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Introduction

Richard H. Steckel and Roderick Floud

The changing state of human welfare during industrialization has long been a staple of debate among scholars. Current views on the subject can be traced back to mid-nineteenth-century England, when Marx and Engels claimed that industrialization impoverished the working class, and authors such as Charles Dickens penned tales of woe set in miserable factories, workhouses, and cities. While historians of thought ponder the theoretical structure of marxist philosophy and audiences suffer with Oliver Twist, the arduous work of discovering what actually happened during industrialization has been turned over to economic historians. Students of the quantitative and qualitative history of living standards are advancing knowledge on the subject. They are collecting evidence on the quality of life in the past, exploring mechanisms of causation, and appraising trends, fluctuations, and class differences in welfare.

Although the standard of living debate is liveliest in England, every country that had industrialized by the early twentieth century has been the object of study and review. Economic historians have extended national income series for many countries into the nineteenth century, and the results have been compared with alternative measures of the quality of life. Moreover, new methods and new sources of data have been brought to bear on these questions during the past two decades. Thus, a standard of living debate of some sort exists for each early industrializer. No single study, however, has attempted to assemble evidence, investigate patterns, and draw conclusions on health and welfare in numerous countries.

This volume brings together nine essays that examine a wide range of evidence on health and welfare during industrialization and its aftermath in eight

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countries: the United States, England, Sweden, the Netherlands, France, Germany, Japan, and Australia. The goal is to place the standard of living debate in comparative international perspective by examining several indicators of the quality of life, especially real per capita income and health, but also real wages, education, and inequality. The authors employ traditional measures of health such as life expectancy at birth and mortality rates but make extensive use of vast amounts of data recently collected on stature, which measures nutritional status. The papers also contribute to the standard of living debate within each country. The collection of country studies is introduced by Stanley Engerman's survey, which places the standard of living debate in international perspective.

The value of the project as a whole exceeds the sum of the individual studies because the countries under examination are diverse by region of the world, timing of industrialization, nature of government policy, pace of change, and cultural circumstances. By comparing and contrasting the experiences of these countries from a broad perspective of indicators, it may be possible to generalize about the ways that industrialization influenced human welfare. The number of countries under study is modest, but pronounced patterns can emerge in small samples, and we expect to define a larger research agenda.

It is an open question whether the course of national welfare during the various industrialization experiences was governed largely by idiosyncratic factors and the cumulative influence of historical accidents that affected countries unequally—such as major wars or the acquisition and settlement of new territories—or whether general tendencies and similar causal structures prevailed. Aligning the results for particular countries by time period and by stage of industrialization establishes a common framework for study. From this structure more can be learned about the significance of government policy for the course of economic growth and human welfare, the role of transportation and trade in spreading diseases that were detrimental to welfare, and the ways that public health measures helped offset the undesirable side effects for health created by congested arrangements for living and work.[1]

Methodology

Some differences of opinion in standard of living debates stem from alternative ways of defining the problem. Although material indicators such as per capita income or real wages have predominated, the literature encompasses measures as far ranging as stress on the family and psychological adjustments required for adapting to an urban-industrial way of life. While it is assumed that several of the measures used in this volume are well known (real per capita income, real wages, life expectancy, and literacy) and require no introduction

1. We note that the mechanisms underlying relationships between trade and health and between urbanization and health may have been complex. Both trade and urbanization may have raised incomes, something beneficial per se for health, while spreading disease. In addition, these processes may have had consequences for the distribution of income and health.

or special explanation, this chapter includes a methodology section for readers who may be unfamiliar with anthropometric measures such as stature and the body mass index. In the past two decades numerous studies by economic historians have used stature to investigate health aspects of the standard of living.[2] In addition, the concluding section on health and welfare includes a brief introduction to the problem of welfare assessment using alternative measures.

