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Development Data Constraints and the Human Development Index

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

Contents

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).

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[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, Nicaragua and others that have undertaken mass adult literacy programmes, the adult literacy rate is not a proxy for educational attainment. To equate the social effort of providing access to primary and perhaps secondary schooling with that of an adult literacy course devalues the true importance of investments in primary and secondary schooling. Levine et al. (forthcoming) has attempted to study the relationship between years of schooling and literacy and the more general question of the outputs from the educational system but definitive results are not yet available.

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where d is the arbitrarily chosen desirable minimum length of life; x is the age; m_x is the mortality rate for the x age group; and p_x is the standardized population for the x age group.

[6] See Prost and Prescott (1984) and Barnum (1987) for examples of the common practice in health economics of discounting future streams of potential life lost.

Using the same census or survey data that provides estimates of adult literacy, one can usually find data on the population by the number of years of schooling completed or highest educational level attained. A simple index of educational deprivation could be formulated. By multiplying the population at each age by the number of years of schooling completed, an estimate of total adult population years of schooling can be obtained. Some arbitrary standard such as 6 or 8 or 10 years of schooling can be taken as a development goal just as 100 per cent literacy has been taken as a development goal. The educational deficit would be the adult population, times the desired educational goal, such as 10 years, minus the actual number of years of schooling achieved, divided by the total population, times the school duration standard. This index would be comparable across countries and would be a more accurate reflection of the outputs from social investments in education.[7]

Both adult literacy and measures of adult educational attainment are prevalence measures. Unlike mortality and income which reflect current levels of effort, these measures of education reflect the average effort over many years. The average age of the developing world population over 15 is 36[8] so that adult education measures reflect the average social effort for education about 20 to 35 years ago (assuming education takes place between the ages of five and 15).[9] Such prevalence measures are relatively insensitive to the current social investment in educating its youth. Total adult educational levels can at most change 3.3 per cent per year if a completely educated cohort entered a completely uneducated adult population. Real changes will be closer to one per cent per year even when a substantial educational effort is being made.

How can sensitivity to current conditions be increased – especially so that the education indicator is equivalent to the indicators for mortality and income which largely reflect current efforts? Measures of current schooling could be used such as primary or secondary school enrolment ratios. These, however, are plagued by a lack of a consistent definition of the duration of primary school and the tendency in poor developing countries to have a broad age group entering primary school at the same time. McGranahan, Pizarro and Richard (1985) showed that primary school enrolment ratios often decrease as educational attainment improves. An alternative strategy for increasing the sensitivity of indicators is to use a younger and narrower age range. Thus, the educational attainment of women and men aged 15 to 29 or 39 would be an improvement. This would also measure educational attainment in the segment of the population that contributes the most to parenting and social output.

2.3 Income

For those who spend most of their time examining social or cultural aspects of the development process, income measures are viewed with envy. Tables of GDP and GNP are produced by almost all countries every year. The widespread availability and timeliness of income data belie a shaky empirical ground in many situations. Even before considering empirical issues, two conceptual issues must be addressed: the most appropriate measure of

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[7] An education deprivation index would be of the form:
educational deprivation =

$$\frac{\sum_{x=0}^{e} ep_x - \sum_{x=0}^{e}\sum_{j=0}^{m} jp_{xj}}{ep_x}$$

where e is the chosen minimum ideal duration of schooling, p_x is the population in age group x, p_{xj} is the population in age group x with j years of schooling, j is the number of years of schooling completed.

[8] Calculated from the population age-structure for the developing world in 1990 as estimated by the World Bank (Zachariah and Vu, 1988).

[9] This assumes that the rate of increase in the percentage of children attending school is constant. For countries with mass adult literacy programmes this computation does not apply.

national economic activity or income and methods of converting national estimates into a common *numéraire*.

Most countries compute their national accounts according to the international System of National Accounts (the 1968 revision is in current use). Some centrally planned economies do not even use this method of national accounting. These countries calculate net material product which does not include government or private services. Estimates of GDP or GNP for these centrally planned economies are therefore always crude estimates. Amongst those countries following the SNA (System of National Accounts), there is still a choice of several measures of national economic output. The most commonly used is Gross Domestic Product (GDP) which is a geographically defined measure of total economic output within a given country. Gross National Product (GNP) includes net factor income. For countries where a significant portion of the population is temporarily working abroad and sending the money home, the difference between GDP and GNP can be substantial. As a human development indicator includes income because it affects the material well-being of the members of society, GNP which adjusts for flows into and out of the economy would appear to be more appropriate.

