The United Nations Research Institute for Social Development (UNRISD) is an autonomous agency engaging in multi-disciplinary research on the social dimensions of contemporary problems affecting development. Its work is guided by the conviction that, for effective development policies to be formulated, an understanding of the social and political context is crucial. The Institute attempts to provide governments, development agencies, grassroots organizations and scholars with a better understanding of how development policies and processes of economic, social and environmental change affect different social groups. Working through an extensive network of national research centres, UNRISD aims to promote original research and strengthen research capacity in developing countries.

Current research programmes include: Business Responsibility for Sustainable Development; Emerging Mass Tourism in the South; Gender, Poverty and Well-Being; Globalization and Citizenship; Grassroots Initiatives and Knowledge Networks for Land Reform in Developing Countries; New Information and Communication Technologies; Public Sector Reform and Crisis-Ridden States; Technical Co-operation and Women's Lives: Integrating Gender into Development Policy; and Volunteer Action and Local Democracy: A Partnership for a Better Urban Future. Recent research programmes have included: Crisis, Adjustment and Social Change; Culture and Development; Environment, Sustainable Development and Social Change; Ethnic Conflict and Development; Participation and Changes in Property Relations in Communist and Post-Communist Societies; Political Violence and Social Movements; Social Policy, Institutional Reform and Globalization; Socio-Economic and Political Consequences of the International Trade in Illicit Drugs; and the War-torn Societies Project. UNRISD research projects focused on the 1995 World Summit for Social Development included: Economic Restructuring and Social Policy; Ethnic Diversity and Public Policies; Rethinking Social Development in the 1990s; and Social Integration at the Grassroots: The Urban Dimension.

A list of the Institute's free and priced publications can be obtained by contacting the Reference Centre, United Nations Research Institute for Social Development, Palais des Nations,1211 Geneva 10, Switzerland; Tel (41 22) 917 3020; Fax (41 22) 917 0650; Telex 41.29.62 UNO CH; e-mail: info@unrisd.org; World Wide Web Site: http://www.unrisd.org

Development Data Constraints and the Human Development Index

Discussion Paper No. 25, May 1991
Christopher J.L. Murray

Contents

PREFACE 2

INTRODUCTION 3

1. WHAT COMPONENTS SHOULD BE INCLUDED IN A HDI? 3

2. WHAT IS THE BEST WAY OF MEASURING EACH COMPONENT WITHOUT TAKING INTO CONSIDERATION EMPIRICAL DATA DEFICIENCIES? 4

2.1 MORTALITY 4
2.2 EDUCATION 6
2.3 INCOME 7

3. HOW SHOULD REAL WORLD DATA LIMITATIONS ALTER OUR INDICATORS? 13

3.1 DATA FOR PLANNING OR EVALUATION? 13
3.2 MORTALITY DATA 13
3.3 EDUCATION 15
3.4 INCOME 15

4. INTERPRETING CHANGES IN THE HDI OVER TIME. 17

5. RECOMMENDATIONS 18

BIBLIOGRAPHY 19

REFERENCES 22

Preface

Until the late 1970s, social indicators' pre-eminent function lay in their application as alternatives to income as the measure of development. Since then they have increasingly been pressed into more active service, especially as guides for formulating and assessing national policy. In recent years, a great deal of effort has been devoted to theoretical and empirical research on social indicators. The publication of the UNDP **Human Development Report 1990 (HDR)** has aroused widespread interest among researchers, policy makers, the international development community and the general public on the use of social indicators to measure national performance with regard to human welfare and development. The **HDR** provides a useful compilation of existing social statistics and a helpful analysis of the factors determining differential performance concerning social progress. The centrepiece of the **HDR**, the human development index, has aroused a great deal of comment. Like all such indices, it suffers from some weaknesses. The present paper by Dr. Christopher Murray discusses these and suggests ways in which the index may be improved.

While applauding the **HDR** for attracting widespread attention to the need to monitor and assess attempts to foster human development, Murray says it "risks to be counterproductive". The human development index, which combines indicators of income, life expectancy and education into a single dimension, has been challenged by many on statistical grounds. Dr. Murray leaves these questions aside and addresses himself to the methodological and data constraints encountered in computing the three components of the index. He also proposes alternative methods of measuring progress in longevity, education and income.

