GENDER INEQUALITY IN HUMAN DEVELOPMENT: THEORIES AND MEASUREMENT[1]

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1. Motivation

Over the past five years, a great deal has been achieved by the Human Development Report of the UNDP in shifting the focus of attention of the world community from such mechanical indicators of economic progress as GNP and GDP to indicators that come closer to reflecting the well-being and freedoms actually enjoyed by populations. Even though the Human Development Report has been influential primarily because of the extensive and detailed statistical analyses of achievements and limitations of living conditions of people in different parts of the contemporary world, the aggregative Human Development Index (HDI) also has played some part in bringing about this reorientation. Despite the obvious limitations of the HDI (arising in part from its attempt to capture a complex reality in a summary form with imperfect data), it has served as something of a rival to the other summary indicator — the aggregative GNP, which hitherto had been almost universally used as the premier index of the economic achievement of nations.

The HDI has clearly been able to present some aspects of human development that the GNP tends to miss.

From the beginning, the Human Development Report has been concerned with inequalities in the opportunities and predicaments of women and men. Although this perspective has received some attention in past Reports, there is a strong case at this time for concentrating specifically on that issue for a more comprehensive investigation of gender inequality in economic and social arrangements in the contemporary world.

In performing this task, there is need for fresh economic and social analyses as well as careful and probing empirical research. Women and men share many aspects of living together, collaborate with each other in complex and ubiquitous ways, and yet end up — often enough — with very different rewards and deprivations. This note is specifically concerned with developing a framework for "gender-equity-sensitive indicators" of achievements and freedoms. The methodology for this is explored in the sections that follow, ending with specific recommendations to be put into practice.

While this exercise must be a crucial part of the important task that is now being undertaken by the programme of the Human Development Report, there are two other aspects of gender deprivation to which this Report must also pay some attention. First, aside from developing "gender-equity-sensitive indicators", the approach must also look at gender inequality per se. The investigation of such inequalities must have a close link with the development of equity-sensitive overall indicators, and it would be important to explore how the inequality measures should relate to the approach of using gender-equity-sensitive indicators (GESI).

Secondly, aside from looking at the state of advantages and deprivations that women and men respectively have, there is an important need to look at the contrast between (1) the efforts and sacrifices made by each, and (2) the rewards and benefits respectively enjoyed. This contrast is important for a better understanding of gender injustice in the contemporary world. The exacting nature of women's efforts and contributions, without commensurate rewards, is a particularly important subject to identify and explore.

Thus characterized, the new initiative in this Human Development Report has three distinct departures to make, concerning respectively:

(1) the development and use of gender-equity-sensitive indicators;

(2) the formulation and utilization of measures of gender equality and inequality; and

(3) the identification of efforts and contributions made by women that go unrecognized in standard national income and employment statistics.

This paper is primarily concerned with the first two of these three fields, but some analysis of the last problem will also be presented.

2. Group Inequality and Aggregation: The Basic Structure

Aggregate indicators of life expectancy, literacy, and other advantages used in the UNDP's Human Development Report have tended to ignore distributional concerns, using a simple arithmetic average of achievement (or shortfall), in each dimension, over the entire population.[2] Such an average overlooks systematic and potentially large differences between distinct groups of people, in particular women and men, but there are disparities also between different classes, racial groups, regional populations, and so on. We focus here on gender differentials in achievement, but the issues discussed would, to a considerable extent, apply to other inequalities as well.

We may begin by examining the inequality between women and men in a dimension where the "potentials" of the two groups are not really different. Literacy is an obvious example. In contrast, in the case of life expectancy, we must take note of the evident biological advantage in survival of females over males (on this, see Waldron 1983, Sen 1992b, Anand 1993, and the references cited there). Given symmetric treatment in nutrition, health care, and other conditions of living (including the duration and intensity of work), women have systematically lower age-specific mortality rates than men, resulting in a life expectancy for women that is significantly higher than that for men — possibly by some five years or more. There is no corresponding difference in the potential for adult literacy (that is, in the percentage of the population aged 15 and above that is literate).

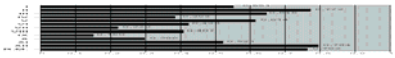
For a given level of mean achievement, relative inequality between groups has some obvious simplicity when there are just two groups. For example, if the first element of the pair (X_f, X_m) represents the female literacy rate for a country, and the second element the male literacy rate, the Human Development Report 1994 (Table 5, pp. 138-39) shows three countries with the same mean or overall literacy rate of 80 percent distributed between females and males as follows: China (68, 92), Malaysia (72, 89), and Mauritius (75, 85). Comparing these three countries, it seems clear that gender inequality in literacy is highest in China and lowest in Mauritius. Similarly, at a higher level of mean achievement of 84 percent literacy rate, gender inequality in Indonesia (77, 91) is greater than in the Dominican Republic (83, 86).

