Human Development Index:
Methodology and Measurement

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HUMAN DEVELOPMENT INDEX: METHODOLOGY AND MEASUREMENT

by

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FOREWORD

Since the publication of the first Human Development Report in 1990, an exciting debate has emerged world-wide on issues of human development. Needless to say, the Human Development Reports published annually by Oxford University Press on behalf of UNDP, have made a significant contribution to the debate.

Over the years, many distinguished experts have contributed to the central ideas in the Human Development Reports. With an objective to make some of the background studies prepared by different members of the Human Development Report teams available to a broader audience of development professionals and policy makers, the Human Development Report Office initiated a series of Occasional Papers in 1992. The series were highly well-received among academics, researchers and policy makers and there is a great demand for the Occasional Papers.

It is, therefore, with great pleasure that the Human Development Report Office decides to continue the series. The present paper is a part of that continuum. We hope that it will receive the same kind of attention as the preceding publications in the series. Any comments and observations on the published papers would be most welcome and could be channelled by UNDP to the concerned author.

The papers reflect the views of the authors and not necessarily those of UNDP or the Human Development Report Office.

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HUMAN DEVELOPMENT INDEX:
METHODOLOGY AND MEASUREMENT

1. The Concept of Human Development

As the 1990 Human Development Report argued, a basic distinction needs to be made between the means and the ends of development. Human beings are the real end of all activities, and development must be centered on enhancing their achievements, freedoms, and capabilities. It is the lives they lead that is of intrinsic importance, not the commodities or income that they happen to possess. Income, commodities ("basic" or otherwise), and wealth do of course have instrumental importance but they do not constitute a direct measure of the living standard itself. A person's income level, for example, does not reveal what expectation of life the person has, whether he or she is presently healthy (or suffering from a disease), is disabled and incapable of moving about freely, etc. Even for those features of the living standard where the instrumental significance of private income is likely to be greater, such as adequate nutrition, there is enormous variation in converting income into achieved well-being.[1] People's metabolic rates vary, as do their activity levels and the climatic conditions in which they live. People living in mountainous areas need more energy from food and fuel because they lose more body energy in the colder ambient temperature. A handicapped person with a physical disability needs more income to achieve the same degree of mobility that a normal person does.[2] The same is true of elderly and infirm people.

To some extent, one can adjust private household incomes for differences in certain very specific and limited needs. For example, a child needs less food to achieve the same level of nutrition as an adult. A large household needs more income than a small household to achieve the same level of consumption of goods and services, though not quite in proportion to the number of its members because of "economies of scale" in such consumption. A household living in a high-price region needs more income to purchase the same food and other commodities than one living in a low-price area. For these differences in needs, and only these, we can adjust household income to take them into account. We do this through so-called "equivalence scales" which correct household income for the size and age-sex composition of its members.[3] And we use price indices to correct for regional and temporal price differences. But it is simply not possible, through income, to account for individual differences in morbidity, mortality or disability

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[1]   The need for income to achieve any specified living conditions can, in fact, vary greatly with various physiological, social, cultural, and other contingent features. For example, to reach the same level of nutrition as another, one needs a larger command over food if one has a higher metabolic rate (or a larger body frame), or if one is pregnant (or breast-feeding), or if one has a disease that makes absorption more difficult, or if one lives in a colder climate, or if one has to toil a lot, or if food has other uses (such as for entertainment, ceremonies or festivals) [Sen (1987:16)].

[2]   The handicapped, in fact, suffer from a double disadvantage. Not only is it harder for them to convert income into well-being, it is also harder for them to earn income in the first place.

[3]   See Deaton and Muellbauer (1980, 1986) for an analysis of different approaches to the construction and estimation of household equivalence scales.

-- and these features would seem to deserve priority in any assessment of the living standard. There are also other, non-private, economic goods and services which cannot be captured adequately through household incomes. These are the standard public or publicly-provided goods -- the environment, infrastructure (such as roads), electricity, transport and communication facilities, epidemiological protection, etc. Thus private incomes fail to capture even some very basic instrumental features of the standard of living in developing countries.

Hence the motivation to focus directly on the lives that people lead -- what they succeed in being and doing. Do they have the capability to live long? Can they avoid mortality during infancy and childhood? Can they escape preventable morbidity? Do they avoid illiteracy? Are they free from hunger and undernourishment? Do they enjoy personal liberty and freedom?

These are basic features of well-being which derive from looking at people as the center of all development activity. Enhancing their capabilities to function in these elementary ways is what lies at the core of human development. The achievements of people -- be it in terms of long life or functional literacy -- are valued as ends in themselves. This should be contrasted with more mainstream economic approaches which discuss human resource development. Here the focus is on human beings as a resource -- an input into production activities. The development of human resources is seen in terms of their contribution to income generation -- as an investment, like any other, in enhancing the productive potential.