Measures such as GDP or GNP measure flows without taking into account changes in the stock of capital in society. In other words, we can calculate national income, which is GNP minus depreciation. Further adjustments could be made for the depreciation of natural resource stocks or the losses from environmental degradation. Such measures are under consideration for the 1990 revision of the SNA. While more complete measures of national economic output are appealing, they are currently not available for the vast majority of countries.

The inadequacy of international comparisons of GDP or GNP using official exchange rates has been the subject of much investigation (Kravis, 1984; Kravis, Heston and Summers, 1982; Marris, 1984; Summers and Heston, 1988). Official exchange rates particularly in the last decade have been highly volatile so that rankings of GDP or GNP per capita can change dramatically over a short period. For example, the real exchange rate between the US dollar and the SDR (Special Drawing Rights) changed by 27.4 per cent in just two years from 1985 to 1987. Thus, most developing countries' incomes denominated in US dollars using official exchange rates would be reduced by this amount all other things being equal. The International Comparison Programme (ICP), begun in 1968 and now in its sixth phase, was created to try and develop more meaningful comparisons on national income independent of official exchange rates. The goal of the programme is to develop purchasing power parity ratios which are ratios that would theoretically equate GDP in terms of purchasing power. Without detailing the highly complex methodology involved in the computation of purchasing power parity ratios, we must make several observations. First, each phase of the ICP which occurs every five years covers approximately only 60 countries. For example, the phase V included no countries in Latin America, 20 countries in Africa, 20 OECD countries and the rest in the Middle-East and Asia. The limited coverage of the ICP at each round requires the use of short-cut techniques or regression-based estimates of purchasing power parity ratios if a complete set of PPPs is desired for any given time period. Second, one can compare estimates for the same set of countries based on different phases of the ICP (World Bank, 1989). These, unfortunately, are not stable for a number of countries. For example, the estimated GNP per capita for Kenya in 1983, based on phase III, was 790, falling to 480, based on phase V. While there are many possible explanations for the variation in estimates between the different Phases of the ICP, they illustrate that a stable set of GDP or GNP estimates for developing and industrialized countries are not yet available. Despite the clear limitations of purchasing power parity ratios, for the purposes of measuring the contribution of income to human development they would seem to be a better measure of the purchasing power that national income provides.

Because income is thought to have decreasing marginal returns to human development, the log of income has been used. In addition, income above US $4,861 is not counted in the index (UNDP, 1990: 13). UNDP justified this second truncation by claiming that an income of US $4,861 implied "a desirable or adequate value" and in their own words "no deprivation". In other words, the peculiar weighting system used by UNDP produces two indexes. One for developing countries, which includes income, education and health, and another for developed countries with an income of more than US $4,861 which only measures literacy and mortality. Most inhabitants of industrialized countries would not agree that income above the official poverty line in nine industrialized countries makes no further contribution to human development. For those interested, Table 1 provides revised HDI estimates based on examining the full range of income including income over US $4,861. Calculating an HDI that includes income, mortality and education for all countries has a trivial effect on the ranks of low and middle income countries. The relative ranks of high income countries, however, change considerably – for example the United States rises from rank 112 to rank 125 out of 130 countries.

Table 1		
Human development index recalculated including income estimates for countries with real GDP per capita greater than US $4,861		
Rank	**Country**	**Human Development Index**
1	Niger	0.090
2	Mali	0.115
3	Burkina Faso	0.126
4	Sierra Leone	0.128
5	Chad	0.136
6	Guinea	0.136
7	Somalia	0.152
8	Afghanistan	0.161
9	Mauritania	0.167
10	Benin	0.187
11	Bhutan	0.202
12	Mozambique	0.211
13	Burundi	0.216
14	Sudan	0.218
15	Central African Republic	0.222
16	Senegal	0.227
17	Malawi	0.228
18	Nepal	0.236
19	Angola	0.253
20	Ethiopia	0.260
21	Rwanda	0.270
22	Yemen Arab Republic	0.274
23	Bangladesh	0.278
24	Nigeria	0.285
25	Zaire	0.291
26	Liberia	0.295
27	Togo	0.306
28	Haiti	0.315
29	Democratic Yemen	0.321
30	Uganda	0.331
31	Ghana	0.339
32	Côte d'Ivoire	0.339
33	Namibia	0.344
34	Congo	0.352

