below z_{ki}. The probability that the i'th household will respond that actual consumption of the k'th good is adequate will then be given by:

$$Prob(y_{ki} > z_{ki}) = F_k[y_{ki}/\sigma_k - \varphi_k(y_i, x_i)/\sigma_k] \tag{17}$$

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[27] This follows from the Brouwer fixed point theorem given my assumptions. Stronger assumptions are needed to rule out multiple solutions.

As long as the specific parameterizations of the function φ_k are linear in parameters (though possibly nonlinear in variables) we can estimate the model as a standard probit. Let us follow the literature on the MIQ and assume a log linear specification for the individual subjective poverty lines. Defining $y' \equiv (lny_1,..,lny_m)$, equation (14) becomes:

$$lnz_{ki} = \alpha_k + \beta_k' y_i + \pi_k' x_i + \varepsilon_{ki} \quad (k=1,..,m;\ i=1,..,n) \tag{18}$$

If we observed the values of z_{ki} then a unique solution for the subjective poverty line could be obtained by directly estimating equation (18) and solving (assuming that the relevant coefficient matrix is non-singular; for details see Pradhan and Ravallion, 1997).

The parameters are not identified with only qualitative data on consumption adequacy relative to (latent) norms. With the specification in (18), equation (17) becomes

$$Prob(y_{ki} > z_{ki}) = F_k[(lny_{ki})/\sigma_k - (\alpha_k + \beta_k' y_i + \pi_k' x_i)/\sigma_k] \tag{19}$$

As in any probit, we do not identify the parameters of the underlying model generating the latent continuous variable (equation 18), but only their values normalized by σ_k. Thus, armed with only the qualitative welfare assessments (telling us $Prob(y_{ki} > z_{ki})$), we cannot identify the parameters of the model determining the individual basic needs.

However, that fact does not limit our ability to identify the SPL. To see why, consider first the special case of one good with $lnz = \alpha + \beta lny + \varepsilon$. The SPL is $\alpha/(1-\beta)$. The probability of reporting that actual consumption is adequate is $F[lny(1-\beta)/\sigma - \alpha/\sigma]$ which only allows us to identify $(1-\beta)/\sigma$ and α/σ. Nonetheless $\alpha/(1-\beta)$ is still identified. This property caries over readily to the more general model with more than one good, and other sources of heterogeneity in welfare, as in (18) (Pradhan and Ravallion, 1997).

Thus we can solve for the subjective poverty line without the MIQ as long as we have the qualitative data for determining $Prob(y_{ki} > z_{ki})$ for all i and k. Instead of asking respondents what the precise minimum consumption is that they need, we can simply ask whether or not they consider their current consumption to be adequate. These results appear to open up potential future applications of this approach in developing country settings.

Poverty Lines Found in Practice

So far we have looked at poverty lines in theory, and the two broad schools of thought in practice. The discussion has been abstract, however. In this section I provide an overview of the poverty lines found in practice.

Poverty lines across the world

In practice, the objective methods described above have been more popular in developing countries, while the subjective methods have been more in developed countries. However, there are exceptions. One finds objective methods in some rich countries; an example is the official poverty line for the U.S., based on the method proposed by Orshansky (1963). And there are subjective poverty lines for developing countries; Pradhan and Ravallion (1997) apply the method to Jamaica and Nepal, and find that the subjective poverty measures turn out to be quite close to (independent) objective measures for both countries.

Even within the objective approach, one finds wide differences across countries in the poverty lines obtained. A compilation of poverty lines internationally was done for the 1990 *World Development Report* (World Bank, 1990; Ravallion, Datt and van de Walle, 1991). This allowed a comparison of poverty lines found in practice with the average consumption levels from national accounts, across both developing and developed countries; one finds the picture in Figure 5. The log of the country-specific poverty line is on the vertical axis, with the log of private consumption per person on the horizontal axis, with both at Purchasing Power Parity. There were 36 countries for which all the relevant data were available at the time. The regression equation is:[28]

$$\ln z_i = \underset{(5.09)}{6.704} - \underset{(-3.60)}{1.773}\ln y_i + \underset{(5.08)}{0.228}(\ln y_i)^2 + residual_i \qquad (20)$$

where z_i is the poverty line in the i'th country on a per person basis (at average household size and demographics when relevant), while y_i is average consumption per person, with both the poverty line and the mean calculated at purchasing power parity. At the overall mean, the elasticity of the poverty line to the mean is 0.71. The elasticity starts from a low level in poor countries; the elasticity is 0.23 at one standard deviation below the mean, and is 0.00 at almost exactly 1.5 standard deviations below the mean, which is the consumption level in the poorest country in the sample. The elasticity is unity at about one standard deviation above the mean.[29]