Whereas the human development approach values capabilities related to, say, health, nutrition, and basic education as ends in themselves -- and income only as a means to achieve these -- human resource development (like "human capital" investment) is based on precisely the opposite valuation. This approach assesses investment in human capital -- including health, nutrition, and education -- entirely in terms of the extra income or output the investment generates, judging it to be worthwhile if the rate of return exceeds the capital cost. By contrast, proponents of the human development approach would argue for the enhancement of people's ability to read and write, or to be well-nourished and healthy, even if the conventionally measured economic return to investment in literacy, or improved food intake and health care, were zero (though, of course, they are typically quite high anyway).

2. Aggregative Indicators and Intrapopulation Inequality

The usual measures of group performance (such as the gross national product, net national income, life expectancy at birth) tend to be aggregative indicators that are based on averaging the individual circumstances. This inevitably involves the loss of some valuable information. A situation in which, say, three people have respectively income levels (1, 9, 11) looks much like one in which the three respectively have (7, 7, 7), even though the two social situations can scarcely be seen as equivalent in terms of our concerns and values. There is, thus, an understandable demand to see whether distribution-sensitive measures could not be used instead of the usual aggregate indicators based on simple averages.

In understanding this demand, we have to distinguish between two different aspects of the problem that are sometimes lumped together. First, there is some loss of detailed information in using an aggregate number (a "scalar") for a bunch of numbers representing individual circumstances (a "vector"). Secondly, the procedure of simple averaging overlooks the actual distribution pattern of the bunch of numbers and concentrates only on their mean value. In seeking a distribution-sensitive measure, the object is to tackle the second problem. But even a distribution-sensitive scalar measure would continue to involve some loss of information, since there is no way of capturing the entire wealth of knowledge embedded in a set of numbers in one real number. For example, while a distribution-sensitive measure would respond both to the average value and in some ways to the dispersion around that average value,

it would not be able to tell between (i) how much of a change is due to a shift in the average value, and (ii) how much a result of a changed distributional pattern. Indeed, such a measure could remain stationary even when both the average and the distributive pattern changes, if the two effects cancel each other out. There are also many different ways of assessing inequality, and any particular distribution-sensitive measure would have to pick one and thus can be insensitive to the rationale of the other measures of dispersion. The case for a distribution-sensitive measure must not, therefore, be seen simply in terms of having "more" information, but rather in terms of using "more relevant" information, which incorporates distributional concerns along with aggregative ones.

There is a further distinction that is worth making in interpreting the search for distribution sensitivity, and this concerns the distinction between the "efficiency argument" and the "equity argument" for more equality.[4] The former relates to the fact that many of the indicator variables (such as income) are means to other ends. They are not valuable in themselves -- only for the ends they serve -- and the functional relation relating these means to the real ends may involve "diminishing returns". The traditional utilitarian argument for a more equal distribution of incomes (given the total income to be distributed) has never rested on wanting a more equal distribution of <u>utilities</u> themselves, but on the efficiency advantage of distributing incomes more equally in generating more <u>total</u> utility, given the diminishing marginal utility of a shared utility function. Indeed, utilitarianism does not value at all the distribution of what it takes to be the real ends (i.e., utilities), and concentrates instead entirely on the distribution-independent total size of the aggregate of utilities generated.

In contrast to that approach, it is possible to incorporate into the evaluation a concern for the equity of the distribution of utilities themselves, or of other variables (quality of life, capabilities, etc.) that are taken to be intrinsically valuable -- not just instrumentally so. For example, in Rawls's theory of justice as fairness, the Difference Principle pays a good deal of attention to the distribution of indices of primary goods -- the indicator that Rawls uses to judge individual advantage -- and concentrates in fact on a formula that gives priority to the advantage of the "worst off" sections of the community.[5] Within the more traditional "welfarist" framework based on utilities, James Meade develops his theory of economic justice by combining a distributive concern about utilities themselves along with taking note of the diminishing marginal utility from income in generating utilities.[6] While utilitarians would readily accept the case for a more equal distribution of incomes based on the latter (efficiency) argument, they are committed to opposing the former (equity) argument in this form. It is possible to debate this issue extensively, but what is most important for conceptual clarity is to understand the differences between the distinct arguments for equality of <u>means-variables</u> (such as incomes) and the disparate bearing they have on the assessment of equality of <u>ends-variables</u> (such as utilities).

2.1 Income Distribution and Poverty

The human development index, as used in the first <u>Human Development Report</u> [UNDP (1990)], had three components, dealing respectively with (1) life expectancy at birth, (2) the proportion of literacy among the adult population, and (3) the logarithm of the gross national product (up to the level of the internationally fixed poverty line). Of the three, both life expectancy and literacy can be seen to be valuable in themselves (even though they may also be useful for pursuing other ends too). Income, however, is quintessentially a means to other ends. The case for a distribution-sensitive measure of incomes can, therefore, be very firmly linked both with the efficiency and equity arguments for equality.

