3 Welfare, poverty, and distribution

One of the main reasons for collecting survey data on household consumption and income is to provide information on living standards, on their evolution over time, and on their distribution over households. Living standards of the poorest parts of the population are of particular concern, and survey data provide the principal means for estimating the extent and severity of poverty. Consumption data on specific commodities tell us who consumes how much of what, and can be used to examine the distributional consequences of price changes, whether induced by deliberate policy decisions or as a result of weather, world prices, or other exogenous forces. In this chapter, I provide a brief overview of the theory and practice of welfare measurement, including summary measures of living standards, of poverty, and of inequality, with illustrations from the Living Standards Surveys of Côte d'Ivoire from 1985 through 1988 and of South Africa in 1993. I also discuss the use of survey data to examine the welfare effects of pricing and of transfer policies using as examples pricing policy for rice in Thailand and pensions in South Africa.

The use of survey data to investigate living standards is often straightforward, requiring little statistical technique beyond the calculation of measures of central tendency and dispersion. Although there are deep and still-controversial conceptual issues in deciding how to measure welfare, poverty, and inequality, the measurement itself is direct in that there is no need to estimate behavioral responses nor to construct the econometric models required to do so. Instead, the focus is on the data themselves, and on the best way to present reliable and robust measures of welfare. Graphical techniques are particularly useful and can be used to describe the whole distribution of living standards, rather than focussing on a few summary statistics. For example, the Lorenz curve is a standard tool for charting inequality, and in recent work, good use has been made of the cumulative distribution function to explore the robustness of poverty measures. For other questions it is useful to be able to display (univariate and bivariate) density functions, for example when looking at two measures of living standards such as expenditures and nutritional status, or when investigating the incidence of price changes in relation to the distribution of real incomes. While cross-tabulations and histograms are the traditional tools for charting densities, it is often more informative to calculate nonpara-
metric estimates of densities using one of the smoothing methods that have recently been developed in the statistical literature. One of the purposes of this chapter is to explain these methods in simple terms, and to illustrate their usefulness for the measurement of welfare and the evaluation of policy.

The chapter consists of three sections. Section 3.1 is concerned with welfare measurement, and Section 3.3 with the distributional effects of price changes and cash transfers. Each section begins with a brief theoretical overview and continues with empirical examples. The techniques of nonparametric density estimation are introduced in the context of living standards in Section 3.2 and are used extensively in Section 3.3 This last section shows how regression functions—conditional expectations—can often provide direct answers to questions about distributional effects of policy changes, and I discuss the use of nonparametric regression as a simple tool for calculating and presenting these regression functions.

3.1 Living standards, inequality, and poverty

Perhaps the most straightforward way to think about measuring living standards and their distribution is a purely statistical one, with the mean, median, or mode representing the central tendency and various measures of dispersion—such as the variance or interquartile range—used to measure inequality. However, greater conceptual clarity comes from a more theoretical approach, and specifically from the use of social welfare functions as pioneered by Atkinson (1970). This is the approach that I follow here, beginning with social welfare functions, and then using them to interpret measures of inequality and poverty.

Social welfare

Suppose that we have decided on a suitable measure of living standards, denoted by \( x \); this is typically a measure of per capita household real income or consumption, but there are other possibilities, and the choices are discussed below. We denote the value of social welfare by \( W \) and write it as a nondecreasing function of all the \( x \)'s in the population, so that

\[
W = V(x_1, x_2, \ldots, x_N)
\]

where \( N \) is the population size. Although our data often come at the level of the household, it is hard to give meaning to household or family welfare without starting from the welfare of its members. In consequence, the \( x \)'s in (3.1) should be thought of as relating to individuals, and \( N \) to the number of persons in the population. The issue of how to move from household data to individual welfare is an important and difficult one, and I shall return to it.

It is important not to misinterpret a social welfare function in this context. In particular, it should definitely not be thought of as the objective function of a government or policymaking agency. There are few if any countries for which the maximization of (3.1) subject to constraints would provide an adequate description of the political economy of decisionmaking. Instead, (3.1) should be seen as a statistical "aggregator" that turns a distribution into a single number that provides an overall judgment on that distribution and that forces us to think coherently about welfare and its distribution. Whatever our view of the policymaking process, it is always useful to think about policy in terms of its effects on efficiency and on equity, and (3.1) should be thought of as a tool for organizing our thoughts in a coherent way.

What is the nature of the function \( V \), and how is it related to the usual concepts? When \( V \) is increasing in each of its arguments, social welfare is greater whenever any one individual is better-off and no one is worse-off, so that Pareto improvements are always improvements in social welfare. For judging the effects of any policy, we shall almost always want this Pareto condition to be satisfied. However, as we shall see, it is often useful to think about poverty measurement in terms of social welfare, and this typically requires a social welfare function that is unresponsive to increases in welfare among the nonpoor. This case can be accommodated by weakening the Pareto condition to the requirement that \( V \) be nondecreasing in each of its arguments.

Social welfare functions are nearly always assumed to have a symmetry or anonymity property, whereby social welfare depends only on the list of welfare levels in society, and not on who has which welfare level. This makes sense only if the welfare levels are appropriately defined. More income does not translate into the same level of living at different price levels, and a large household can hardly be as well-off as a smaller one unless it has more money to spend. I shall return to this issue below, when I discuss the definition of \( x \), and in Chapter 4, when I discuss the effects of household composition on welfare.