The assessment of relative inequality in achievement can be reasonably perspicuous when there are only two groups — as in the case of gender. The larger the gender gap, holding the overall mean constant, the larger is inequality as measured by any index belonging to the Lorenz class (see Anand 1983, Appendix D); this class includes most commonly used inequality measures such as the Gini coefficient, the two Theil indices, the Atkinson index, and the squared coefficient of variation. A bigger gender gap, with the same overall mean (and the same population proportions of the two groups) is equivalent to a simple mean-preserving regressive transfer. (In terms of Lorenz curves,

this would correspond to an unambiguously lower curve.) In the special 2-group case, disparity ratios or gaps will unambiguously reflect the inequality in achievement between the two groups. Given equality preference and the same overall mean, more relative inequality will indicate a worse social state of affairs, and this evaluative feature must be reflected in the gender-equity-sensitive indicators.

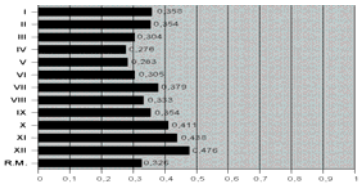
This simple recognition still leaves open the question of what would be appropriate standards of comparison when the overall or mean levels of achievement are different. In particular, how might we think about "trading off" more relative equality against a higher absolute achievement? Honduras, for example, has a total literacy rate of 75 percent divided between females and males as (73, 78).[3] Should this social outcome be judged worse or better than the case of China, which has a total literacy rate of 80 percent distributed as (68, 92) between females and males? Honduras has less gender inequality in literacy levels than China, but it also has a lower overall rate of literacy. A comparison between the two countries now calls for some way of assessing the comparative claims of more relative equality against higher absolute achievement. An explicit evaluative exercise on this "trade off" will be required in such situations.

We begin with the approach explored by A.B. Atkinson (1970) for the purposes of measuring relative income inequality, and extend this analysis to fit our task.[4] Let X be the indicator of achievement, and let X_f and X_m refer to the corresponding female and male achievements. If n_f and n_m are the numbers of females and males in the population,



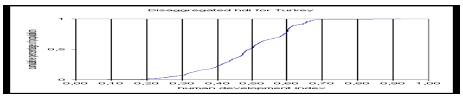
respectively, then the overall or mean achievement is given by

We posit a social valuation function for achievement which is additively separable, symmetric, and of constant elasticity marginal valuation form



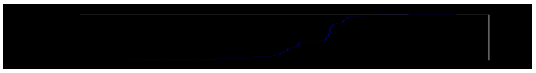
up to a positive affine transformation. Only values of 0 are considered so as to reflect a preference for equality in the social valuation function.

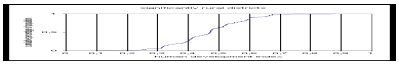
For any pair (X_f, X_m) of female and male achievements, we can construct an "equally distributed equivalent achievement" X_{ede}. This is defined to be the level of achievement which, if attained equally by women and men, as (X_{ede}, X_{ede}), would be judged to be exactly as valuable socially as the actually observed achievements (X_f, X_m). According to



the formula for social valuation, for a given , X_{ede} is thus defined through the equation

which implies that





where we define the proportions $p_f = n_f/(n_f + n_m)$ and $p_m = n_m/(n_f + n_m)$. Hence X_{ede} is formed from (X_f, X_m) by taking what we shall call a "(1-)-average" of X_f and X_m rather than a simple arithmetic average of the female and male achievements.[5] In the case when = 0, X_{ede} reduces to , the simple arithmetic average; here there is no concern for equality, and the arithmetic mean indicates the social achievement. But when > 0, there is a social preference for equality (or an aversion to inequality) which is measured by the magnitude of the parameter .

Assuming that female achievement falls short of male achievement, i.e. (0) $X_f < X_m$, the following results can be demonstrated for "(1-)-averaging"[6]:

(1) X_f X_{ede} X_m .

(2) The larger is , the smaller is X_{ede} (given $X_f, X_m > 0$).

(3) X_{ede} for 0 (with equality holding when = 0).

(4) X_{ede} X_f as .

Result (4) corresponds to the Rawlsian maximin situation where social achievement is judged purely by the achievement of the worst-off group, which in the case of gender may typically refer to women.[7] If $X_f < X_m$ in every country, and if (equity preference tending to infinity), then social achievement across countries will be measured by female achievement alone: in the averaging, the weight given to male achievement in excess of female achievement will tend to zero. In this case, the equally distributed equivalent achievement index X_{ede} reduces to the index for the relatively deprived group (typically women), and countries are ranked according to the absolute achievement of women in those countries.