Anthropometric Measures

There is a long tradition among human biologists and nutritionists of using stature to assess health aspects of human welfare (Tanner 1981). The realization that environmental conditions influenced growth stimulated interest in human growth studies in the 1820s. Auxological epidemiology (auxology is the study of human growth) arose in France, where Villermé studied the stature of soldiers; in Belgium, where Quetelet measured children and formulated mathematical representations of the human growth curve; and in England, where Edwin Chadwick inquired into the health of factory children. Charles Roberts judged the fitness of children for factory employment by using frequency distributions of stature and other measurements, such as weight-for-height and chest circumference. Franz Boas identified salient relationships between the tempo of growth and height distributions and in 1891 coordinated a U.S. national growth study, which he used to develop national standards for height and weight. The twentieth century has witnessed a worldwide explosion of growth studies (Eveleth and Tanner 1976, 1990).

These studies have shown, among many other things, that two periods of intense activity characterize the growth process following birth (Tanner 1978). The increase in height, or velocity, is greatest during infancy, falls sharply, and then declines irregularly into the preadolescent years. During adolescence, velocity rises sharply to a peak that equals approximately one-half of the velocity during infancy then declines rapidly and reaches zero at maturity. The adolescent growth spurt begins about two years earlier in girls than in boys, and during their spurt girls temporarily overtake boys in average height. As adults, males are taller than females primarily because they have approximately two additional years of growth prior to adolescence.

The height of an individual reflects the interaction of genetic and environmental influences during the period of growth (Waterlow and Schürch 1994). According to Eveleth and Tanner (1976, 222),

> Such interaction may be complex. Two genotypes which produce the same adult height under optimal environmental circumstances may produce different heights under circumstances of privation. Thus two children who would be the same height in a well-off community may not only be smaller under poor economic conditions, but one may be significantly smaller than the other. . . . If a particular environmental stimulus is lacking at a time when

2. For the most recent survey of this literature, see Steckel (1995).

it is essential for the child (times known as "sensitive periods") then the child's development may be shunted as it were, from one line to another.

Although genes are important determinants of individual height, studies of genetically similar and dissimilar populations under various environmental conditions suggest that differences in average height across most populations are largely attributable to environmental factors. In a review of studies covering populations in Europe, New Guinea, and Mexico, Malcolm (1974) concluded that differences in average height between populations are almost entirely the product of the environment. Using data from well-nourished populations in several developed and developing countries, Martorell and Habicht (1986) reported that children from Europe or of European descent, from Africa or of African descent, and from India or the Middle East have similar growth profiles. Far Eastern children or adults are an exception that may have a substantial genetic basis; well-off Japanese, for example, reach, on average, the 15th height percentile of the well-off in Britain (Tanner et al. 1982). Important for interpreting stature in the United States is the fact that Europeans and people of European descent and Africans and people of African descent who grew under good nutritional circumstances have nearly identical stature (Eveleth and Tanner 1976, appendix).[3]

Height at a particular age reflects an individual's history of *net* nutrition, or diet minus claims on the diet made by maintenance, work (or physical activity), and disease. The synergy between malnutrition and illness may further reduce the nutrition left over for growth (Scrimshaw, Taylor, and Gordon 1968). Poorly nourished children are more susceptible to infection, which reduces the body's absorption of nutrients. The interaction implies that analyses of stature must recognize not only inputs to health such as diet and medical care but also work effort and related phenomena such as methods of labor organization. Similarly, researchers must attempt to understand ways that exposure to infectious disease may have placed claims on the diet.[4] For example, Sophia Twarog's paper on nineteenth-century Germany in this volume argues that early termination or complete lack of breast-feeding impaired infant health because a nutritious diet (breast milk) was replaced by starchy paps and gruels that were often contaminated or fed with contaminated utensils.[5]

Studies of nutrition and health in the past have identified many instances in which dietary intake was important for health and human growth. Thomas McKeown (1976) has been one of the foremost proponents of the thesis that

3. To compare health status in situations where genetic differences are relevant, stature can be converted into percentiles of the appropriate (ethnic, regional, or country specific) height standards.