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[4]   *On this and related matters, see Sen (1993).*
[5]   *See Rawls (1971); also Phelps (1973).*
[6]   *See Meade(1976); also Atkinson (1983).*

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A more equal distribution of income would generate more desirable ends (such as utilities, capabilities, and so on), but can also serve to bring about a more equal distribution of these end-variables, given a homogeneous population.

The use of the logarithm of income can serve, to some extent, the purpose of equality preference on either or both grounds, since it is a strictly concave transformation, and the average of the logarithms of incomes tends to increase as the given total income is more equally distributed. However, in the actual use of this formula in UNDP (1990) the logarithmic transformation was applied not to the individual incomes but to the average income of the nation, and this immediately obliterates that possibility of equality-preference in assessing the national situation. The unfortunate fact, however, is that the information we have on individual incomes is very limited indeed for most countries (and nearly absent for some), so that any attempt to use such a distributive correction on the basis of detailed individual income data is bound to be unrealistic at the present time. This is not the only respect in which practical feasibility limits the scope for using more adequate criteria of human development, and the compromises reflect what can be sensibly done here and now.

However, in the context of the more advanced countries (such as those in North_America or in Europe, or Japan), the distributional information is much better. This is among the arguments for trying to do some additional analysis for a particular group of countries, even though the same exercise would not be useful for another group (see Section 4). There is a case for using the distributional measures available for more advanced countries to correct the figures for GDP per capita, and this is what is being done in this 1993 Human Development Report. In taking note of inequality in the distribution of incomes, it is possible to use various alternative measures of inequality. Perhaps the most widely available information on income distribution is that given by the Gini coefficient. This measure of inequality has many limitations, and it is not particularly easy to use in building up an overall picture of inequality on the basis of inequalities within and between groups.[7]

On the other hand, it does also have some merit in terms of conceptual understandability and axiomatic interpretation.[8] It can even be shown that calculated with appropriate price indices, a view of social welfare based on rank-order weighted individual income levels is well expressed by a Gini-corrected mean national income. That is, when G is the Gini coefficient, and m is the mean national income, the average income corrected by rank-order weights, W , is given by:

$$W = m(1 - G).$$

If the social value of a commodity j going to individual i is seen to depend in a multiplicative way on the price of that commodity j (positively related) and on the income level y_i of person i (negatively related), and if furthermore the latter relation is seen in the simple terms of attaching a weight of n to each dollar of the n-th richest person (that is, a higher weight on a poorer person's dollar given by the rank in the income order), then m(1 - G) does indeed turn out to be quite significant. In particular, if one nation has a higher value of m(1 - G) in terms of its own price structure than another, then it can be seen as having a higher social welfare level than the latter, given the specified interpretations.[9]

This model does, of course, have many limiting assumptions, and its focus on commodities as the only ultimate source of individual well-being or social welfare is clearly a gross oversimplification. But the commodity concentration can indeed be supplemented by other criteria that focus on other aspects of human development. For example, for the more advanced countries, the possibility of using Gini-corrected

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[7]   *The problem is one of lack of decomposability of the Gini coefficient, ...; see Anand (1983).*

[8]   *See Sen (1973, 1976), Pyatt (1976, 1987), Anand (1983), ...*

[9]   *On this and related results, see Sen (1976), Hammond (1978), Roberts (1980).*

income measures (reflecting one aspect of human development) can be supplemented by information on life expectancy and related criteria such as maternal mortality and child (under-five) mortality, and also by educational information -- not just literacy but also the proportions of secondary and higher-educated population.

[Many such indicators are possible, and no doubt in the future Human Development Reports more will be brought into the realm of systematic analysis. In this 1993 Human Development Report in particular, the overall HDI applied to all countries would be supplemented by the use of a particular index for more advanced countries that takes note of nine variables discussed in Section 4.]

2.2 Life Expectancy and Inequality

Is there an exactly similar case for using some distribution corrected measure of life expectancy as there is for income level? The case cannot in fact be exactly similar, since life expectancy clearly has an intrinsic importance in a way that income does not, so that the efficiency argument for equality applies more simply in the case of incomes than with life expectancies. For example, the utilitarian argument for a more equal distribution of incomes on grounds of shared diminishing marginal utility simply does not translate into an argument for a more equal distribution of life expectancies, if life expectancies are seen, unlike incomes, as valuable in themselves.

The line, however, is not really very sharp, since life expectancy can be thought to be both valuable in itself and also helpful for pursuing other objectives. There may well be diminishing returns in the pursuit of those other objectives. Thus, the efficiency argument is not entirely irrelevant to the importance of reducing inequalities in the distribution of life expectancies. Furthermore, there is also the "equity argument" for the distribution of longevities. Taking both these into account, there remain good reasons to be concerned not only with the average life expectancy value, but also with its distributive pattern, even though the case is not altogether analogous to that of income distribution.