As mentioned earlier, X_{ede} is a "(1-)-average" of X_f and X_m. When = 0, X_{ede} = , the arithmetic average of X_f and X_m. When = 1, X_{ede} is the geometric average; and when = 2, X_{ede} is the harmonic mean of X_f and X_m.[8] When , X_{ede} Min $\{X_f, X_m\}$. The equally distributed equivalent achievement can be calculated for each country for different values of , the parameter of equity preference. Thus if the preference for equity is small (close to 0), China's literacy rates of (68, 92) for females and males, respectively, corresponding to an overall literacy rate of 80 percent, will be judged to be better than Honduras's figures of (73, 78), corresponding to an overall rate of 75 percent. As the equity preference parameter is raised, Honduras's achievement will overtake that of China's; in the limit, as tends to infinity, Honduras's equally distributed equivalent achievement will be 73 while China's will be 68. For all values of above the critical cutoff 5.693, at which the two countries' achievements are the same, Honduras's achievement will be judged to be better than China's.

The equally distributed equivalent achievement X_{ede}, applied to gender differences, yields a measure that is, in fact, a gender- equity-sensitive indicator (**GESI**). This is, of course, an index of overall achievement which takes note of inequality, rather than a measure of gender equality as such. But it uses — explicitly or by implication — equity-sensitive weights on the achievements of the two groups, rather than the unweighted mean of the two sets of achievements that is more commonly used (including, hitherto, in the Human Development Report). It incorporates implicitly something like a gender equality index. The index of relative equality E that underlies X_{ede} can be defined simply as

$E = X_{ede} /$.

This can vary from 0 to 1 as equality is increased[9]; its properties are examined in Appendix A.3, "Properties of the Relative Gender- Equality Index E". Hence, the measure of social achievement

$X_{ede} = E.$ is just the relative equality index E multiplied by the overall or mean achievement measure . Relative equality and mean absolute achievement are thus integrated into the Gender-Equity- Sensitive Indicators (**GESI**). Applying the correction for equality to each of the "human development" indicator (**HDI**) variables and aggregating them would yield a new gender-equity adjusted measure of "human development" — to be called the gender-related development index (**GDI**).

3. Equity-Sensitive Aggregation and Life Expectancy

So far the analysis has been confined to achievements in which the "potentials" of women and men do not differ (for example, each group has the same range of achievable literacy, from 0 to 100 percent). The situation is different, however, when it comes to mortality rates and life expectancy (as was mentioned earlier). Given the evidence of biological differences in survival rates favouring women (with comparable care),[10] we are forced to address the question of the appropriate comparable scales of achievement of life expectancy respectively for women and men. And we have to integrate that differential scaling into the general evaluative scheme of gender-equity-sensitive indexes.

Letting (L_f, L_m) denote the life expectancy at birth of females and males, respectively, the Human Development Report 1994 shows the following comparisons for some advanced countries: Italy (81,74), Finland (80,72), France (81,73), United States (80,73), Japan (82,76). For all high-income countries together, the gender gap in life expectancy in 1992 was six years. The higher potential life expectancy of females relative to males is anticipated in demographic projections of the future as well. For the year 2050, for example, life expectancy projections of (87.5, 82.5) years for females and males, respectively, averaging to 85 years, have been made for the developed countries (Human Development Report 1993, p. 111).

In considering the disaggregation of the Human Development Index (**HDI**) by gender, in our paper (Anand and Sen 1993) for the Human Development Report 1993 we had suggested separate goalposts for maximal life expectancy of 87.5 and 82.5 years for females and males, respectively, that is, a five-year gender gap. The minimum life expectancy levels have been taken to be 37.5 and 32.5 years for women and men, respectively, giving the same range of variation (viz. 50 years) for both sexes. When no adjustment is made for gender inequality, this implies that a unit increase in longevity for either sex will contribute the same increment to the overall **HDI**.

In the corresponding disaggregation of **HDI** in Human Development Report 1993, female and male achievements in life expectancy, X_f and X_m respectively, have been assessed through

$X_f = (L_f - 37.5)/50$

$X_m = (L_m - 32.5)/50.$

The simple arithmetic average  of X_f and X_m, assuming female and male population proportions of ½ each, is then calculated as

 $= ½X_m + ½X_f$

$= (\bar{L} - 35)/50$

where $\bar{L} = (L_f + L_m)/2$ is the average life expectancy attained in the population.

Equality between persons can be defined in two quite distinct ways, in terms of attainments, or in terms of the shortfalls from the maximal values that each can respectively attain. For "attainment equality" of achievements, we have to compare the absolute levels of achievement. For "shortfall equality", what must be compared are the shortfalls of actual achievement from the respective maximal achievements of each group. Each of the two approaches has some considerable interest of its own.[11] Shortfall equality takes us in the direction of equal use (relative or absolute) of the respective

$$X_{ede}^{1-\alpha} = \frac{1}{2}X_f^{1-\alpha} + \frac{1}{2}X_m^{1-\alpha}, \quad [(L_{ede} - 35)/50]^{1-\alpha} = \frac{1}{2}[(L_f - 37.5)/50]^{1-\alpha} + \frac{1}{2}[(L_m - 32.5)/50]^{1-\alpha}.$$

potentials. In contrast, attainment equality is concerned with equal absolute levels of achievement (irrespective of what the maximal potentials are).