4. An alternative view of stature is the "small but healthy" paradigm emphasized by Sukhatme (1982), Seckler (1982), and others, in which it is claimed that many individuals adapt with low costs to nutritional deprivation. For critiques of this view, see James (1987), Martorell (1989), and Dasgupta (1993).

5. Most women in Württemburg did not breast-feed at all, largely for cultural reasons. Those that did (in Schwarzwald Kreis) worked heavily and produced insufficient milk.

improving diets were significant for the long-term decline of mortality rates in nineteenth-century Europe. In this vein, Robert Fogel (1994) estimated that diets in late-nineteenth-century France were so poor that the bottom fifth of the labor force was either incapable of work or could put forth less than three hours of light work per day. Richard Steckel (1986) reported that dietary deficiencies, especially of protein, significantly retarded growth among American slave children while improved access to food stimulated growth among teenagers.

The sensitivity of growth to deprivation depends on the age at which it occurs. For a given degree of deprivation, the adverse effects may be proportional to the velocity of growth under optimal conditions (Tanner 1966). Thus, young children and adolescents are particularly susceptible to environmental insults. The return of adequate nutrition following a relatively short period of deprivation may restore normal height through catch-up growth.[6] If conditions are inadequate for catch-up, individuals may still approach normal adult height by an extension of the growing period by as much as several years. Prolonged and severe deprivation results in stunting, or a reduction in adult size.

Figure 1 is a useful organizing device for exploring the relationship of height to living standard. Stature is a function of proximate determinants such as diet, disease, and work intensity during the growing years, and as such it is a measure of the consumption of basic necessities that incorporates demands placed on one's biological system. Because family income heavily influences purchases of basic necessities such as food and medical care, stature is ultimately a function of access to resources and environmental sanitation. It is noteworthy that stature may be diminished by consumption of products, such as alcohol or drugs, that are harmful to health, but excessive consumption of food, while leading to rapid growth, may impair health in later life. Public health measures, personal hygiene, and the disease environment affect the incidence of disease that places claims on nutrition. In addition, human growth may have functional consequences for health, labor productivity, mental development, and personality, which in turn may influence socioeconomic conditions.

Numerous sources of evidence exist for stature, including records on military recruits, slaves, convicts, and Southern oath takers who swore allegiance to the Union. Among these, the military records are the most abundant and widely used in this volume, but good use is also made of data about schoolchildren, convicts, and national guardsmen. Minimum height standards, age and height heaping, ethnic differences in growth potential, and selectivity biases among those measured complicate the interpretation of stature from these sources, but researchers have devised techniques to address these problems. For example, volunteer armies often applied minimum height standards that varied with personnel needs, but flexible enforcement of the standards eroded

6. Ingestion of toxic substances, such as alcohol or tobacco, in utero or in early childhood may create permanent stunting regardless of subsequent nutritional conditions.