Adjustments in the methods of computation will not, however, redress the inadequacies of available data. In the short term, for reasons cited in previous work by UNRISD and others and noted by the author, most of the 160 countries covered in the report cannot yet provide reliable and comparable data required to compute the index on an annual basis. Nonetheless, the index is to be recomputed and published annually. The author argues that this "gives the false impression that we know the levels of these important activities in all developing countries... [and] devalues a host of efforts that are needed to get real and timely information on mortality and education in developing countries".

Dr. Murray concludes with a plea that future versions of the **HDR** contain only estimates based on real data without the assumed model changes or other short-cut estimates. He also recommends that the dates of the most recent empirical estimates for each country and for each variable be clearly marked. By so doing, the **HDR** will highlight to the international community "the true extent of our ignorance on the current levels of important social indicators such as mortality and educational attainment and even income in real purchasing power terms".

This paper was presented at a meeting of experts on social development indicators held in Rabat, Morocco, in April 1991. The meeting was organized by UNRISD in co-operation with the government of Morocco – and with the support of international agencies, especially UNDP – as part of the Institute's ongoing efforts to improve social data and indicators of development. It is planned to publish the selected conference papers in book form. Christopher Murray, a medical doctor with advanced training in economics, is a researcher and professor at the Harvard University Center for Population Studies. He has written extensively on issues of health and mortality data in developing countries and consults on related issues for a number of international organizations. At UNRISD, the work on social indicators is being co-ordinated by Claude Richard and David Westendorff.

May 1991

Dharam Ghai
Director

Introduction

Monitoring and evaluating the development process is a major priority for all those concerned with ameliorating the conditions of the world's poor and underprivileged. To this aim, the United Nations Development Programme Human Development Report 1990 is a major contribution (UNDP, 1990). Clearly, it is intended to bring as much attention to improvements in human welfare as the World Development Report (World Bank, 1990) brings to changes in the global economy. While the motives behind the design, preparation and dissemination of the Human Development Report are to be applauded, the difficulties of measuring the development process should not be trivialized. This short piece uses the new human development index in the Human Development Report as focal point for discussing the empirical constraints on monitoring and evaluating social and economic development. Not intended to be an encyclopedic litany of the limitations of various datasets, my comments will be restricted to the human development index (HDI) and its component parts. The basic conclusion is that real data problems limit the ways in which we can measure development especially over time.

1. What components should be included in a HDI?

We can divide the methodological and empirical issues of designing a human development index into three basic categories: the aspects of development that should be included in an index and their relative weights; the best way of measuring each of these components ignoring data difficulties; and finally the limitations that real world data impose.

The human development index as crafted by UNDP includes measures of mortality, education and economic activity. These are undoubtedly three of the most important components of human development. Other quantities such as the physical quality of the household and community environment, nutritional status or more abstract concepts such as autonomy or capabilities could have been included. A long literature has developed on various formulations of social indicators (for example, McGranahan, Pizarro and Richard, 1985, Morris, 1979). Other indicators of development are actively being developed by the World Bank, United Nations and others – for example, as part of the Least Developed Nations programme of the United Nations an indicator with five components is being considered. It is not the purpose, however, of this piece to add one more opinion to the extensive literature on the appropriate aspects of development to include in a human development index. A second conceptually difficult issue that has plagued the adoption of a social development indicator is the question of relative weights. Any composite indicator must include weights to be attached to each of the component indicators of development. While levels and trends of many aspects of socio-economic development are highly correlated, there is enough variance to make the choice of weights important for the final results. Despite complex justifications for particular weighting schemes, the ultimate choice is arbitrary. In the UNDP human development index, mortality, education and income are given equal weights.[1] The merit of this equal weighting scheme on theoretical grounds will not be further discussed.

[1] For those readers unfamiliar with the UNDP human development index, its formulation is based on calculating deprivation indicators for mortality, education and income of the form:

$$I_{ij} = \frac{\text{maximum } X_{ij} - X_{ij}}{\text{maximum } X_{ij} - \text{minimum } X_{ij}}$$

where I_{ij} is the deprivation index for the ith variable in the jth country, X_{ij} is the basic indicator for the ith variable such as life expectancy, literacy or real GDP per capita. The final indicator is simply one minus the average of the three deprivation indicators so calculated.