Finally, and perhaps most importantly, social welfare functions are usually assumed to prefer more equal distributions to less equal ones. If we believe that inequality is undesirable, or equivalently that a gift to an individual should increase social welfare in (3.1) by more when the recipient is poorer, then for any given total of \( x \)—and ignoring any constraints on feasible allocations—social welfare will be maximized when all \( x \)'s are equal. (Note that policies that seek to promote equality will often have incentive effects, so that a preference for equality is not the same as a claim that equality is desirable once the practical constraints are taken into account.) Equity preference will be guaranteed if the function \( V \) has the same properties as a standard utility function, with diminishing marginal utility to each \( x \), or more formally, when it is quasi-concave, so that when we draw social indifference curves over the different \( x \)'s, they are convex to the origin. Quasi-concavity of \( V \) means that if \( x_1 \) and \( x_2 \) are two lists of \( x \)'s, with one element for each person, and if \( V(x_1) = V(x_2) \) so that the two allocations are equally socially valuable, then any weighted average, \( \lambda x_1 + (1-\lambda)x_2 \) for \( \lambda \) between 0 and 1, will have as high or higher social welfare. A weighted average of any two equally good allocations is at least as good as either. In particular, quasi-concavity implies that social welfare will be increased by any transfer of \( x \) from a richer to a poorer person, provided only that the transfer is not sufficiently large to reverse their relative positions. This is the "principle of transfers," originally proposed by Dal-
Inequality and social welfare

For the purposes of passing from social welfare to measures of inequality, it is convenient that social welfare be measured in the same units as individual welfare, so that proportional changes in all $x$'s have the same proportional effect on the aggregate. This will happen if the function $V$ is homogeneous of degree one, or has been transformed by a monotone increasing transform to make it so. Provided the transform has been made, we can rewrite (3.1) as

\[
W = \mu V \left( \frac{x_1}{\mu}, \ldots, \frac{x_N}{\mu} \right)
\]

where $\mu$ is the mean of the $x$'s. Equation (3.2) gives a separation between the mean value of $x$ and its distribution, and will allow us to decompose changes in social welfare into changes in the mean and changes in a suitably defined measure of inequality. Finally, we choose units so that $V(1,1,\ldots,1) = 1$, so that when there is perfect equality, and everyone has the mean level of welfare, social welfare is also equal to that value.

Since social welfare is equal to $\mu$ when the distribution of $x$'s is perfectly equal, then, by the principle of transfers, social welfare for any unequal allocation cannot be greater than the mean of the distribution $\mu$. Hence we can write (3.2) as

\[
W = \mu (1 - I)
\]

where $I$ is defined by the comparison of (3.2) and (3.3), and represents the cost of inequality, or the amount by which social welfare falls short of the maximum that would be attained under perfect equality. $I$ is a measure of inequality, taking the value zero when the $x$'s are equally distributed, and increasing with disequalizing transfers. Since the inequality measure is a scaled version of the function $V$ with a sign change, it satisfies the principle of transfers in reverse, so that any change in distribution that involves a transfer from rich to poor will decrease $I$ as defined by (3.2) and (3.3).

Figure 3.1 illustrates social welfare and inequality measures for the case of a two-person economy. The axes show the amount of $x$ for each of the two consumers, and the point $S$ marks the actual allocation or status quo. Since the social welfare function is symmetric, the point $S'$, which is the reflection of $S$ in the 45-degree line, must lie on the same social welfare contour, which is shown as the line $SS'$. Allocations along the straight line $SCS'$ (which will not generally be feasible) correspond to the same total $x$, and those between $S$ and $S'$ have higher values of social welfare. The point $B$ is the point on the 45-degree line that has the same social welfare as $S$; although there is less $x$ per capita at $B$ than at $S$, the equality of distribution makes up for the loss in total. The amount of $x$ at $B$ is denoted $x^*$, and is referred to by Atkinson as "equally distributed equivalent $x$." Equality is measured by the ratio $OBI/O$, or by $x^*/x$, a quantity that will be unity if everyone has the same, or if the social welfare contours are straight lines perpendicular to the 45-degree line. This is the case where "a dollar is a dollar" whoever receives it so that there is no perceived inequality. Atkinson's measure of inequality, defined by (3.3), is shown in the diagram as the ratio $BCIOC$.

One of the advantages of the social welfare approach to inequality measurement, as embodied in (3.3), is that it precludes us from making the error of interpreting measures of inequality by themselves as measures of welfare. It will sometimes be the case that inequality will increase at the same time that social welfare is increasing. For example, if everyone gets better off, but the rich get more than the poor, inequality will rise, but there has been a Pareto improvement, and most observers would see the new situation as an improvement on the original one. When inequality is seen as a component of social welfare, together with mean levels of living, we also defuse those critics who point out that a focus on inequality misdirects attention away from the living standards of the poorest (see in particular Streeten et al 1981). Atkinson's formulation is entirely consistent with an approach that pays attention only to the needs of the poor or of the poorest groups, provided of course that we measure welfare through (3.3), and not through (negative) $I$ alone. Just to reinforce the point, we might define a "basic-needs" social welfare function to be the average consumption of the poorest five percent of society, $\mu^*$ say. This measure can be rewritten as $\mu (1 - I)$, where $I$ is the inequality measure $1 - \mu^*/\mu$. 
Measures of Inequality

Given this basic framework, we can generate measures of inequality by specifying a social welfare function and solving for the inequality measure, or we can start from a standard statistical measure of inequality, and enquire into its consistency with the principle of transfers and with a social welfare function. The first approach is exemplified by Atkinson’s own inequality measure. This starts from the additive social welfare function

\[(3.4a)\]

\[W = \frac{1}{N} \sum_{i=1}^{N} x_i^{1-\epsilon}, \quad \epsilon \neq 1\]

\[(3.4b)\]

\[\ln W = \frac{1}{N} \sum_{i=1}^{N} \ln x_i, \quad \epsilon = 1.\]

The parameter \(\epsilon > 0\) controls the degree of “inequality aversion” or the degree to which social welfare trades off mean living standards on the one hand for equality of the distribution on the other. In Figure 3.1, social welfare indifference curves are flatter when \(\epsilon\) is small, so that, for the same initial distribution \(S\), the point \(B\) moves closer to the origin as \(\epsilon\) increases.