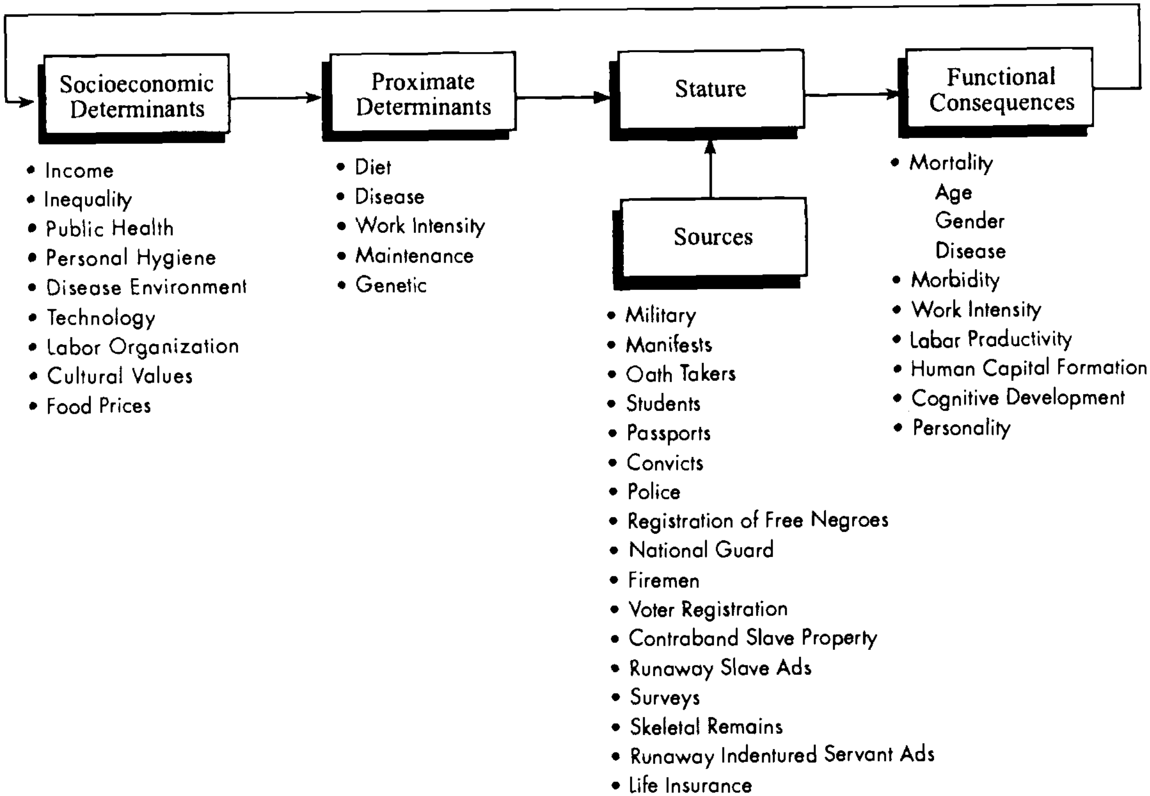

Fig. 1 Relationships involving stature

the lower tail of the height distribution. Assuming that the underlying distribution was normal, or Gaussian, Wachter and Trussell (1982) devised techniques such as the Quantile Bend Estimator and the Reduced-Sample Maximum Likelihood Estimator to identify the height below which standards were applied and to compensate for those omitted. In situations where normality may not hold, such as small samples (less than a few hundred observations), Komlos and Kim (1990) proposed a restricted sample estimator based on the mean estimated from the upper portion of the distribution unaffected by changes in height minimums. These techniques are unnecessary in the case of conscript armies, in which all or nearly all the young-adult male population was measured. The papers in this volume on Sweden (Sandberg and Steckel) and on France (Weir) utilize conscript records, which also have the advantage of nearly complete representation of the male population and its various socioeconomic classes and geographic divisions.

Heaping, or concentrations of measurements at whole feet or meters, at even-numbered ages or units, and at ages or units ending in zero plagues many data sources, including some modern studies. Simulations suggest that these problems were relatively minor for estimates of sample means, primarily because their effects are largely self-canceling (Fogel et al. 1983). Rounding by the U.S. military during World War II probably biased average heights by approximately 0.5 cm below the actual mean. In any event, rounding practices that were uniform over time and across space would not distort comparisons of relative height averages. In addition, smoothing techniques help to overcome heaping irregularities that contaminate the picture of the growth profile.

After such measurement issues have been dealt with, it is possible to compare stature with other indicators. Because real GNP per capita is the most widely used indicator of living standards, it is particularly useful to compare and contrast this measure with stature (Steckel 1983, 1995; Floud 1994). Income is a potent determinant of stature that operates through diet, disease, and work intensity, but one must recognize that other factors such as personal hygiene, public health measures, and the disease environment affect illness, while work intensity is a function of technology, culture, and methods of labor organization.[7] In addition, the relative price of food, cultural values such as the pattern of food distribution within the family, methods of food preparation, and tastes and preferences for foods may also be relevant for net nutrition. Yet influential policymakers view higher incomes for the poor as the most effective means of alleviating protein-energy malnutrition in developing countries

7. Empirical models of the relationship between a country's per capita GNP and average height are discussed below. More elaborate models would consider a lagged relationship between income and stature, both at the household and the aggregate (national) level. E.g., adult stature is a function of average income in each year from conception to maturity, and growth is more sensitive to income levels at ages when growth is ordinarily high, i.e., during early childhood and adolescence. For an application of this idea, see Brinkman, Drukker, and Slot (1988).