2. What is the best way of measuring each component without taking into consideration empirical data deficiencies?

2.1 Mortality

Having decided that mortality is a desirable component of a human development index, how should it be measured so as to capture equitably and representatively mortality changes in all parts of the community? If all age-specific mortality rates were perfectly correlated with each other than the choice of a general indicator of mortality would be largely academic.[2] The popularity of indicators of child mortality such as the infant mortality rate and the probability of death between birth and age five (5q0) as measures of general mortality change reflect the belief that age-specific mortality rates are indeed highly correlated. Unfortunately, infant mortality and other age-specific mortality rates are not so closely related. As early as 1956, Stolnitz showed for all known populations with life tables at the time that the correlation between the infant mortality rate and mortality at other ages measured by life expectancy at age one was as low as 0.46 for males in non-western European countries. Murray (1988) has examined empirical data on the age pattern of mortality in developing countries and shown that the infant mortality rate is a poor predictor of life expectancy. The 95 per cent confidence interval for predicted life expectancy from the infant mortality rate is 14 years. With the widespread application in developing countries of health technologies targeted to infants and children such as immunization for measles, diphtheria, polio and tetanus and oral rehydration therapy for diarrhoea, the link between child mortality and mortality at other ages has been further weakened.

The evolution of mortality in Sri Lanka over the last three and half decades provides an excellent example of the complex age and sex trends in mortality. Most are familiar with the well-documented decline in mortality in Sri Lanka since the Second World War.[3] The infant mortality rate declined from 140 in 1945 to the low 50s during the decade of the 1960s; a further decline beginning in the mid-1970s has reduced it to 20 in 1987. Life expectancy increased from an average of 46 in 1945-1947 to 71 in 1987 (UNDP, 1990). Figure 1 shows the trends in mortality in adults between the ages of 15 and 59 since 1950, measured using 45q15.[4] These are taken from a World Bank study on the patterns, levels and causes of adult mortality in developing countries (Murray, Yang and Qiao, forthcoming). While adult female mortality declined as did child mortality for both sexes, adult male mortality is nearly the same in 1983 as in 1950. Nearly total stagnation in the health and mortality conditions for adult males is masked in life expectancy by the continued decline in male child mortality. A similar phenomenon, where increases in adult mortality can be masked in life expectancy at birth figures by declines in child mortality, has been observed for England and Wales (Davey-Smith and Marmot, forthcoming) and Eastern Europe (Eberstadt, 1989).

---

[2] Demographers make frequent use of model life tables for estimating, projecting and modeling mortality. Various types of model life tables have been developed (Coale and Demeny, 1966; United Nations, 1982 and 1983). Within a particular family of model life tables, there is a one to one mapping of each age-specific mortality rate with every other age-specific mortality rate. Thus from an infant mortality rate or an age-specific mortality rate for 30-34-year-olds, one can derive all other age-specific mortality rates and life expectancy at birth. The most commonly used model life tables, the Coale and Demeny regional life tables, do not allow for variation in the trends for different age-specific mortality rates.

[3] The literature on the mortality and health status of Sri Lanka is extensive. See, for example, Krishnan (1976, 1984 and 1985), Nag (1985), Panikar and Soman (1984), and Ratcliffe (1978).

[4] For those less familiar with demographic notation, q is the probability of death. The number before q represents the length of the interval considered and the number after q is the starting point of the interval. Thus 5q0 is the probability of death from birth to age five; 45q15 is the probability of death from age 15 to age 60.

Figure 1
Changes in adult male and female mortality measured using 45q15 in Sri Lanka, 1950-1983.

The World Bank's adult health study has illustrated a wide range of adult mortality conditions (Murray, Yang and Qiao, forthcoming). There are numerous examples where the patterns of child mortality and adult mortality can be quite different. In Botswana, child mortality is relatively low by African standards and has declined to a 5q0 of 52 but adult mortality in males is excessively high. Last measured by Timaeus (1991) to be 42.6 based on the 1981 census data. This is substantially more than adult females in Botswana and adult males in other countries of Africa with higher child mortality. For 46 countries with empirical data on adult and child mortality and income per capita, the relationship between income and child and adult mortality has been examined. In 14 countries, adult male mortality was lower than expected for income and child mortality was higher than expected for income or vice versa. Such discordance between child and adult mortality patterns with GDP per capita was true in nine countries for females.