The distributive issue in the context of life expectancies also differs in another respect from the income distributional question. Life expectancy is, by its very nature, an average figure, representing the expected value of the number of living years of a group member. A person does not have a life expectancy in the same way as he or she has an individual income -- as a particular achievement. A person has a life expectancy as a member of a group, and this is a statistically expected value. So the concept of individual life expectancy is not viable in the way that individual income is, and the problem of distribution must, of necessity, take an inter-group form in the context of life expectancies.

Life expectancies can indeed be separately calculated for a population classified according to class, gender, and other categories, and they can be very useful in understanding the overall social picture. Unfortunately, the quality of life-expectancy data is often not very good, and this has caused some worries in interpreting and using the Human Development Index (HDI) from past reports.[10] The scope for using reliable life expectancy figures for different groups within a nation is typically quite limited. However, there are exceptions in those cases in which the demographic information is collected in an already well-classified form.

This applies to the distinction between male and females, and to some extent also to differences between regions in a country (such as states in India or provinces in China). The case for using sex-specific life expectancy is particularly strong for a different reason as well. There is considerable medical

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[10]   See Srinivasan (1992); also Chamie (1992).

evidence to suggest that if males and females receive similar health care, nutritional opportunities, and so on, women tend to have significantly lower death rates at most age groups and end up living much longer than men do. This is so despite the fact that in many parts of the world men outnumber women by a large margin. This is so not just because of the fact that more males are born than females (as they are all over the world). Indeed, despite that higher male ratio at birth, women are much more numerous than men -- by about 5 percent or so -- in Europe and North America, mainly because of systematically lower age-specific death rates. In those countries in the world -- mostly in Asia and North Africa -- where males predominate in number, there is evidence of serious neglect of women vis-à-vis men (and particularly of girls vis-à-vis boys).[11] There seems to be little reason to doubt that as the inequalities of attention between males and females reduces and disappears (and as general life expectancy rises), these countries too will have a preponderance of females over males.

The higher potential life expectancy of females vis-à-vis males is anticipated in the demographic projections for the future as well. For example, a projected life expectancy of 87.5 years for females and 82.5 years for males have been averaged to give something like 85 years of average life expectancy for the world population in 2050.[12]

In the context of this difference between life expectancy potentials, the lower actual life expectancy of females in many parts of the world may be thought to be particularly unfortunate. This point may be readily accepted, but a related point that is sometimes ignored concerns the fact that an equal life expectancy of males and females may still indicate a systematic anti-female bias in the distribution of health care, nutrition, and other ingredients of living. If such unequal treatment is thought to be itself objectionable, no matter how equal or unequal the resulting life expectancies are, then there is a good case for not trying to eliminate inequality in life expectancies irrespective of gender. In fact, a distributional correction (for example, like that through the Gini coefficient) applied here -- in analogy with the income distribution correction -- can, in this context, end up being highly inegalitarian in terms of its impact on basic equality of treatments. Since it is, in general, easier to expand the life expectancy of females than of the males when they have the same level of life expectancy, it can even be argued that concentrating on enhancing the simple average of life expectancy is more fair than the use of a distribution-corrected life expectancy would be (in this specific respect).

In the present Report the overall HDI uses life expectancy in the aggregated form, but at the same time the life expectancies of females and males are also identified and analyzed separately in particular applications (see Section 3.3).

2.3 Literacy and Education

The question of distribution correction is not a terribly central one for an index of education that is based simply on whether or not the person is literate (as the literacy part of the traditional HDI is). The individual value of achievement can then take only a 0 or 1 form, and the problem of diminishing returns does not directly arise.

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[11]   See Sen (1992b) and the literature cited therein.

[12]   See Barbara Torrey (   ), ...

On the other hand, it is possible to go into the distributional question when the attention shifts to more variegated indicators of education. Here again, there is some advantage in looking at intergroup differences, rather than at the purely size distribution of educational attainments, given the social interest in inter-group contrasts. The difference between male and female educational achievements is particularly important both because of question of gender justice and because of the practical importance -- confirmed in many empirical studies -- of the long-run impact of women's education on social well-being of both women and men.[13]

3. Reviewing the Construction of the Human Development Index

In the last three <u>Human Development Reports</u>, the human development index (HDI) has been formulated in terms of a country's deprivation or shortfall in each of three separate dimensions -- life expectancy (X_1), education (X_2), and adjusted income (X_3). The shortfall perspective has some merit in drawing attention to the distance a country still has to travel in order to achieve what is regarded as a desirable target or goal. Thus the 1990 Report defined I_{ij} as the deprivation indicator for country j with respect to variable X_i as

$$I_{ij} = \frac{\max_{k}\{X_{ik}\}-X_{ij}}{\max_{k}\{X_{ik}\}-\min_{k}\{X_{ik}\}} .$$

By construction each deprivation indicator for country j, I_{ij}, $i = 1,2,3$, lies between 0 and 1. An average deprivation index I_j for country j across the three variables was defined as a simple unweighted average of the I_{ij}:

$$I_j = \frac{1}{3}\sum_{i=1}^{3} I_{ij} .$$

The shortfall in the human development index for country j was then defined to be just this average deprivation. Thus if H_j is the human development index for country j, we have, by definition $1 - H_j = I_j$ or $H_j = 1 - I_j$.