(World Bank 1993, 75).[8] Extremely poor families may spend two-thirds or more of their income on food, but even a large share of their very low incomes purchases inadequate calories. Malnutrition associated with extreme poverty has a major impact on height, but at the other end of the income spectrum expenditures beyond those needed to satisfy calorie requirements purchase largely variety, palatability, and convenience.

Gains in stature associated with higher income are not limited to developing countries. Within industrialized countries, height rises with socioeconomic class (Eveleth and Tanner 1990, 199). These differences in height are related to improvements in diet, reductions in physical workloads, reduced exposure to pathogens (through sewage disposal, cleaner water supply, and improved housing), and better health care. Expenditures on health services rise with income, and there is a positive relationship between health services and health (Fuchs 1972).

At the individual level, extreme poverty results in malnutrition, retarded growth, and stunting. Higher incomes enable individuals to purchase a better diet, and height increases correspondingly; but once income is sufficient to satisfy caloric requirements, individuals often consume foods that also satisfy many vitamin and mineral requirements. Height may continue to rise with income because individuals purchase a more complete diet or better housing and medical care. As income increases, consumption patterns change to realize a larger share of genetic potential, but environmental variables are powerless after individuals attain the maximum capacity for growth.[9] The limits to this process are clear from the fact that people who grew up in very wealthy families are not physical giants.

While the relationship between height and income is nonlinear at the individual level, the relationship at the aggregate level depends on the distribution of income. Average height may differ for a given per capita income depending on the fraction of people with insufficient income to purchase an adequate diet or to afford medical care. Because the gain in height at the individual level increases at a decreasing rate as a function of income, one would expect average height at the aggregate level to rise, for a given per capita income, with the degree of equality of the income distribution (assuming that there are people who have not reached their genetic potential).

The empirical relationship between average height and per capita income has been studied by linking data from late-twentieth-century national height studies with per capita GNP. Despite the large number of factors that may influence average height at a given level of per capita income, the simple correlations between a country's average height and the logarithm of its per capita

8. Development economists have debated the effects of income on the diets of the poor. See Behrman and Deolalikar (1987).

9. Of course, it is possible that higher incomes could purchase products such as alcohol, tobacco, or drugs that impair health.

income are in the range of 0.82 to 0.88 (Steckel 1983, 1995).[10] Regression estimates of height on per capita income and other variables indicate that the elasticity of height with respect to the log of per capita income (at sample means) is 0.27 for adolescents and 0.19 for adults, and the elasticity of height with respect to the Gini coefficient (at sample means) is −0.041 for adolescents and −0.086 for adults.

A strong association between stature and per capita income also existed a century earlier. In a study of European countries in the late nineteenth and early twentieth centuries, Floud (1994) found a height-income relationship similar to that observed in more recent data. Although the height-income relationship has been less well studied in eras before the late nineteenth century, the available evidence points to diverse outcomes, including a strong association (see papers in this volume by Weir on France, by Drukker and Tassenaar on the Netherlands, and by Honda on Japan), a weak relationship, and possibly a negative correlation. Certainly counterexamples (countries with populations taller than their income alone would suggest) can be found, including Ireland in the early nineteenth century and America in the late colonial and early national periods (Mokyr and Ó Gráda 1988; Nicholas and Steckel 1992; Costa and Steckel, chap. 2 in this volume). It has also been noted that taller populations of the eighteenth and nineteenth centuries tended to live in rural, isolated, and less commercial regions (Komlos 1989; Sandberg and Steckel 1988; Shay 1986; Margo and Steckel 1983). Given that a nonlinear relationship between height and income has been found in the past century and that the height-income relationship could shift over time, we conclude that heights and income measure different but related aspects of the quality of life.