35	Pakistan	0.367
36	India	0.392
37	Tanzania	0.396
38	Madagascar	0.404
39	Papua New Guinea	0.407
40	Cameroon	0.418
41	Kampuchea	0.419
42	Morocco	0.427
43	Kenya	0.437
44	Zambia	0.443
45	Egypt	0.449
46	Gabon	0.452
47	Laos	0.453
48	Oman	0.478
49	Bolivia	0.489
50	Honduras	0.515
51	Lesotho	0.520
52	Zimbabwe	0.520
53	Myanmar	0.523
54	Guatemala	0.524
55	Algeria	0.527
56	Indonesia	0.527
57	Viet Nam	0.558
58	Botswana	0.566
59	Iran	0.576
60	Tunisia	0.577
61	El Salvador	0.588
62	Syria	0.609
63	South Africa	0.633
64	Dominican Republic	0.639
65	Saudi Arabia	0.643
66	Philippines	0.647
67	China	0.648
68	Libya	0.656
69	Turkey	0.664
70	Nicaragua	0.667
71	Mongolia	0.667
72	Lebanon	0.668
73	Jordan	0.673
74	Peru	0.673

75	Ecuador	0.681
76	Iraq	0.686
77	Brazil	0.689
78	Mauritius	0.707
79	Paraguay	0.707
80	Thailand	0.709
81	Malaysia	0.712
82	Colombia	0.712
83	Albania	0.722
84	Sri Lanka	0.722
85	Democratic People's Republic of Korea	0.723
86	Jamaica	0.746
87	United Arab Emirates	0.756
88	Venezuela	0.770
89	Mexico	0.777
90	Romania	0.785
91	Panama	0.790
92	Cuba	0.799
93	Trinidad and Tobago	0.801
94	Korea	0.809
95	Bulgaria	0.818
96	Yugoslavia	0.818
97	Argentina	0.819
98	Portugal	0.819
99	Uruguay	0.821
100	Kuwait	0.822
101	Hungary	0.824
102	Poland	0.824
103	Costa Rica	0.828
104	Chile	0.839
105	USSR	0.840
106	Greece	0.866
107	Czechoslovakia	0.874
108	Singapore	0.876
109	German Democratic Republic	0.899
110	Ireland	0.904
111	Israel	0.913
112	Hong Kong	0.918
113	Spain	0.921
114	New Zealand	0.929

115	Italy	0.932
116	Austria	0.932
117	Finland	0.944
118	Belgium	0.946
119	Australia	0.947
120	United Kingdom	0.950
121	Germany	0.955
122	France	0.960
123	Netherlands	0.962
124	Denmark	0.966
125	USA	0.966
126	Sweden	0.968
127	Japan	0.974
128	Switzerland	0.977
129	Norway	0.979
130	Canada	0.981

Human Development Index calculated using data on life expectancy, literacy and real GDP per capita in 1987 from UNDP (1990). The index differs from the one presented by UNDP in that income deprivation indicator used in the calculation of the HDI takes as its maximum income the highest income reported within the set of countries. UNDP used as its maximum US $4,861 which was the average poverty line in nine high income countries.

3. How should real world data limitations alter our indicators?

3.1 Data for planning or evaluation?

Compilations of development indicators are routinely produced by many institutions (e.g. World Bank, 1990; UNDP, 1990). These data are used for two distinct purposes: planning and evaluation. The best available estimate, regardless of how weak its empirical base, is usually better than no estimate for the purposes of planning programmes or policies. Governments, international agencies, bilateral donors, and foundations have a constant need for estimating various aspects of the development process to inform resource allocation decisions and adjust the directions of programmes. On the other hand, development data are also needed to evaluate and assess the efficacy of different development strategies, their impact on parts of communities and the real trends in health, education, food security and other components of socio-economic development. Research, analysis and evaluation require real empirical data. Model-based or arbitrary data are not adequate for this second purpose. Most of the available development data, however, are produced by planners with their needs in mind. Unfortunately, these estimates are also used for research and evaluation purposes by the unwary and poorly informed. The confusion between estimates for planning purposes and real data for evaluation is particularly common for demographic data.