For some purposes, however, it is preferable to express the human development index H_j in terms of the attainments rather than shortfalls of country j. This formulation certainly seems more natural if one wishes to assess changes in HDI over time. The attainment perspective is more relevant in assessing how <u>well</u> a country is doing, whereas the shortfall perspective is more relevant in looking at the <u>difficulty</u> of the task still remaining.[14] Which perspective we adopt depends on the nature of the exercise.

We now express H_j directly in terms of the attainment levels X_{ij}. From the above,

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[13] *See Caldwell (1986), Preston (1975), ...*

[14] *The distinction between assessing what Hicks (1939) referred to as "substitution" (as in welfare indifference curves) and "transformation" (as in production possibilities), respectively, is relevant here.*

$$H_j = 1 - \frac{1}{3}\sum_{i=1}^{3} I_{ij}$$

$$= \frac{1}{3}\sum_{i=1}^{3} (1 - I_{ij})$$

$$= \frac{1}{3}\sum_{i=1}^{3}\left[1 - \frac{\max_{k}\{X_{ik}\} - X_{ij}}{\max_{k}\{X_{ik}\} - \min_{k}\{X_{ik}\}}\right]$$

$$= \frac{1}{3}\sum_{i=1}^{3} \frac{X_{ij} - \min_{k}\{X_{ik}\}}{\max_{k}\{X_{ik}\} - \min_{k}\{X_{ik}\}}$$

$$= \frac{1}{3}\sum_{i=1}^{3} H_{ij},$$

where

$$H_{ij} = \frac{X_{ij} - \min_{k}\{X_{ik}\}}{\max_{k}\{X_{ik}\} - \min_{k}\{X_{ik}\}}$$

is the ith variable's contribution to the human development index for country j.

Some commentators of the <u>Human Development Report 1990</u> have been disconcerted by this normalization of each component H_{ij} of the aggregate index H_j. They point out, for example, that an improvement in the achievement of the lowest-achieving country in the sample would decrease the HDI for country j, and this is not the sort of externalities that one wants in an index. But the human development index in the 1990 (and subsequent) Reports was constructed expressly as measure of <u>relative performance</u> across countries at a point in time. No special significance is attached to the absolute value of the index, the entire analysis being conducted in terms of the <u>ranking</u> of countries

relative to one another. Thus although a higher value of $\min_{k}\{X_{ik}\}$ or of $\max_{k}\{X_{ik}\}$ would indeed decrease for H_{ij} for country j, it would do so for all other countries ℓ too, and in proportion to the gap $(H_{ij} - H_{i\ell})$ between countries j and ℓ. This, of course, has the effect -- given the basic information -- of leaving the relative ranking of countries unchanged.[15]

As defined, the human development index H_j for country j is invariant to positive affine transformations of the underlying variables X_i, $i = 1,2,3$. Thus if one were to substitute for each $i = 1,2,3$, $Z_i = a_i X_i + b_i$ where $a_i > 0$, the absolute value of each H_{ij}, and therefore also of H_j, would remain the same. In particular, if one changed the units of measurement of X_i by either scale changes ($a_i > 0$) or level changes ($b_i \neq 0$), the indices H_{ij} and H_j would have the same numerical values as before.

3.1 Measuring Human Development Over Time

While the first two Human Development Reports have been careful to avoid intertemporal comparisons of HDI for a given country j, we should enquire whether H_j as defined above can satisfactorily measure progress in human development over time. In taking the time derivative of H_j, which we denote as $\dot{H}_j$, it is clear from the definition that $\dot{H}_j$ will depend on $\dot{X}_{ij}$ for $i = 1,2,3$, i.e. the changes in attainment by country j along each of the three dimensions of human development. But $\dot{H}_j$ will also depend on the time derivatives of $\min_{k}\{X_{ik}\}$ and $\max_{k}\{X_{ik}\}$ for $i = 1,2,3$ -- in other words, the performance over time of the worst and best performers in the sample of countries for each variable i. Whereas this is not a problem for intercountry comparisons at a given point in time (as demonstrated in the previous subsection), for the purposes of comparing a given country's performance over time, the "goalposts" for each variable X_i must