Stature is only one of several biological indicators of nutritional status. Medical researchers have shown that relative body weight is a useful predictor of illness and mortality risks (James and Ralph 1994). Although investigators use various measures of weight to height, including weight divided by height and weight divided by the cube of height, the most widely used measure is the body mass index (BMI). Defined as weight in kilograms divided by the square of height in meters, BMI is easy to calculate and highly correlated with other indicators of obesity such as skinfold thickness (Keys et al. 1972).

Height and BMI measure different aspects of nutritional status. Stature measures the history of net nutrition from conception to the time of measurement (in the case of a child) or until the age that adult height was attained. In contrast, BMI reflects current levels of nutrition since the numerator (weight) may change rapidly relative to the denominator (height). BMI is similar to stature, however, in that it reflects the balance between dietary intakes and claims on those intakes made by maintenance, work, and disease.

10. The log specification fits about as well as a quadratic or cubic polynomial, and given these results the log is preferred on grounds of simplicity.

The value of height and weight in forecasting health has been established in longitudinal studies of child growth in developing countries (Martorell 1985). In two West African villages, children who died were significantly smaller and lighter than the survivors (Billewicz and McGregor 1982). Consistent with these studies, Gerald Friedman (1982) reported that shorter slaves were more at risk of death in Trinidad. Adult BMI is also a useful indicator of the chances of developing chronic diseases later in life. A Norwegian study of adult men shows that the mortality risk was a U-shaped function of BMI, where men whose BMI was in the range 21–29 had the lowest chances of death (Waaler 1984). A similar U-shaped pattern between BMI and subsequent mortality risk applied to Union Army veterans (Costa 1993). The paper in this volume by Costa and Steckel investigates the relationship between BMI and health in the United States during the late nineteenth and early twentieth centuries.

Health and Welfare

Real per capita income remains, however, the most widely used measure of the standard of living. With conceptual origins in the seventeenth century, national income accounts became generally available only in the mid-twentieth century when the Great Depression and World War II created needs for evaluating policy and planning military efforts. Although economists recognize the great contributions of the national accounts, current research momentum has shifted to alternatives or supplements that address shortcomings of per capita income as a welfare measure or that provide insights into the quality of life in time periods or among groups for which conventional measures cannot be calculated.

When national income accounting methodology emerged as an important subject in the 1930s, economists such as Kuznets (1941), Davis (1945), and Bennett (1937) urged the creation of welfare measures that would reflect the satisfaction of consumers. In particular, Kuznets proposed several refinements to GNP that would incorporate nonmarket activities, occupational costs, leisure, costs of urban living, and inequality. However, the emergency created by the Great Depression did not allow time to ponder carefully or incorporate these refinements. Policymakers understandably gave high priority to rapid deployment of a system of accounts that would be helpful in designing policies to combat the number one problem, unemployment. Thus, the Commerce Department adopted a narrow approach to the standard of living by focusing on the value of final goods and services.

A revival of interest in social accounting occurred in the 1970s, when urban sprawl, pollution, congestion, and crime stimulated interest in broad welfare measures. Seeking a better measure of consumption or welfare, Nordhaus and Tobin (1973) adjusted GNP for capital services, leisure, nonmarket work, and disamentities. Others extended these ideas to international comparisons using inequality as an ingredient in welfare (Kakwani 1981). International organizations and economists, concerned with the slow progress of the poor in developing countries, proposed a basic human needs approach to living standards that advocated minimum amounts of food, clothing, shelter, water, and sanitation (Adelman and Morris 1973; Chenery et al. 1974).