3.2 Mortality Data

Indicators of general mortality, such as life expectancy at birth, require data on age-specific mortality rates for all age groups for their computation. Such data are obtainable only from a vital registration system that records all or nearly all births and deaths in a community on an annual basis. While a routine part of developed country statistical systems, complete vital registration systems are not the rule in developing countries. Less than 40 developing countries, mostly in Latin America, have vital registration systems recording 90 per cent or

more of deaths (Murray, 1987). Very few countries in Asia and no countries in continental sub-Saharan Africa have such systems. For these countries mortality estimates are based indirect techniques that take advantage of data collected in surveys and censuses. Even for those countries with complete vital registration systems, the estimates produced by international agencies may not be accurate because of the overuse of model life tables. Figure 3 shows a graph of the World Bank estimates of female 45q15 and the estimates from real vital registration data for the same countries. The lack of agreement where there is absolutely no reason for variation is astounding.[10]

Figure 3

A comparison of World Bank estimates of 45q15 and the true 45q15 based on vital registration data.

Indirect measurement techniques that have been developed for measuring child mortality have been widely applied and are considered robust (United Nations, 1988). The infant mortality rate derived from indirect analyses is quite sensitive to the arbitrary choice of model life table but the 5q0 is much less sensitive (United Nations, 1988). One should always use 5q0 in preference to the infant mortality rate for international comparisons of infant and child mortality. Indirect measurement techniques for measuring adult mortality are not as widely used and are still considered less robust (Blacker, 1984). Also, questions on orphanhood and widowhood provide estimates of adult mortality as it was many years (15 or more) before the survey. In many cases, no independent data on adult mortality are available so that estimates are based solely on child mortality and an arbitrary family of life tables. The discordance between adult and child mortality illustrated earlier for countries like Sri Lanka and Botswana illustrate the danger of accepting such estimates.

Some 18 countries including the Democratic People's Republic of Korea, Laos, Myanmar, Viet Nam, and a number of African states, have never had a national survey or census that provides suitable data to estimate even child mortality (United Nations, 1988). For these countries, averages of neighbouring countries are used to generate mortality measurement. Such an assumption completely divorces the "measured" changes in mortality from the specific health, food security and education policies pursued. Examples of countries with no empirical mortality data at all include the Democratic People's Republic of Korea that ranks 82nd in the HDI largely on the basis of its life expectancy of 70.

Censuses usually come once a decade so that the raw data for estimating child mortality and on occasion adult mortality is infrequently updated. The Demographic and Health Surveys funded by USAID have been conducted in 28 countries during the 1980s and provide another major source of estimates. The estimates from infrequent censuses and surveys must be updated to provide more current estimates of mortality for planning purposes. Sometimes, rather old empirical estimates are updated; for example, 12 developing countries' most recent data source is more than 20 years old (United Nations, 1988). An assumed model of mortality decline is used to generate the current mortality estimates. The United Nations Population Division assumes for most developing countries that life expectancy increases two years for every five calendar years. The assumed rates of decline diminish as life expectancy

[10] The reason for the discrepancy is not negligence. The primary in-house use of the World Bank mortality and population estimates is for planning purposes. To facilitate the projection of mortality, real empirical data are used to calculate a life expectancy at birth. A model life table is then used to generate the age-specific mortality rates from these life expectancies at birth. Although, the real age-specific mortality rates differ considerably from the model estimated rates as illustrated in Figure 3, the model system is easier to use for mortality projections. These model-based estimates are then disseminated for wider use.

approaches 70 and more. Relative ranks in any index based on this model derived data mortality data will change significantly only as new empirical data for selected countries are reported.

Finally, sex differences in mortality are most variable in the young adult age groups (Stolnitz, 1956; Dyson, 1987; Murray, Yang and Qiao, forthcoming). International mortality estimates by sex do not often reflect real patterns in the data. They are usually assumed from a particular family of model life tables (Murray, Yang and Qiao, forthcoming). While most model-based estimates show higher female mortality than male in high mortality populations, empirical data suggest that, except for South Asia, this is not the case (Murray, Yang and Qiao, forthcoming). The UNDP discussion of the human development index calculated by sex largely reflects spurious differences in life expectancy by sex in higher mortality populations.

3.3 Education

Literacy and educational attainment measures can only be measured from census and survey data. Unlike mortality, however, there is much less difficulty directly measuring these quantities. To the extent that definitions are compatible and the population answers honestly, the results can be used directly. Because measurements are infrequent short-term changes must be assumed. As with mortality, if the changes in education variables are assumed over the short-term then the relative rank of developing countries in terms of education can only change significantly as new census or more rarely survey data become available.