Atkinson’s social welfare function, which will also prove useful in the tax reform analysis of Chapter 5, has the property that the ratio of marginal social utilities of two individuals is given by the reciprocal of the ratio of their \(x\)’s raised to the power of \(\epsilon\):

\[(3.5)\]

\[\frac{\partial W/\partial x_i}{\partial W/\partial x_j} = \left(\frac{x_j}{x_i}\right)^\epsilon.\]

Hence, if \(\epsilon\) is zero so that there is no aversion to inequality, marginal utility is the same for everyone, and social welfare is simply \(\mu\), the mean of the \(x\)’s. If \(\epsilon = 2\), for example, and \(i\) is twice as well-off as \(j\), then the marginal social utility of additional \(x\) to \(i\) is one-fourth the marginal social utility of additional \(x\) to \(j\). As \(\epsilon\) tends to infinity, the marginal social utility of the poorest dominates over all other marginal utilities, and policy is concerned only with the poorest. When social welfare is the welfare of the poorest, which is what \(3.4\) becomes as \(\epsilon\) tends to infinity, social preferences are sometimes said to be maximin (the object of policy is to maximize the minimum level of welfare) or Rawlsian, after Rawls (1972). Thinking about relative marginal utilities according to \(3.5\) is sometimes a convenient way of operationalizing the extent to which one would want poor people to be favored by policies or projects.

The inequality measure associated with \(3.4\) are, when \(\epsilon \neq 1\),

\[(3.6a)\]

\[I = 1 - \left(\frac{\frac{1}{N} \sum_{i=1}^{N} x_i^{1-\epsilon}}{\frac{1}{N} \sum_{i=1}^{N} x_i^{-\epsilon}}\right)^{1/(1-\epsilon)}\]

and, when \(\epsilon = 1\), the multiplicative form

\[(3.6b)\]

\[I = 1 - \prod_{i=1}^{N} \left(\frac{x_i}{\mu}\right)^{\mu N}.\]

These expressions are obtained by raising social welfare to the power of \(1/(1 - \epsilon)\), which makes the function homogeneous of the first degree, and then following through the procedures of the previous subsection. In line with the interpretation of \(\epsilon\) as an aversion or perception parameter, there is no (perceived) inequality when \(\epsilon\) is zero, no matter what the distribution of the \(x\)’s. Conversely, if \(\epsilon > 0\) and one person has all but a small amount \(\alpha\), say, with \(\alpha\) spread equally over the others, then \(I\) tends to one as the number of people becomes large. Values of \(\epsilon\) above 0 but below 2 appear to be useful, although in applications, it is often wise to look at results for a range of different values.

We may also choose to start from the standard measures of inequality. Provided these satisfy the principle of transfers, they will be consistent with Atkinson’s approach, and will each have an associated social welfare function that can be recovered by applying \(3.3\). Some statistical measures of inequality do not satisfy the principle of transfers. The interquartile ratio—the 75th percentile less the 25th percentile divided by the median—is one such. Transferring \(x\) from a richer to a poorer person in the same quartile group will have no effect on inequality, and a transfer from someone at the bottom quartile to someone poorer will lower the bottom quartile and so will actually increase inequality. Less obviously, it is also possible to construct cases where a transfer from a better-off to a poorer person will increase the variance of logarithms. However, this can only happen when both people are far above the mean—which may not be relevant in some applications—and the other conveniences of the log variance may render it a competitive inequality measure in spite of this deficiency.

Other standard measures that \(do\) satisfy the principle of transfers are the Gini coefficient, the coefficient of variation, and Theil’s “entropy” measure of inequality. The Gini coefficient if often defined from the Lorenz curve (see below), but can also be defined directly. One definition is the ratio of the mean of half the average over all pairs of the absolute deviations between people; there are \(N(N-1)/2\) distinct pairs in all, so that the Gini is

\[(3.7a)\]

\[\gamma = \frac{1}{\mu N(N-1)/2} \sum_{i \neq j} x_j - x_i.\]