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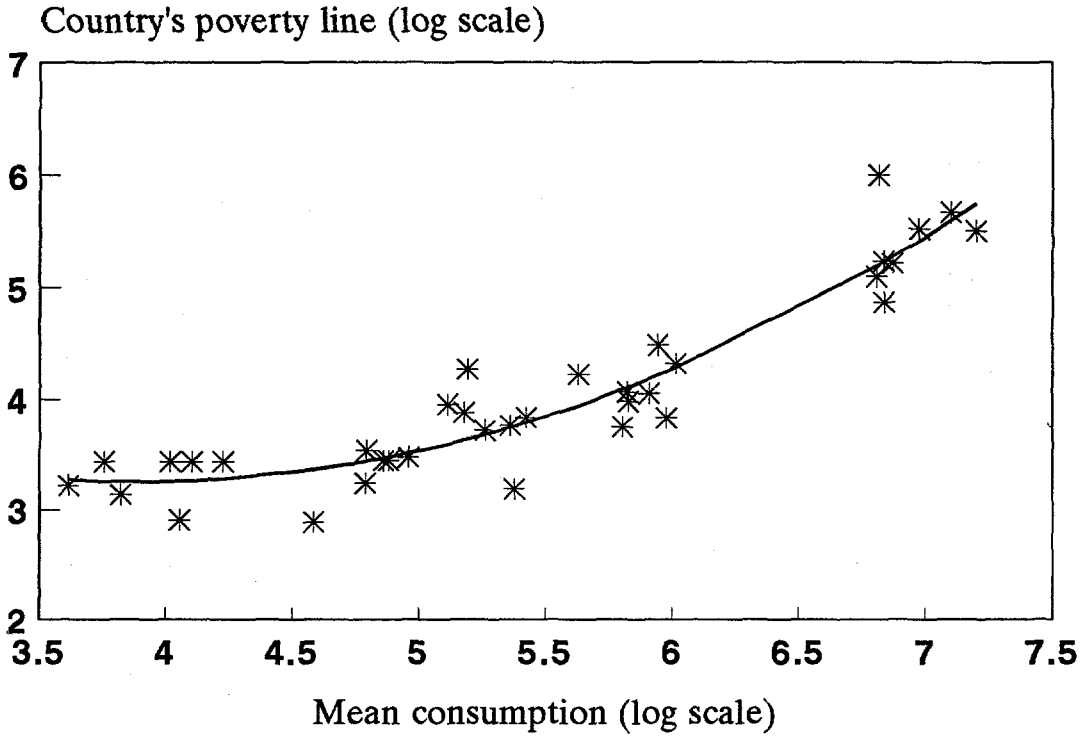
[28] The figures in parentheses are t-ratios. The value of R^2 is 0.887. The regression comfortably passed LM tests for functional form, normality and heteroskedasticity. The countries included and sources are given in the working paper version of Ravallion, Datt and van de Walle (1991).

[29] Ravallion, Datt and van de Walle (1991) report a different regression specification in which the log of the poverty line is regressed on a quadratic function of the level (not log) of consumption per person.

Figure 5: Poverty lines across countries



Note: Each point is one country. Both poverty line and mean consumption are measured at purchasing power parity.
Source: Ravallion, Datt and van de Walle (1991)

One region which is poorly represented in the data set used for Figure 5 is Africa. Only four Sub-Saharan African countries were used, namely Burundi, Kenya, South Africa and Tanzania. However, it is now possible to add a number of extra African countries to the data set underlying Figure 5. I compiled the poverty lines from 24 completed World Bank Poverty Assessments for Sub-Saharan Africa, and converted these into $/month at 1985 PPP, similarly to the data used for Figure 5. I then re-estimated equation (20) on this new (independent) data set. (I left out the four African observations in the original data set, so the data sets are entirely different.) The result was:[30]

$$\ln z_i = \underset{}{6.698} \underset{(1.74)}{-2.116\ln y_i} \underset{(-1.13)}{+0.309(\ln y_i)^2} \underset{(1.37)}{+ residual_i} \qquad (21)$$

[30] There was an indication of heteroskedasticity in the OLS residuals so White standard errors are used to calculate the t-ratios in parentheses.