3.4 Income

Data limitations for income measures can be divided into problems with national data in local currency and problems with purchasing power parity ratios. Local currency estimates of GNP or GDP are subject to substantial variation. Many components are estimated and government figures are frequently revised. International compilations produced largely by the United Nations, the World Bank and the International Monetary Fund do not necessarily agree even for figures in local currency. Table 2 shows a selection of indicators for Liberia from three international references. Differences in nominal and constant GDP in local currency as large as 30 per cent are disturbing. A study of the differences between the various compilations (Ahmad, 1980; Ahmad and Kwon, 1981) found that discrepancies were present nearly 10 per cent of the time. They identified five major reasons for discrepancies: (a) adjustments made by the World Bank; (b) errors in calculation, updating or reporting; (c) fiscal years treated differently; (d) splicing with previous data by one organization but not by the other; (e) vintage, i.e. official data received or put in the data bank at different points in time.

Table 2				
National Accounts Data of Liberia				
A. Gross Domestic Product at Current Prices (millions L$)				
Year	**United Nations**	**World Bank**	**I M F**	**Percentage Difference**
1970	407.8	408.4	351.6	16.2
1971	430.0	429.9	372.5	15.4
1972	466.0	466.5	405.9	14.9
1973	544.9	492.6	414.6	31.4
1974	507.2	617.8	507.2	21.8
1975	609.6	725.9	609.6	19.1
1976	631.7	761.8	631.7	20.6
1977	706.2	872.9	706.2	23.6
1978	773.7	943.7	773.7	22.0
1979	891.3	1,067.6	880.5	21.2
1980	916.6	1,116.8	916.6	21.8
1981	870.9	1,055.4	841.1	25.5
B. Gross Domestic Product at Constant Prices (millions 1971 L$)				
Year	**United Nations**	**World Bank**	**I M F**	**Percentage Difference**
1970	409.3	409.8	355.3	15.3
1971	430.0	429.9	373.0	15.3
1972	445.5	447.7	387.1	15.7
1973	462.7	437.6	377.2	22.7
1974	389.6	458.4	405.2	17.7
1975	374.5	442.5	343.9	28.7
1976	392.5	466.0	357.6	30.3
1977	396.2	473.4	354.6	33.5
1978	419.0	496.2	368.6	34.6
1979	439.0	512.4	384.9	33.1
1980	411.4	491.4	366.6	34.0
1981	395.9	480.1	350.8	36.9

Sources: United Nations, **National Accounts Statistics: Main Aggregates and Detailed Tables, 1982** (1985: 887-889); World Bank, **World Tables, the third edition, Volumes 1 and 2** (1983: 106-107); IMF, **International Financial Statistics Yearbook 1982** (1982: 280-281). **Note:** Percentage Difference is the difference between the maximum and the minimum divided by the minimum value.

For those countries that do not report by the System of National Accounts, comparable estimates of GDP or GNP are extremely difficult to derive. The estimates used by UNDP must be from other sources such as western intelligence agency projections. As the World Bank attempts to correct national accounts figures in close collaboration with their country

economists and national governments, their estimates are probably the best source for national accounts figures.

Despite their limitations discussed above, GNP or GDP per capita converted using purchasing power parity ratios is probably preferable in comparisons of human development. Unfortunately, the real GDP per capita figures used by UNDP in the human development index are necessarily based on real information on the purchasing power parity ratios. Phase V of the ICP includes only 64 countries and the results are currently available for only 57 (World Bank, 1990). The rest of the UNDP real GDP estimates are based on approximations. PPPs have been derived for the 73 countries without real information from an undisclosed regression equation or similar short-cut estimation technique. In a number of cases, PPPs from earlier phases may have been used. The relationship between various rounds of the ICP for the same country as discussed above is not necessarily stable. The true meaning of the rankings by real GDP per capita is difficult to assess given the mixture of real and completely estimated purchasing power parity information.

4. Interpreting changes in the HDI over time.

With the publication of a human development report each year, many will be encouraged to examine changes in the human development index over time. The nature and frequency of the data for mortality and literacy will make such comparisons extremely problematic. To illustrate the difficulties of interpreting any temporal trends in the HDI or in relative HDI ranks, we have simulated the impact of changes in each of the variables *ceterus paribus*.