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[15] *Even more can be said. If we were to apply a monotonic-increasing transformation $\Phi(.)$ to the original X_i, the ranking of countries by H_{ij} would remain the same. In other words,*

$$\frac{X_{ij} - \min_{k}\{X_{ik}\}}{\max_{k}\{X_{ik}\} - \min_{k}\{X_{ik}\}} > \frac{X_{i\ell} - \min_{k}\{X_{ik}\}}{\max_{k}\{X_{ik}\} - \min_{k}\{X_{ik}\}}$$

and only if if

$$\frac{\Phi(X_{ij}) - \min_{k}\{\Phi(X_{ik})\}}{\max_{k}\{\Phi(X_{ik})\} - \min_{k}\{\Phi(X_{ik})\}} > \frac{\Phi(X_{i\ell}) - \min_{k}\{\Phi(X_{ik})\}}{\max_{k}\{\Phi(X_{ik})\} - \min_{k}\{\Phi(X_{ik})\}}$$

all $\Phi(.)$ sucfothat $\Phi(.) > 0$. In this sense, each component H_{ij} of H_j is an ordinal measure.

be held constant. In this way changes in HDI over time for country j will depend only on changes in X_{ij} over time for country j -- and not on how the worst- and best-performing countries are also doing.[16]

Granted that the "goalposts" need to be fixed if the HDI is to be comparable over time, we need to ask how the goalposts should be determined. It will not be enough to fix the range of values for each X_i by simply looking at the minimum and maximum levels achieved retrospectively, say in the period from 1960 to 1990. We also need to look prospectively at the projections for each X_i and ensure that individual country levels will remain inside the range forecast in the future, in other words, over the entire period -- backward and forward -- during which intertemporal comparisons are required to be undertaken.

In the main this affects the range for the longevity variable. Looking back in time to a point when sufficient data were available for intercountry comparisons (e.g. the year 1960), the minimum level of life expectancy at birth achieved was about 35 years. For comparisons in the future going as far as 2050, national life expectancy at birth has been projected to reach 85 years for some countries [see Barbara Torrey ( ) and other references...]. Thus keeping to the basic definition of HDI, we choose as our fixed endpoints for X_1 a minimum value of 35 years and a maximum value of 85 years. This range encompasses the lower and upper bound of life expectancy estimates over which both cross-country and intertemporal comparisons of HDI are envisaged.

As far as the literacy variable is concerned we choose the natural range of 0 to 100 percent. Although the lower end of the range is at the present time unlikely to be experienced at a national level, there are disaggregations we are proposing for which literacy rates even today fall below 10 percent (e.g. the female adult literacy rate in Burkina Faso or Somalia). Moreover, if intertemporal comparisons were to start back from 1960, we would indeed be approaching the lower end of the 0 to 100 percent range in some cases. Hence, we take 0 to 100 percent as the min-max interval for adult literacy.[17]

The final component of HDI is the logarithm of per capita GDP in 1987 Kravis dollars truncated at the average official poverty line income in nine developed countries. The logarithmic transform of income is taken in order to reflect diminishing returns to transforming income into human capabilities. The ceiling on income at the poverty line is imposed because of the particular relevance of poverty removal in human development [Desai (1991:355)]. The upper bound of the min-max range for the income variable is kept constant over time at the logarithm of PPP\$4,861 in 1987 prices. The lower bound for the variable again poses a slight difficulty: we choose a value of 0 to reflect negligible human development beyond the minimal levels of life expectancy and literacy achieved in the past in some countries.

3.2 Disaggregation of HDI by Population Subgroups

We shall often want to examine the state of human development within population subgroups in a country. Such subgroups may be defined relative to geographical or administrative region, stratum (i.e. urban-rural residence), ethnicity, or occupation and other characteristics of the household head. Our formulation of the HDI in terms of fixed goalposts allows us to measure human development within such

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[16]   This has to be slightly modified if there is more than one worst- or best-performing country at a point of time. In this case, it is the slope of the lower and upper envelope of the time paths of X_{jk} for all countries k with respect to which the relevant derivatives must be defined.

[17]   A lower bound of 0 for life expectancy is much harder to defend. Using a range of [35, 85] instead of [0, 85] for life expectancy will incidentally have the effect of increasing the weight on longevity relative to literacy in the HDI. However, using a [0,85] range creates a problem for the male-female disaggregation of HDI that we propose to undertake (see Section 3.3).

subgroups in a reasonably consistent manner. With the ranges of X_1 (life expectancy), X_2 (literacy), and X_3 (logarithm of per capita GDP up to the poverty line) as above, the HDI for country j can be expressed simply as:

$$H_j = \frac{1}{3}\left[\frac{X_{1j}-35}{50} + \frac{X_{2j}}{100} + \frac{X_{3j}}{3.687}\right].$$

It is useful in some contexts to be able to express the overall index as a weighted average of its subgroup indices for any partition of the national population into mutually exclusive and exhaustive subgroups (such as regions within a country). The HDI is not, however, disaggregable in a strictly subgroup-consistent manner, such that the overall index can be built up from information about the subgroup index values and population (or income) shares only. There are three reasons why such disaggregation proves to be impossible. First, and most importantly, the variable X_3 is non-linear in income -- it is, specifically, the logarithm of income. The population-weighted average of the logarithm of per capita income for each subgroup is not the logarithm of average per capita income for the national population as a whole.[18] Secondly, the average life expectancy at birth and average literacy rate for the national population are not strictly-speaking the population-weighted averages of life expectancy and literacy at the subgroup level. In the case of life expectancy, the appropriate weights are the subgroup shares of total births, and in the case of literacy, the appropriate weights are the subgroup proportions of adults aged 15 and above. These latter sets of weights will not necessarily be the same as the population shares of the subgroups.