Note that when everyone has the same, \(\mu\), the Gini coefficient is zero, while if one person has \(N\mu\), and everyone else zero, there are \(N-1\) distinct nonzero absolute differences, each of which is \(N\mu\), so that the Gini is 1. The double sum in \(3.7a\) can be expensive to calculate if \(N\) is large, and an equivalent but computationally more convenient form is

\[(3.7b)\]

\[\gamma = \frac{N+1}{N-1} \frac{2}{N(N-1)\mu} \sum_{i=1}^{N} \rho_i x_i\]

where \(\rho_i\) is the rank of individual \(i\) in the \(x\)-distribution, counting from the top so that the richest has rank 1. Using \(3.7b\), the Gini can straightforwardly and rapidly be calculated from microeconomic data after sorting the observations. I shall give examples below, together with discussion of how to incorporate sample weights, and how to calculate the individual-level Gini from household-level data.
The social welfare function (3.1) transforms the distribution of $x$'s into a single number that can be interpreted as a summary welfare measure that takes into account both the mean of the distribution and its dispersion. However, we are free to choose a function that gives little or no weight to the welfare of people who are well-off, so that social welfare becomes a measure of the welfare of the poor, in other words, a (negative) measure of poverty. In this sense, poverty measures are special cases of social welfare measures. However, in practical work, they serve rather different purposes. Poverty measures are designed to count the poor and to diagnose the extent and distribution of poverty, while social welfare functions are guides to policy. Just as the measurement of social welfare can be an inadequate guide to poverty, so are poverty measures likely to be an inadequate guide to policy.

As far as measurement is concerned, what separates the social welfare from the poverty literatures is that, in the latter, there is a poverty line, below which people are defined as poor, and above which they are not poor. In the language of social welfare, this effectively assigns zero social welfare to marginal benefits that accrue to the nonpoor, whereas the inequality literature, while typically assigning greater weight to benefits that reach lower in the distribution, rarely goes so far as assigning zero weight to the nonpoor. While the simplicity of a poverty line concept has much to recommend it, and is perhaps necessary to focus attention on poverty, it is a crude device. Many writers have expressed grave doubts about the idea that there is some discontinuity in the distribution of welfare, with poverty on one side and lack of it on the other, and certainly there is no empirical indicator—income, consumption, calories, or the consumption of individual commodities—where there is any perceptible break in the distribution or in behavior that would provide an empirical basis for the construction of a poverty line.

Even when there exists an acceptable, readily comprehensible, and uncontroversial line, so that we know what we mean when we say that a percent of the population is poor, we should never minimize this measure as an object of policy. The poverty count is an obviously useful statistic, it is widely understood, and it is hard to imagine discussions of poverty without it. However, there are policies that reduce the number of people in poverty, but which just as clearly decrease social welfare, such as taxes on very poor people that are used to lift the just-poor out of poverty. Similarly, a Pareto-improving project is surely socially desirable even when it fails to reduce poverty, and it makes no sense to ignore policies that would improve the lot of those who are poor by many definitions, but whose incomes place them just above some arbitrary poverty line.

**The construction of poverty lines**

Without an empirical basis such as a discontinuity in some measure, the construction of poverty lines always involves arbitrariness. In developed countries where most people do not consider themselves to be poor, a poverty line must be below the median, but different people will have different views about exactly how much money is needed to keep them out of poverty. Almost any figure that is reasonably

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In developing countries, attention is often focussed less on social welfare and inequality than on poverty. Indeed, poverty is frequently seen as the defining characteristic of underdevelopment, and its elimination as the main purpose of economic development. In such a context, it is natural for welfare economics to have a poverty focus. Even so, and although the poverty measurement literature has developed in a somewhat different direction, the social welfare function approach of this section is quite general, and as we have already seen, can readily accommodate a preference and measurement structure that is focusses attention exclusively towards the poor.
central within the distribution of these views will make an acceptable poverty line. The official poverty line in the United States evolved from work in the earlier 1960s by Orshansky (1963, 1965) who took the cost of the U.S. Department of Agriculture’s “low-cost food plan” and multiplied it by three, which was the reciprocal of the average food share in the Agriculture Department’s 1955 household survey of food consumption.

While such a procedure might seem to be empirically well-grounded—and the perception that it is so has been important in the wide and continuing acceptance of the line—it is arbitrary to a considerable extent. The food plan itself was only one of several that were adapted by nutritional “experts” from the food consumption patterns of those in the lowest third of the income range in the 1955 survey, while the factor of three was based on food shares at the mean, not at the median, or at the 40th or the 25th percentile, for all of which a case could be mounted. In fact, Orshansky’s line of a little over $3,000 for a nonfarm family of four was adopted, not because of its scientific foundations, but because her procedure yielded an answer that was acceptably close to another arbitrary figure that was already in informal use within the federal government (see Fisher 1992 for more on the history and development of the U.S. poverty line).

In India, poverty lines and poverty counts have an even more venerable history stretching back to 1938 and the National Planning Committee of the Indian National Congress. The more recent history is detailed in Government of India (1993), from which the following account is drawn. In 1962, “a Working Group of eminent economists and social thinkers” recommended that people be counted as poor if they lived in a household whose per capita monthly expenditure was less than 20 rupees at 1960–61 prices in rural areas, or 25 rupees in urban areas. These “bare minimum” amounts excluded expenditure on health and education, both of which were “expected to be provided by the State according to the Constitution and in the light of its other commitments.” The precise economic and statistical basis for these calculations is not known, although the cost of obtaining minimally adequate nutrition was clearly taken into account, and the difference between urban and rural lines made an allowance for higher prices in the former.