Life expectancy as an indicator of general mortality is preferable to the infant mortality rate or 5q0 because it at least reflects all mortality rates to some extent. Because mortality under age five has an enormous impact on its calculation, life expectancy at birth is still quite insensitive to changes in adult mortality that may run counter to the trend of child mortality. The more general issue is the relative weight that should be attached to death at different ages in a general index of mortality (Murray, 1986, 1988 and 1990). The importance to society of deaths at different ages is fundamentally a ethical and philosophical question. Starting from different ethical frameworks and theories of social justice, one can derive a variety of age-weights for mortality (Murray, 1990). An economist might choose to weight death by age by the relative contribution to social output of different age groups; peak relative weights would be in the working adult age groups decreasing at younger and older ages. An advocate of fundamental human rights could argue that every death should be counted equally; the appropriate mortality index would be the age-standardized mortality rate which weights each death equally.

There is no *a priori* reason why the age-weights implicit in the calculation of life expectancy must be accepted as superior to any other. Because of the iterative nature of its calculation, the implied age-weights are not constant from country to country. One way to understand the implicit age-weights in life expectancy is to consider the relative duration of life expectancy at each age as the implicit weight given to death at different ages. The death of a 40-year-old mother is not given the same weight in the final index of mortality in all countries. A death at age 40 will be given relatively less weight in life expectancy in a community with higher mortality than in a community with lower mortality. For an indicator of decreasing deprivation, this is rather inequitable. For computing an index of deprivation, most would prefer to attach equal weight to death at each age across the communities being examined. An example of a more equitable and more easily calculated index of mortality is the linear index of mortality proposed by Murray (1986). Death at each age is weighted by the number of years of life lost from some predefined desired minimum duration of life. Eighty-five years was originally chosen but this could as well be 75 or 80. Age-specific mortality rates are then weighted by the desired minimum duration of life minus the mean age of death in each age group and the standard population age structure of the developing world.[5]

[5] In notation, a linear index of mortality is of the form:

$$\mathrm{LIM} = \sum_{x=0}^{e} (d - x) m_x p_x$$

The age-weights in this linear index of mortality were developed based on John Rawls' (1971) theory of justice (Murray, 1986 and 1988). They are not the only justifiable set of age-weights for mortality measurement. An entire class of equitable linear indexes of mortality exist. For those who value benefits to society now as opposed to the future, they may choose to discount the future streams of lost potential life.[6] Such a discounted linear index of mortality would be as easy to calculate and would preserve the equitable characteristic of having constant age-weights across communities. The relative weights attached to death at different ages in the linear index of mortality described above and a discounted linear index of mortality are illustrated in Figure 2 where the weight attached to a death at 45 is set equal to one.

Figure 2
The relative weight attached to death at different ages in a linear index of mortality (LIM) and a discounted linear index of mortality, discounted at 3%.

2.2 Education

Education is a fundamental component of human development. The process of education pervades all aspects of social life. Through years of schooling, individual and ultimately community ideas, aspirations, behaviours and self-perception changes. Female autonomy, for example, is closely linked to the process of female education (Caldwell, 1986). The overwhelming importance of schooling is illustrated by the powerful relationship between maternal education and child mortality (Clelland and van Ginneken, 1988). Higher rates of child mortality are seen in uneducated mothers as compared to mothers who have been to school. Typically, the more years of schooling the lower is child mortality. The mechanisms through which the number of years of maternal schooling have such an effect on child mortality are still being investigated (Levine et al., forthcoming; Clelland and van Ginneken, 1988). It is important to note that the relationship is not between literacy and child mortality but years of schooling completed and child mortality.

Literacy was chosen by UNDP as the most appropriate measure of educational achievement. "Literacy is a person's first step in learning and knowledge building, so literacy figures are essential for any measurement of human development" (UNDP, 1990: 12). Unfortunately, adult literacy rates measure only the superficial capacity to read and write one's name or a simple sentence. In many censuses and surveys, such a capacity is self-reported and is not routinely evaluated by enumerators (McGranahan, Pizarro and Richard, 1985). Education produces far more than just a population that can read and write a simple sentence. In countries where literacy is an output of the formal educational system, literacy may be a proxy measure for years of schooling completed. But in countries such as Tanzania,