3.3 Disaggregation of HDI by Gender

As discussed in Section 2.3, there is considerable evidence of anti-female bias in some countries in the world. This takes the form of unequal treatment in access to food, health care, education, employment and income-earning opportunities -- and is reflected in differential achievements of women relative to men. Gender bias exists both within the household and outside the household, for example, in the labour market or the provision of public health services. We should like to use the HDI to illuminate the gender disparities that result from such unequal treatment.

Unlike conventional measures of development, such as those based on income or the possession of commodities, the HDI is particularly well-suited to examining gender inequalities. The reason is that the informational requirements of resource-use measures such as income -- especially when estimation of their allocation within the household is involved -- makes them very problematic in shedding light on inter-individual differences.[19] By contrast, the consequences of female disadvantage and gender bias, both intra- and extra-household, will be reflected in the achievements of the individuals concerned in terms of their life expectancy, literacy, survival chances, and so on. Data on these achievements are collected not at the household level through household income and expenditure surveys, but at the individual level through demographic surveys and population censuses. There is, thus, a strong practical reason -- in

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[18] *The population-weighted average of the logarithms of per capita income is equal to the logarithm of the geometric mean of per-capita incomes of the subgroups, not their arithmetic mean (which is what would be required for subgroup-consistent disaggregation).*

[19] *See, however, Deaton (1987), and other references....*

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addition to concern for what is intrinsically important -- in adopting the HDI to examine gender and other inter-individual disparities.

In considering the disaggregation of HDI by gender, we must take note -- as argued in Section 2.3 -- of the higher potential life expectancy of females vis-à-vis males. For fixing the separate goalposts of life expectancy for females and males over the period in question (from around 1960 to around 2050), the minimum and maximum average levels of life expectancy are taken to be 37.5 and 87.5 years for women, and 32.5 and 82.5 years for men. Thus the life expectancy range is 50 years for both women and men; this implies that a unit increase in longevity for either sex (over time) will contribute the same increment to the overall HDI. This procedure is in keeping with a "distributive concept" in which, as Aristotle argued, "people should do best in so far as their circumstances admit".[20]

The range for adult literacy is the same for females and males, as is that for the logarithm of per capita GDP truncated at the poverty line income. While separate adult literacy figures are in general available by gender, sex-specific estimates of income-use are difficult, if not impossible, to establish with any accuracy even for the advanced industrial countries (for the reasons mentioned earlier). Thus if F and M refer to females and males, respectively, the female and male HDIs for country j are given by

$$H_j(F) = \frac{1}{3}\left[\frac{X_{1j}(F) - 37.5}{50} + \frac{X_{2j}(F)}{100} + \frac{X_{3j}(F)}{3.687}\right]$$

and

$$H_j(M) = \frac{1}{3}\left[\frac{X_{1j}(M) - 32.5}{50} + \frac{X_{2j}(M)}{100} + \frac{X_{3j}(M)}{3.687}\right].$$

argued in Section 3.2, the overall HDI for country j, H_j, will not be equal to the population-weighted average of the two subgroup HDIs for females and males, $H_j(F)$ and $H_j(M)$, respectively.

4.   Supplementary Criteria for Measuring Human Developmentin the Advanced Countries

The concept of human development that we have discussed hitherto has been concerned only with the enhancement of very basic capabilities of people. We have assessed these capabilities in terms of the elementary achievements of life expectancy at birth, adult literacy, and a logarithmic transform of income up to the poverty line. It is not surprising, therefore, that the HDI which incorporates just these three variables will not have much cutting power to distinguish between the performance of various advanced industrial countries. Most countries in this group have per capita GDP levels which exceed the average poverty line income specified, and thus have a value for this component of HDI (H_{3j}) equal to unity. Moreover, the adult literacy rates for the advanced countries -- whether empirically estimated or assumed -- are all in the high 90s.[21] Thus the discrimination among countries with the highest levels of HDI (say the top 15 or 20 countries) is largely due to their small life expectancy differences. In one sense, this is how it should be, if the HDI is trying to measure only basic human

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[20]   Reference to Aristotle, *Politics*, VII.1. Or better reference.
[21]   Most of the assumed adult literacy rates for this group of countries are as high as 99 percent.

development; survival would seem to be a prerequisite for the enjoyment of any other capability or functioning.