Dandekar and Rath (1971a, 1971b) refined these poverty lines using a method that is still in widespread use. They started from an explicit calorie norm, 2,250 calories per person per day in both urban and rural areas. Using detailed food data from the National Sample Surveys (NSS), they calculated calorie consumption per capita as a function of total household expenditure per capita—the calorie Engel curve—and found that the norms were reached on average at 14.20 rupees per capita per month in rural areas, and 22.60 rupees per capita in urban areas, again at 1960–61 prices. These estimates were further refined by a “Task Force” of the Planning Commission in 1979, who revised the calorie norms to 2,400 in rural areas, and 2,100 in urban areas; the difference comes from the lower rates of physical activity in urban areas. The 28th round (1973–74) of the NSS was then used to estimate regression functions of calories on expenditure, and to convert these numbers to 49.09 rupees (rural) and 56.64 rupees (urban) at 1973–74 prices. These numbers—updated for all-India price inflation—have been the basis for Indian poverty counts since 1979, although the “Expert Group” that reported in 1993 has recommended that allowance be made for interstate variation in price levels.

In poor countries such as India, where food makes up a large share of the budget, and where the concern with poverty is closely associated with concerns about undernutrition, it makes more sense to use food and nutritional requirements to derive poverty lines than it does in the United States. The “low-cost food plan” in the United States can be replaced by something closer to the minimum adequate diet for the country and type of occupation, and because food is closer to three-quarters than a third of the budget, the “multiplier” needed to allow for nonfood consumption is smaller, less important, and so inherently less controversial.

Even so, the calorie-based procedure of setting a poverty line is subject to a number of serious difficulties. First, the minimum adequate calorie levels are themselves subject to uncertainty and controversy, and some would argue that resolving the arbitrariness about the poverty line with a calorie requirement simply replaces one arbitrary decision with another. Second, the concept of a behavioral Engel curve does not sit well with the notion that there is a subsistence level of calories. Suppose, for example, that a household is poor in that its expected calorie intake is conditional on its income is inadequate, but has more than enough to buy the subsistence number of calories if it spent more of its budget on food. It seems that the subsistence number of calories is not really “required” in any absolute sense, or at least that the household is prepared to make tradeoffs between food and other goods, tradeoffs that are not taken into account in setting the line. Third, it is always dangerous to measure welfare using only a part of consumption, even when the part of consumption is as important as is food. When food is relatively cheap, people will consume more—even if only marginally so—and poverty lines will be higher where the relative price of food is higher, even though consumers may be compensated by lower prices elsewhere in the budget.

Badi and Ravallion (1994) have examined this phenomenon in Indonesia. They show that higher food prices in the cities, together with the lower calorie requirements of more sedentary urban jobs, imply that the urban calorie Engel curve is lower than the rural calorie Engel curve. At the same level of consumption, urban consumers consume less calories than do rural consumers. In consequence, a common nutritional standard requires a higher level of calorie in the cities. In the Indonesian case, this results in a poverty line much higher in urban than rural areas that there appears to be more poverty in the former, even though real incomes and real levels of consumption are much higher in the cities.

Once poverty lines are established they often remain fixed in real terms. In the United States, the current poverty line is simply Orshansky’s 1961 poverty line updated for increases in the cost of living. In India, as detailed above, there have been revisions to methodology, but the lines have changed very little in real terms, and a number of studies, such as Bardhan (1973) and Ahsuwalia (1978, 1985), have used poverty lines close to those proposed by Dandekar and Rath in 1971. This constancy reflects a view of poverty as an absolute; poverty is defined by the ability to purchase a given bundle of goods so that the poverty line should remain fixed in real terms. However, not everyone accepts this position, and it can be ar-
gued that poverty lines should move with the general standard of living, although perhaps not at the same rate. Some would argue that poverty is a purely relative phenomenon, defined by current social customs, and that the poor are simply those in the bottom percentiles of the distribution of welfare.

An intermediate view comes from Sen’s (1985, 1992) view of welfare in terms of the capability to function in society. If economic growth means that food is sold with an increased amount of packaging and service built in, in city center stores relocate to suburban areas that cannot be reached on foot, and if urban growth increases the cost and time to travel to work, then a fixed absolute poverty line makes no sense. There is also some relevant empirical evidence that comes from asking people whether they are poor and what the poverty line ought to be (see Mangahas 1979, 1982, 1985, who makes good use of such surveys to assess poverty in the Philippines). In the United States, Gallup polls have regularly asked respondents how much money they would need “to get along,” and more occasionally what they think would be an adequate poverty line. In the 1960s, the mean distances between the latter were close to the official (Orshansky) line, but have since increased in real terms, although not always as fast as has average real disposable income (see Rainwater 1974 and Vaughan 1992). Ravallion (1993) has also examined the cross-country relationship between real gross domestic product (GDP) and poverty lines, and found that the elasticity is close to unity. While many people—including this author—are uncomfortable with an entirely relative concept of poverty, it is surely right that there should be some movement of the line in response to changes in mean levels of living.

The conceptual and practical difficulties over the choice of a poverty line mean that all measures of poverty should be treated with skepticism. For policy evaluation, the social welfare function is all that is required to measure welfare, including an appropriate treatment of poverty. While it is possible—and in my view desirable—to give greater weight to the needs of the poorest, I see few advantages in trying to set a sharp line, below which people count and above which they do not. Poverty lines and poverty counts make good headlines, and are an inevitable part of the policy debate, but they should not be used in policy evaluation. Perhaps the best poverty line is an infinite one; everyone is poor, but some a good deal more so than others, and the poorer they are the greater weight they should get in measuring welfare and in policy evaluation.

The concept of a poverty line is deeply embedded in the poverty literature, and measures of poverty are typically based on it. Even so, a good deal of the recent literature on poverty has followed Atkinson (1987) in recognizing that the poverty line is unlikely to be very precisely measured, and trying to explore situations in which poverty measures are robust to this uncertainty. I shall return to this approach below once I have introduced some of the standard measures.