The papers in this volume utilize some of these new approaches to assessing welfare, which will be grouped for purposes of discussion into multiple indicators and adjustments to GNP. There is no general agreement within the profession on the suitability of alternative approaches, and here we do not attempt to resolve these larger questions. Instead, the papers try various methods employed in the literature and compare their implications. For example, in the cases of Sweden and France all indicators of the standard of living rose during industrialization, which leaves little doubt that the quality of life improved for the vast majority of people. Other countries, such as the United States and the United Kingdom, experienced cycles or fluctuations in some indicators, which raises questions about methods and weights in drawing conclusions about the course of welfare. In these cases, summary statements about the direction and extent of welfare change require an explicit scheme for weighting the indicators.

A multiple indicator approach to the standard of living has a tradition within the United Nations. By the 1950s, the United Nations had outlined a component approach that included indicators such as nutrition, health, consumption, and housing (United Nations 1954). This method recognizes the difficulty and complexity of measuring the quality of life and accepts the shortcomings of any single indicator. All the papers in this volume utilize the multiple indicator approach, and some authors supplement their analyses with additional methods. Standard indicators such as per capita GDP, life expectancy, stature, and literacy are widely used, but several papers also use measures such as meat consumption and urbanization. Several papers make use of the Human Development Index, discussed below, but some authors prefer a general discussion of indicators over an explicit weighting scheme.

The United Nations' multiple indicator approach has evolved over time, and a recent version takes the form of the Human Development Index, or HDI (United Nations Development Programme [UNDP] 1990). Designed as a minimal measure of the standard of living, this index has three components, which are given equal weight: longevity (measured by life expectancy, X_1), educational attainment (measured by the literacy rate, X_2), and access to resources (measured by the log of per capita GDP, X_3).[11] Comparisons are made across countries by selecting maximum and minimum values for the indicators and defining a deprivation measure that places a country on a scale of zero to one. Specifically, if I_{ij} is the deprivation indicator for country j with respect to indicator i, where $I_{ij} = (\max X_{ij} - X_{ij})/(\max X_{ij} - \min X_{ij})$ and the average level of deprivation for country j is given by $I_j = (I_1 + I_2 + I_3)/3$, then $(\text{HDI})_j = (1 - I_j)$.

11. The log formulation was inspired by arguments for declining marginal utility of income.

Critiques of HDI have clarified several of its attributes and suggested refinements (UNDP 1993, 104–13). It is a minimal measure that distinguishes among levels of deprivation rather than gradations of opulence. It incorporates essential aspects of the standard of living—health, education, and income—but is not comprehensive. Important aspects of the quality of life, such as equality, political and religious freedom, and opportunities for social and economic mobility are not included. One may also question the choice of indicators. Per capita GDP is a logical choice for access to resources, and life expectancy at birth represents the state of health, but education often includes more than basic literacy.[12] The choice of equal weights has attracted criticism, but defenders note that components of the measure tend to be positively correlated, and therefore alternative but reasonable choices for weights would give similar results.

HDI can be adapted for use in economic history by defining maximum and minimum values that encompass the range of historical experience and by substituting alternative indicators where appropriate or where the data ordinarily used are lacking. Although the individual papers in this volume employ various values, the range often chosen for the literacy rate is zero to 100 percent and that for per capita GDP is approximately $410 in 1987 prices (the cost of a subsistence diet) to $4,861 in 1987 prices (the upper bound chosen by the United Nations, which was inspired by the poverty-level income of the industrial countries in the Luxembourg Income Study).[13] Limits for life expectancy at birth are 30 years (roughly the lower end of experience for national populations in the preindustrial and early industrial period) to 80 years (approximately the highest observed in the world today). Additional calculations sometimes use other ranges or make use of different indicators. In situations where adequate mortality data are lacking, as in the United States, life expectancy is replaced by adult male stature, where the limits are 156 cm (taken from possibly the shortest population ever measured, the Bundi of New Guinea) to 180 cm (approximately the highest average stature in the world today).