Yet once we take note of the high and similar levels of achievement of basic capabilities, it becomes relevant to assess performance using more refined capabilities. Indeed one can divide all countries into three groups -- on the basis of their achieved HDI values -- as has been done in the 1990 Human Development Report. For countries with a "low" level of human development (say with a recomputed HDI value on HDR 1990 data of 0.610 or less), we simply use the basic HDI to rank and assess their performance. For countries with a "medium" level of human development (say with a recomputed HDI value on HDR 1990 data greater than 0.610 but less than or equal to 0.820), we add one supplementary indicator belonging to each of the three categories of basic variables. In the survival (longevity) category, we add under-5 (i.e., infant and child) mortality; in the education category, we add secondary school enrollment; and in the income category, we add the incidence of income poverty in the country. For countries with a "high" level of human development (say with a recomputed HDI value on HDR 1990 data greater than 0.820), we add a further supplementary indicator to the two already existing for each category in the "medium" human development group. In the survival (longevity) category, we add the maternal mortality rate; in the education category, we add tertiary enrollment; and in the income category, we add the Gini-corrected mean national income (i.e., per capita GDP multiplied by (1-G)) -- as discussed in Section 2.1.

A simple table will help illustrate this schema:

Human Development Level	Low	Medium	High
Human Development Indicators	1.1 Life expectancy	1.1 Life expectancy 1.2 Under-5 mortality	4.1 Life expectancy 1.2 Under-5 mortality 1.3 Maternal mortality
	2.1 Adult literacy	2.1 Adult literacy 2.2 Secondary school enrollment	2.1 Adult literacy 2.2 Secondary school enrollment 2.3 Tertiary enrollment
	3.1 Log per capita GDP (up to international poverty line)	3.1 Log per capita GDP (up to international poverty line) 3.2 Incidence of poverty	3.1 Log per capita GDP (up to international poverty line) 3.2 Incidence of poverty 3.3 Gini-corrected mean national income

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**HUMAN DEVELOMENT
REPORT 1990**

The Report addresses, as its main issue, the question of how economic growth translates — or fails to translate — into human development. The focus is on people and on how development enlarges their choices. The Report discusses the meaning and measurement of human development, proposing a new composite index. But its overall orientation is practical and pragmatic. It summarises the record of human development over the past three decades, and it analyses the experience of 14 countries in managing economic growth in the interest of the broadest possible number of people. With this as its foundation, the Report then sets forth strategies for human development in the 1990s, emphasizing the importance of restructuring budgetary expenditures, including military expenditures, and creating an international economic and financial environment conducive to human development.

**HUMAN DEVELOPMENT
REPORT 1991**

The lack of political commitment, not of financial resources, is often the real cause of human neglect. This is the main conclusion of *Human Development Report 1991* — the second in a series of annual reports on the subject. The Report points to an enormous potential for restructuring of both national budgets and international aid allocations in favour of human development. But the plea for greater allocative efficiency and more effective spending does not mean indifference to the need for economic growth, or for increased resource mobilization. On the contrary. The Report's position is that a more efficient and effective public sector will help strengthen the private role in human development. And the best argument for additional resources is that the existing funds are well spent.

**HUMAN DEVELOPMENT
REPORT 1992**
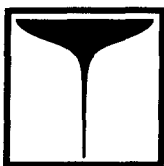
The Report suggests a two-pronged strategy to get out of this dilemma. First, making massive investments in their people and strengthening national technological capacity can enable some developing countries to acquire a strong competitive edge in international markets (witness the East Asian industrializing tigers). Second, there should be basic international reforms, including restructuring the Bretton Woods institutions, setting up a Development Security Council within the United Nations, and convening a World Summit on Social Development to consider a global compact for all nations and all people.

**HUMAN DEVELOPMENT
REPORT 1993**

The Report examines how and how much people participate in the events and processes that shape their lives. It looks at three major means of peoples's participation: people-friendly markets, decentralized governance and community organizations, especially non-governmental organizations (NGOs), and suggests concrete policy measures to address the growing problem of jobless growth. The Report concludes that five pillars of a new people-centred world order must be built: • new concepts of human security • new strategies for sustainable human development • new partnerships between state and markets • new patterns of national and global governence • new forms of international cooperation.

**HUMAN DEVELOPMENT
REPORT 1994**

The Report introduces a new concept of human security, which equates security with people rather than territories, with development rather than arms. It examines both the national and the global concerns of human security. The Report seeks to deal with these concerns through a new paradigm of sustainable human development, capturing the potential peace dividend, a new form of development cooperation and a restructured system of global institutions. It proposes that the World Summit for Social Development approve a world social charter, endorse a sustainable human development paradigm, create a global human security fund by capturing the future peace dividend, approve a 20:20 compact for human priority concerns, recommend global taxes for resource mobilization and establish an Economic Security Council.

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