**Measures of poverty**

There are a number of good reviews of alternative poverty measures and their properties, see in particular Foster (1984) and Ravallion (1993), so that I can confine myself here to a brief discussion of the most important measures. The obvious starting point—and the measure most often quoted—is the *headcount ratio*, defined as the fraction of the population below the poverty line. If the line is denoted by $z$, and the welfare measure is $x$, then the headcount ratio is

$$
P_0 = \frac{1}{N} \sum_{i=1}^{N} I(x_i < z)
$$

where $I(\cdot)$ is an indicator function that is 1 if its argument is true and 0 otherwise. The sum of the indicators on the right-hand side of (3.9) is the number of people in poverty, so that $P_0$ is simply the fraction of people in poverty.

It is worth noting that with a change of sign, (3.9) could conceivably be regarded as a social welfare function. It is the average value of a rather strange valuation function in which $x$ counts as $-1$ when it is below the poverty line $z$, and as 0 when it is above $z$. This function is illustrated as the heavy line labeled $P_0$ in Figure 3.2; it is nondecreasing in $x$, so it has some of the characteristics of a utility function, but its discontinuity at the poverty line means that it is not concave. It is this lack of concavity that violates the principle of transfers, and makes it possible to increase social welfare by taking money from the very poor to lift some better-off poor out of poverty.

Even if the poverty line were correctly set, and even if it were acceptable to view poverty as a discrete state, the headcount ratio would be at best a limited measure of poverty. In particular, it takes no account of the degree of poverty, and would, for example, be unaffected by a policy that made the poor even poorer. The
The headcount ratio gives the same measure of poverty whether all the poor are just below a generous poverty line, or whether they are just above an ungenerous level of subsistence. One way of doing better is to use the poverty gap measure

$$P_1 = \frac{1}{N} \sum_{i=1}^{N} \left( 1 - \frac{x_i}{z} \right) 1(x_i \leq z).$$  

According to (3.10), the contribution of individual \( i \) to aggregate poverty is larger the poorer is \( i \). \( P_1 \) can also be interpreted as a per capita measure of the total shortfall of individual welfare levels below the poverty line; it is the sum of all the shortcomings divided by the population and expressed as a ratio of the poverty line itself. Hence if, for example, \( P_1 \) were 0.25, the total amount that the poor are below the poverty line is equal to the population multiplied by a quarter of the poverty line.

It is tempting to think of \( P_1 \) (or at least \( P_1 z \)) as a measure of the per capita “cost” of eliminating poverty, but this is far from being so except in the impractical case where lump-sum taxes and subsidies are possible. Even when tax and subsidy administration is efficient and is not corrupt, redistributive taxes have incentive effects that may render the elimination of poverty neither possible nor desirable given the actual range of feasible policies. This is clearly the case in an economy where everyone is poor, but applies much more widely. Once again, the appropriate way to think about tax systems for poverty alleviation is to go back to the social welfare function (3.1), to make sure that it incorporates the appropriate degree of weighting towards the poor, and to apply the general theory of tax design (see Newbery and Stern 1987 for a general discussion of such problems in the contexts of developing countries, and Chapter 5 below for some of the empirical issues).

The poverty gap measure (3.10) has a number of advantages over the headcount ratio (3.9). In particular, the summand is now a continuous function of \( x \), so that there is no longer a discontinuity in the contribution of an individual to the poverty measure as that individual’s \( x \) passes through the poverty line. When \( x \) is just below \( z \), the contribution to poverty is very small, it is zero when \( x \) equals \( z \), and remains at zero above \( z \). Furthermore the function \( (1 - x/z) 1(x \leq z) \) is convex in \( x \)—although not strictly so—so that the principle of transfers holds—at least in a weak form. As a result, the social welfare interpretation of the poverty gap measure also makes more sense than that of the headcount ratio. The behavior of each individual’s contribution to \( -P_1 \) is illustrated in Figure 3.2 by the piecewise linear function rising from -1 to 0, a value which it retains above \( z \). This function is increasing in \( z \), and is (just) concave, so while social welfare is not altered by transfers among the poor or among the nonpoor, it is no longer possible to increase social welfare by acting as an anti-Robin Hood, taking resources from the poor to give to the rich.

The poverty gap measure will be increased by transfers from poor to nonpoor, or from poor to less poor who thereby become nonpoor. But transfers among the poor have no effect on the measure of poverty, and on this account we may wish to consider other poverty measures. Sen’s (1976b) measure of poverty remedies the defect by incorporating the inequality among the poor. The definition is

$$P_s = P_0 \left( 1 - (1 - \gamma^p) \frac{\mu^p}{z} \right)$$

where \( \mu^p \) is the mean of \( x \) among the poor, and \( \gamma^p \) is the Gini coefficient of inequality among the poor, calculated by treating the poor as the whole population. Note that when there is no inequality among the poor, \( P_s \) reduces to the poverty gap measure \( P_1 \). Conversely, when all but one of the poor has nothing, \( P_s = P_0 \) and the Sen measure coincides with the headcount ratio. More generally, the Sen measure is the average of the headcount and poverty gap measures weighted by the Gini coefficient of the poor,

$$P_s = P_0 \gamma^p + P_1 (1 - \gamma^p).$$

Because Sen’s measure depends on the Gini coefficient, it shares two of its inconveniences. First, the Gini—and thus the Sen index—is not differentiable. Although there is no economic reason to require differentiability, the inability to differentiate is sometimes a nuisance. More seriously, Sen’s measure cannot be used to decompose poverty into contributions from different subgroups, something that is often informative when monitoring changes in poverty. If the aggregate poverty measure can be written as a weighted average of the poverty measures for the rural and urban sectors, or for households by age, or by occupation of the head, then changes over time can be similarly decomposed thus helping to identify groups that are particularly at risk, as well as sometimes pointing to the underlying mechanisms. While decomposability is hardly as fundamental a property as (say) the principle of transfers, it is extremely useful.