Life expectancy estimates for each country will change for two reasons. First, when new censuses or surveys are undertaken in particular countries, their life expectancy estimates are likely to be substantially revised. For example, the Human Development Report provides a 5q0 of 92 for Botswana which will be revised to only 52 when the data from the Demographic and Health Survey is incorporated into the United Nations dataset. This will radically alter the life expectancy, the life expectancy deprivation index and their absolute and relative rank of HDI. Such a change would be interpreted by the ill-informed as a dramatic increase in socio-economic status over just one year. Because mortality information will for most developing countries continue to come every five or 10 years, dramatic revisions will be the norm not the exception. For many countries, censuses are concentrated around the beginning of a decade; over the next one to two years many countries' mortality estimates will be revised, but for the subsequent eight years much less new data will be injected into the system.

Annual life expectancy estimates will continue to be produced using assumed rates of mortality improvement (United Nations, 1989), what will be the impact of these purely hypothetical increases in longevity on the level and rank of the human development index? We have simulated the impact of the standard United Nations mortality reduction on HDI for all 130 countries assuming no changes in income or literacy. Surprisingly, in multiple simulations on average 76 per cent of countries did not change rank over five years, 18 per cent changed one rank and 6 per cent changed two or even three ranks. A model of decline applied equally to all countries changes some countries' relative HDI rank because some countries hold their rank more because of a high life expectancy than because of income or literacy. Such countries are more affected by the slight changes in the deprivation index brought about by an increase in life expectancy that is greater than the decrease in the range of life expectancy.

New data on adult literacy come infrequently as well. If assumed rates of improvement were used to project changes in literacy that were only a function of the current level of literacy, the impact on relative HDI ranks would be quite similar to the modeled mortality changes. Overall rank would change little but some countries will move one, two or even three ranks.

As new data on income will be available each year for many countries, changes in the real GDP per capita should be the major determinant of changes in the HDI. Real GDP estimates will change for two reasons. First, changes in GDP per capita denominated in local currency will change over a relatively small range (at most ±10 per cent) each year. When these small changes are simulated by assuming that growth in GDP per capita is a random function independent of current GDP per capita, it shows that each year we can expect at most 30 per cent of countries to change one rank and five per cent to change two or more ranks. Over five years, these smaller changes could accumulate. Second, when the purchasing power parity ratios which are currently based on 1980 price data are revised, major changes in real GDP per capita that will far outweigh the relatively slow changes in GDP per capita in local currency will be introduced. Thus, like mortality and literacy, major revisions will come infrequently while the changes in the intervening years will be relatively minor.

Trends in HDI from year to year as currently calculated and presented will be uninterpretable. Small changes in relative rank can be due to a pure model effect or real changes in income per capita. Major shifts in the human development index from one year to the next will not be sudden accelerations in socio-economic development but rather the introduction of new data on mortality, education or purchasing power parity ratios that will radically alter country estimates. Change in the HDI will become highly correlated not with human development but rather the timing of censuses and surveys.

5. Recommendations

Human development is too important to monitor and evaluate to allow data limitations to wholly prevent attempts at measurement. UNDP efforts at developing a human development index should be encouraged. As currently formulated, the human development index risks to be counterproductive. Instead of highlighting the tremendous importance of improvements in mortality and education for human advancement, it gives the false impression that we know the levels of these important activities in all developing and developed countries. In some sense, it devalues a host of efforts that are needed to get real and timely information on mortality and education in developing countries. Such efforts include the development of cost-effective methods for measuring adult mortality, the testing and refinement of techniques to measure child mortality through mothers attending routine health service clinics, and the development of more appropriate methods for measuring educational attainment, to list only a few. Who will take seriously efforts to measure mortality or education, if convenient estimates are available each year from prestigious international compendiums?

An extraordinarily simple procedure would allow the human development index to be meaningfully calculated and presented and at the same time highlight the dire need for information in many regions of the developing world. Only estimates based on real data without the assumed model changes or other short-cut estimates added on should be published. The date of this most recent empirical estimate should be clearly marked. If the most recent mortality and literacy estimate for a country is 1980 then the HDI would be calculated for 1980 and would be so indicated. This would 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. We can only hope that such a small effort at intellectual honesty will be adopted as soon as possible. By highlighting both the importance of health and education in the development process and the state of our knowledge of these aspects of development, the Human Development Report could be an important contribution.

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