Researchers dissatisfied with cardinal weighting schemes have proposed ordinal measures for intercountry comparisons of quality of life. The paper by Costa and Steckel on the United States employs the Borda rule to rank welfare outcomes over time.[14] This procedure gives each alternative outcome a point

12. A modified HDI measures education by literacy and years of schooling. Unfortunately, the latter are often unavailable for historical settings.

13. Stigler's (1945) subsistence diet (largely wheat flour, cabbage, and pancake flour, supplemented by spinach and pork liver) cost $59.88 in 1944, which amounted to approximately $140 in 1970 prices and $410 in 1987 prices.

In 1994 the United Nations (UNDP 1994) suggested a new method for calculating the deprivation index for per capita GDP, which was based on a threshold that discounted income values above the global average in that year ($5,120). Since the per capita incomes in the countries under study in this volume did not reach that level until well into the twentieth century, we believe that the earlier method employed here is preferable for historical research.

14. For a discussion and application, see Dasgupta (1993, 108–16).

equal to its rank within each index. For example, suppose there are three criteria—income, life expectancy, and literacy—and they rank i, j, and k, respectively, for a particular time period, then the Borda score is $i + j + k$. Rankings are arranged from the worst (lowest) to the best (highest) score.

Among some countries studied in this volume, income and health trends diverged (the United States and Britain) or gains in health were largely unrelated to gains in income (Sweden). These examples raise the question of whether per capita income adequately incorporates the value of health status. To the extent that per capita income fails to include the value of health, it is important to have methods for appraising its contribution to welfare change.

An early attempt to adjust estimates of income uses age-specific mortality rates and their shadow prices as determined from a model of consumer choice (Usher 1973, 1980). Under the strong assumptions that utility is separable, consumption is constant across all ages, and utility functions take the form $U_t = \sum_{i=0}^{t-1} C_i^{\beta}/(1 + r)^i$, where β is the elasticity of annual utility, U_t, with respect to consumption C_t in period t and r is the subjective discount rate, Usher derived a measure of the contribution of gains in life expectancy to economic growth. After defining $\hat{C}(t)$ to be the consumption level at which one would be as well-off with the mortality rates of some base year, T, as one was with the actual consumption level, $C(t)$, and the mortality rates of that year, he shows that $\hat{C}(t) = C(t)[L(t)L(T)]^{1/\beta}$ where $L(t)$ is an index of survival rates. Therefore, $G_{\hat{c}} = G_c + (1/\beta)G_L$, and the value of improvements in health is given by the difference between the growth rates of $\hat{C}(t)$ and $C(t)$.

In contrast with Usher's shadow prices, Thaler and Rosen (1976) used market information on wages across occupations with various health risks to measure the value of life. In this approach, workers demand premiums in the form of equalizing wage differentials to offset the risks of employment in more hazardous jobs. They estimated that workers were willing to pay 2–4 percent of their annual income to reduce the risk of death by 0.001. Viscusi (1978) placed the risk premium at approximately 5 percent. No comparable work has been done for the past, but pending historical research one might venture to assume that the risk premium remained constant over time. Comparisons of growth rates in per capita income with mortality rate changes suggest trade-offs that workers would have been willing to make.

Each method for appraising welfare has strengths and shortcomings, which suggests the need for careful consideration of their implications. While single measures have the advantage that comparisons are easily made over time and across countries, they also have the liability of excluding or failing to incorporate fully some aspects important to the quality of life. Among these, per capita income is the most comprehensive, but it is not always available in the past and it may fail to capture the value of health, education, and other important dimensions of living standards. The value of health can be estimated enroute to adjusting GDP, but approaches now available also have problems. In particular, it may be difficult to estimate the extent to which expenditures on health are already included in GNP. The multiple indicator approach incorporates a vast array of information relevant to the quality of life, but a summary statement on welfare requires a set of relative weights for the indicators. Weights can be chosen, as in HDI, but they are subject to debate. To the extent that the conclusions of the various methods agree, however, our confidence in the interpretation of history is strengthened, and where they differ, we can define an agenda for research.

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