Our final poverty measure, or set of measures, comes from Foster, Greer, and Thorbecke (1984). Their measures are direct generalizations of the poverty gap (3.10) and are written, for some positive parameter \( \alpha \),

$$P_\alpha = N^{-1} \sum_{i=1}^{N} (1 - x_i/z)^\alpha 1(x_i \leq z)$$

so that \( P_0 \) and \( P_1 \) are special cases corresponding to values for \( \alpha \) of 0 and 1, respectively. The larger the value of \( \alpha \), the more does the measure penalize the poverty gaps. Most frequently used is \( \alpha = 2 \), which yields a poverty measure like the Sen index that is sensitive to distribution among the poor. The decomposability property of (3.13) follows immediately from its additive structure. In particular, if sectors are denoted by \( s \), and there are \( S \) of them, we can write

$$P_\alpha = N^{-1} \sum_{s=1}^{S} \sum_{j \in s} (1 - x_{ij}/z)^\alpha 1(x_{ij} \leq z) = \sum_{s} (n_s / N) P^s_\alpha$$

where \( n_s \) is the number of people in sector \( s \) and \( P^s_\alpha \) is the Foster, Greer, and Thorbecke index for poverty within the sector. Using (3.14), changes in aggregate poverty can be assigned to changes in sectoral poverty measures \( \alpha \) to changes in the proportion of people in each sector.
The choice of the individual welfare measure

Apart from a brief reference in the context of choosing a poverty line, I have so far avoided discussion of exactly how welfare is to be measured, and what practical concept should replace the x's in the various poverty and inequality formulas. Ideally, we should like a survey based measure that approaches as closely as possible the individual welfare measures of economic theory. Particularly useful here is the concept of money metric utility—see Deaton and Muellbauer (1980a, ch. 7) for an overview—whereby the indifference curves of individual preference orderings are labeled by the amount of money needed to reach them at some fixed set of prices. In order to avoid the specification of a parametric utility function, money metric utility can be approximated by real income or real expenditure, the two leading candidates for practical welfare measures. However, there are other possibilities, indicators of nutritional status being perhaps the most important, and even if we settle on income or expenditures, there are many other questions that have to be settled before going on to compute the measures. In this subsection, I discuss a few of the most important: the choice between consumption and income or other concepts, the choice between individual and household measures, the choice of time period, as well as some data issues, particularly the effects of measurement error and reporting periods.

In the context of measuring welfare in developing countries, there is a very strong case in favor of using measures based on consumption not income. The standard argument—that by the permanent income hypothesis, consumption is a better measure of lifetime welfare than is current income—is much weaker than arguments based on practicality and data. It is unwise to condition a welfare measure on the validity of a hypothesis whose empirical support is at best mixed. In particular and as we shall see in Chapter 6, there is very little evidence from developing countries—or anywhere else—that lifetime consumption profiles are detached from lifetime income profiles as is required if consumption is to be superior to income as an indicator of lifetime welfare. Of course, there is no doubt that households smooth their consumption over shorter periods, certainly days, months, and seasons, and to some extent over runs of years. Income, especially agricultural income, can be extremely variable, and a farmer's income in any month is a poor indicator of living standards in that month. A better case can be made for annual income, but if farmers can even partially smooth out good years and bad, consumption will be the better measure. At the practical level, and as discussed in Section 1.2, the difficulties of measuring income are much more severe than those of measuring consumption, especially for rural households whose income comes largely from self-employment in agriculture. Given also that annual income is required for a satisfactory estimate of living standards, an income-based measure requires multiple visits or the use of recall data, whereas a consumption measure can rely on consumption over the previous few weeks. Note that these arguments are likely reversed if we were dealing with, for example, the United States, where individual consumption surveys are much less developed than income surveys, where a much smaller fraction of the population is self-employed, where seasonality is much less of an issue, and where it is both feasible and economical to obtain accurate estimates of income for most people.

The conversion of nominal measures of consumption to real measures requires a price index. In most cases, there will exist an adequate consumer price index or cost-of-living estimate that can be used to compare data collected in different time periods. In countries with rapid inflation, this may even have to be done within each survey year, since different households are interviewed at different times. What is often more difficult is the comparison of living costs across regions at a given time, for example, when we are trying to compare living standards or poverty rates across different regions. In some surveys—but not typically in the Living Standards Surveys—households are asked to report both quantities and expenditures on a range of goods, particularly foods, and these data can be used to calculate unit values. Although unit values are not the same as prices—an issue that will be discussed in some detail in Chapter 5—accurate price indexes for each region can nevertheless be obtained from the unit values by averaging within regions and calculating a Laspeyres index for each, that is by pricing a fixed bundle of goods at the average unit values for each region. The Living Standards Surveys have usually collected price data, not from households, but from observations on prices in markets used by the households in the survey, and these data can also be used to construct regional price indexes.