The coefficients are similar to equation (20), although (21) implies higher elasticities of the poverty line to mean consumption.[31] At the mean ln$y$ of the new sample of African countries, the elasticity of the poverty line to mean consumption implied by (21) is 0.23, while that implied by (20) is 0.01 at the same value of ln$y$. If one drops the squared term from (21), the elasticity is 0.35, and is significant at the 2% level (t=2.51). South Africa appears to be an outlier in this relationship however; it is 2.5 standard errors above the regression line and also has both the highest poverty line and mean consumption. Dropping South Africa from the sample gives an elasticity of 0.27, but this is only significantly different from zero at the 8% level (t=1.83).

Explaining figure 5

How might the SPL approach help us understand Figure 5? Let the subjective minimum income of a person with actual income y be

$$z^* = \varphi(y, m) \tag{22}$$

where y is actual income and m is mean income in an appropriate reference population, such as the fellow citizens of the country in which the person lives. I assume that the function φ is smoothly increasing in y with a positive lower bound at zero and finite upper bound as y goes to infinity, as required for the existence of the SPL, defined by the unique fixed point:

$$z = \varphi(z, m) \tag{23}$$

which shows how the income poverty line should vary with mean income. Let η denote the elasticity of the income poverty line with respect to the mean holding the utility poverty line constant. On differentiating (20) with respect to m and re-arranging one finds that:

$$\eta \equiv \frac{\partial \ln z}{\partial \ln m} = \frac{1}{1 - \varphi_y(z, m)} \cdot \frac{\partial \ln \varphi(z, m)}{\partial \ln m} \tag{24}$$

As long as the individual subjective minimum income is strictly increasing in the mean at the SPL, the latter will also be an increasing function of the mean. However, the above formula also reveals a multiplier effect. Under the above assumptions, it clearly must be the case that $1/[1-\varphi_y(z, m)] > 1$. Thus the average-income elasticity of the SPL will be greater than the income elasticity of the individual subjective minimum at the SPL.

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[31] The standard errors are also higher than for equation (20); indeed, at the 1% level one cannot reject the null that the coefficients are jointly zero. (Though one can reject is at the 5% level; the F-statistic is 5.42.) The R^2 has dropped from 0.89 for equation (20) to 0.34 for equation (21). This deterioration in fit is not surprising, however, given that we have dropped so many of the middle and high income countries in Figure 5.

It can now be seen that there are two ways in which the average-income elasticity of the SPL can differ between "poor" and "rich" countries. One way is if the income elasticity of individual subjective minimums (in a neighborhood of the SPL) tends to be lower for poor countries. The other way is that the multiplier could be lower.

We do not yet have a theory for explaining Figure 5, since one cannot determine whether η will increase with mean income from the assumptions made so far. That will clearly also depend on properties of the second derivatives of the subjective minimum income. On log differentiating η with respect to m one obtains

$$\frac{d\ln\eta}{d\ln m} = 1 - \eta + \frac{\partial\ln\varphi_m}{\partial\ln m} + 2\eta\frac{\partial\ln\varphi_m}{\partial\ln y} + \frac{\varphi_y\eta}{1-\varphi_y}\frac{\partial\ln\varphi_y}{\partial\ln y} \qquad (25)$$

So a sufficient condition for the pattern revealed in Figure 5 is that the first derivatives of φ tend to be increasing in the mean and in actual income, in a neighborhood of the SPL. Notice, however, that it is entirely possible to have the individual subjective poverty line behaving as in Figure 5, being concave in actual income ($\varphi_{yy} < 0$) yet find that the income elasticity of the SPL rises with mean income i.e., that the expression in the above equation is positive, which (as can be seen) depends on more than just the sign of φ_{yy}.

This takes us some way toward understanding why poorer countries tend to have lower real poverty lines, and a lower elasticity of the poverty line to the mean, as in Figure 5. What lessons might this hold for drawing the line at different times for the same country?

Implications for setting poverty lines over time

It might be tempting to conclude from Figure 5 that poverty lines in a given country should also move over time in the same way. That would be a big step however, since there is no time series evidence in Figure 5. Comparisons of poverty lines across countries will not be a valid basis for inferring changes over time within countries if there are country-level fixed effects in the poverty lines–fixed effects which are correlated with mean income. That possibility cannot be ruled out easily. Indeed, countries as different as the U.S., India and Indonesia–all three of which have been monitoring poverty over periods of 20 or more years and have seen a positive trend rate of growth in average income–have been using constant real poverty lines over time (with nominal lines updated according to a consumer price index). That practice has been questioned in discussions within each of these countries; there is evidently some degree of pressure to raise the real value of the line. Evidently too, however, the process is slow, and it appears to be difficult to form a consensus around how the adjustment should be made. Nor is it at all clear that the real value of the poverty line should fluctuate with relatively small and short-lived movements in average income; a short spurt of growth will surely not call for an upward revision to the line, and it would seem quite questionable to lower the line in recessions.