Although consumption and income are the standard measures of economic welfare, we will often want to supplement them with other measures of well-being, such as nutritional and health status, life expectancy, and education. While it is possible to consider methods for combining these indicators into a single measure, there is no adequate theory underlying such an aggregate so that weighting schemes are inevitably arbitrary, and it is more informative—as well as honest—to keep the different indicators separate. This is not to downplay the importance of these other indicators, nor to deny that public goods such as hospitals and schools contribute an important part of individual welfare. However, it is important not to confuse the components of economic welfare with their aggregate. We have already seen how the definition of a poverty line in terms of calories can give misleading results when relative prices differ. The same argument applies to attempts to shortcut welfare measurement using indicators such as housing, or the ownership of durable goods. Immigrants to big cities often live in very poor-quality housing in order to have access to employment. In such cases, their poor housing
reflects the high price of housing in urban areas, but may tell us little about their living standards.

Because surveys collect data at the level of the household, and not the individual, poverty and welfare measures must be based on consumption and income totals for the household, not for the individual. Although some surveys collect data on individual earnings, and even on individual income from assets, there is typically a component of household income—a large component in the case of family farms—that is not readily attributable to individual household members. For consumption, the position is even worse. Data on purchases are inevitably purchases for the household as a whole, and although some items—such as food—are conceptually assignable to particular individuals, the cost of observing who eats what is too large for all but specialist nutritional surveys. Even then there are questions about contamination of behavior by the presence of the enumerator during food preparation and family meals. There are also public goods in most households—goods and services the consumption of which by one member of the household does not exclude consumption by others. The consumption of these goods cannot be assigned to specific individuals.

As a result, we can either treat households as the units whose welfare is being measured, or we can use some rule to divide household total expenditure between its members, usually equally or in proportion to some measure of needs, and then treat each individual as the unit in the poverty and welfare calculations. Since it is hard to think of households as repositories for well-being, even in the best case where their membership does not change, as individual basis for measurement is conceptually clearer and is the recommendation carried throughout this book. One difficulty is that the assumption of equal division, or of each according to her or his needs, is bound to underestimate the true dispersion of consumption among individuals, and thus to underestimate inequality and poverty. As pointed out by Haddad and Kanbur (1990), who have also investigated the magnitude of the biases, the assumed equal distribution within the household could be reached from the unknown true one by a system of equalizing transfers, so that any welfare measure that respects the principle of transfers will be overstated (or understated if a poverty measure) using household data.

It is also necessary to recognize that children do not have the same needs as adults. Assigning household PCE to each person gives too little to adults—especially those who do heavy manual work—and too much to children. If there are economies of scale, PCE will understate individual welfare levels, even if all household members are adults. Attempts to do better than PCE measures for individuals are discussed in Chapter 4, where I take up the question of allocation within the household, and the construction of “equivalence scales,” numbers that are the theoretically appropriate deflators to move from household to individual welfare. However, I should point out in advance that the equivalence scale literature is still very far from providing satisfactory answers to these questions, and that the use of household PCE assigned to individuals is still best practice. Even so, it is wise to remain skeptical of estimates that appear to be purely statistical but rely heavily on arbitrary assignments, such as the number of children in poverty, or the average living standards of the elderly. The elderly rarely live by themselves in poor countries, and children do not do so anywhere, so that estimates of their welfare are determined as much by assumption as by measurement and should be treated as such. Measures of the fraction of children in poverty, or of women in poverty, are particularly fragile and international comparisons of such concepts cannot be treated seriously.

The choice of time period, like all of these issues, is partly one of theory and partly one of practicality. In theory, we need to decide the reference period for welfare measurement, whether someone is poor if they go without adequate consumption or income for a week, a month, or a year. The reference period can be shorter for consumption than for income, and if we use income, the choice of reference period will depend on what mechanisms—credit markets, familial support—are available to help people ride out fluctuations in income. In practice, long reference periods require either multiple visits or recall questions; the former are expensive and the latter risk measurement error. Note also that, if poverty and welfare measures are to be comparable across countries or over time, the reference periods must be the same. Because the dispersion of both consumption and income decrease the longer is the reference period, both the extent of inequality and poverty will be larger at short than at long reference periods.

One of the most difficult practical issues in estimating poverty and inequality is to separate genuine dispersion from measurement error. If we start from any distribution of welfare and add measurement errors that have zero mean and are uncorrelated with the true values, the new distribution is a spread-out version of the original one, so that if our measures respect the principle of transfers, measured inequality will be higher and social welfare lower. Poverty measures that satisfy the principle of transfers will also be higher. For the headcount, which does not satisfy the principle, matters are more complicated and measurement error can bias the count in either direction. If the country is wealthy enough for the poverty line to be below the mode, the addition of mean-zero measurement error will cause the measured headcount to overstate the number in poverty, and vice versa. Similarly if we try to assess the persistence of poverty using panel data by seeing who remains in poverty and who escapes it, measurement error will exaggerate the extent of mobility, and make poverty seem less persistent than it is truly the case. In most cases, we have little idea of the magnitude of measurement error, or how much of the variance of consumption or income changes is noise as opposed to signal. However, and bearing in mind the problems of estimating consumption and income in surveys in developing countries, it is always wise to consider the robustness of conclusions to the presence of substantial measurement error.

Example 1. Inequality and poverty over time in Côte d'Ivoire

This subsection applies some of the foregoing concepts to Living Standards data from Côte d'Ivoire for the four years 1985 through 1988, focusing on change over time, while the next subsection uses data from South Africa in 1993 to look at differences by race. The translation of the formulas into numbers is essentially