It can be agreed that a sustained increase in average living standards is likely to lead eventually to more generous perceptions of what "poverty" means in a given society. Possibly Figure 5 is tracing out this long term effect in a rough sort of way. However, it does not seem plausible that people adjust their own subjective poverty lines from year-to-year, with fluctuations (in either direction) in the country's average income, at a given value of their own income. So it would seem far more problematic to go from Figure 5 to a mechanical year-to-year adjustment to the real poverty line.

Conclusions

The practices of poverty measurement go beyond attempts to approximate a well-defined theoretical ideal supplied by economic theory. They also attempt to confront some fundamental problems about the "ideal". Economic theory has been singularly uninformative about the choice of the reference utility level for interpersonal welfare comparisons, including constructing cost of living indices. And theory also tells us that there is an equally fundamental problem of identifying a utility-consistent money metric of welfare from the demand behavior of heterogeneous consumers.

The practices used in drawing poverty lines can be interpreted as ways of expanding the information set typically postulated in economics. Objective methods often draw on information from outside economics on the commodities needed for maintaining normative activity levels appropriate to participation in society; focusing on "capabilities" this way can help greatly in identifying a reference utility level for defining poverty. Subjective methods extend the information base in another direction, namely by drawing on self-reported perceptions of welfare adequacy. Neither group of methods demands that everyone at the poverty line will actually attain these (objective or subjective) norms. The welfare indicator is typically not the actual attainment of the norm, but rather having the minimum income which allows its attainment.

Debates over poverty lines have arisen in large part from disagreements about what the underlying welfare indicator should be (either at a conceptual level, or in its empirical implementation). For example, it is unlikely that one of the most common methods used to anchor the poverty line to nutritional requirements–whereby it is insisted that people living at the poverty line at a given place or date will in fact attain the stipulated food energy intake in expectation–will produce a poverty profile which is consistent in terms of a measure of real income, in that two households with the same command over commodities are treated the same way. Having decided on a welfare indicator, there is however a compelling case for consistency in terms of that indicator, whereby the poverty line at any place or date has the same value in terms of that indicator.

We have seen that there are a number of parameters in any objective poverty line, including the precise composition of the bundle of goods used. (Even when anchored to fixed nutritional requirements, there are infinitely many food bundles which can assure that those requirements are met.) It is my experience that those parameters are typically chosen (explicitly or otherwise) to accord with perceptions of what "poverty" means in a given country, such that people living below the line in that country will typically perceive themselves to be poor, while those above it will not.

To the extent that there is a reasonably well-defined concept of what "poverty" means in a given country, the parameters of the objective poverty line can be chosen appropriately. Arguably then, what one is doing in setting an objective poverty line in a given country is attempting to estimate the country's underlying "subjective poverty line". A close correspondence between subjective and objective poverty lines can then be expected, though arguably it is the subjective poverty line which can then claim to be the more fundamental concept for poverty analysis. Attempts to anchor the poverty line to perceptions of welfare have been relatively rare in developing countries. However, this method has showed promise in developed country applications, and the methods discussed in this paper for adapting the method to developing country settings would appear to open up many potential applications in the future.

An absolute poverty line, fixed in terms of welfare, may still rise with average income if individual welfare depends on both "own income" and income relative to others in the society. Compilations of country-level data suggest that richer countries have higher poverty lines, and that the elasticity of the poverty line to the mean rises as average income rises, starting from a value of roughly zero for the poorest countries. This is consistent with the view that relative income is valued more highly as average income rises, and is least important in the poorest countries where absolute income levels are (understandably) the main consideration of poor people. It also suggests that, with sustained growth, one should not be surprised to see changes in what poverty means in poor countries, entailing higher real poverty lines.

However, this is not a compelling reason for making year-to-year adjustments to the real value of the poverty line according to growth or contraction in average income. A good harvest is unlikely to raise social perceptions of what poverty means, and a drought would surely not lower them. While there is much about drawing the line that remains contentious, the common practice of only adjusting it for cost-of-living differences over time and space (ideally using an index appropriate to the poor) is not thrown into serious doubt by finding that richer countries tend to have higher real poverty lines than poorer ones.

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