In those cases in which human diversity is so powerful that it is impossible to equalize the maximal levels that are potentially achievable, there is a basic ambiguity in assessing achievement, and in judging equality of achievement (or of the freedom to achieve). If the maximal achievement of person 1 — under the most favourable circumstances — is, say, x, and that for person 2 is 2x, then equality of attainment would invariably leave person 2 below her potential achievement. Partly as a response to such issues, Aristotle had incorporated, in his Politics, a parametric consideration of what a person's "circumstances admit" and had seen his "distributive conception" in that light. "For it is appropriate, if people are governed best that they should do best, in so far as their circumstances admit — unless something catastrophic happens."[12] It is possible to question this Aristotelian view in terms of the more rough-and-ready rationale of attainment equality, but there is force in the conception of shortfall equality as well, and it is that approach that is being used here for assessing gender equality in the context of life expectancy variations. The gender-equity-sensitive indicators can also be made to take note of the logic behind this approach.

Thus, the approach to adjusting for gender inequality in achievement in the case of life expectancy must first involve a re-scaling to take note of the potentially higher longevity of women. Such adjustments are, in fact, a part of the already used methodology of the Human Development Report, since these re-scalings have to be done whether or not we wish to take explicit note of gender inequality. However, instead of taking a simple arithmetic average of the female and male achievements X_f and X_m, we take a "(1-)-average" with > 0. As before, we form the average X_{ede}, given for 1 through

which reduces to when = 0.[13] Thus we define L_{ede} through

When = 0, $L_{ede} = \bar{L}$. For > 0, $L_{ede} < \bar{L}$

1. Paper prepared for the Human Development Report 1995. For helpful discussions, we are grateful to Mahbub ul Haq and to the other members of the "human development" team.

2. The situation is slightly different in the case of adjusted income, which is based on a logarithmic transform of per capita GDP for the country as a whole (truncated at the official poverty line income for the richer, developed countries). See Anand and Sen (1993).

3. Human Development Report 1994, Table 5, p. 139.

4. See also Kolm (1969), Sen (1973), Anand (1977, 1983), Blackorby and Donaldson (1978, 1984), Osmani (1982), and Foster (1984, 1985).

5. Considering X_{ede} as a function of e*, we can write*
$X_{ede}(\varepsilon) = [\, p_f X_f^{1-\varepsilon} + p_m X_m^{1-\varepsilon} \,]^{1/(1-\varepsilon)}$.
For X_f , $X_m > 0$, $X_{ede}(\ )$ is well-defined for all (positive or negative) except $= 1$. As 1, we can show that $\log X_{ede}(\ ) \quad (p_f \log X_f + p_m \log X_m)$, i.e. the logarithm of the geometric mean of X_f and X_m; hence $X_{ede}(\ )$ tends to the geometric mean of (X_f , X_m). If one of the X_i , say X_f , is equal to 0, then $X_{ede}(\ )$ is well-defined for < 1. But for > 1, $X_f^{1-} = 1/X_f^{(\ -1)}$ as $X_f \to 0$. In this case,
$X_{ede}(\varepsilon) = 1/[\, p_f / X_f^{(\varepsilon-1)} + p_m / X_m^{(\varepsilon-1)} \,]^{1/(\varepsilon-1)}$,
so that $p_f / X_f^{(\varepsilon-1)}$ and the entire denominator of $X_{ede}(\ )$ tends to infinity as $X_f \to 0$. Therefore for > 1, $X_{ede}(\ ) \to 0$ as $X_f \to 0$. Putting together the cases $= 1$ and > 1, the limiting value of $X_{ede}(\ )$ for 1 is zero as one of the X_i , e.g. X_f , tends to zero. Thus we may simply define $X_{ede}(\ ) = 0$ for 1 when X_f or X_m is equal to zero.

6. The Appendices contain a more general discussion and proofs of the major results.

7. There is some ambiguity as to whether this "extreme inequality aversion" leads to simple maximin, or to the lexicographic version of maximin (sometimes called "leximin"), on which see Hammond (1975).

8. By result (2) above, we have the following relationship between the three means when the two numbers X_f and X_m are positive and different: the harmonic mean is less than the geometric mean, and the geometric mean is less than the arithmetic mean.

9. The corresponding measure of relative inequality I is simply the Atkinson index
$I = 1 - (X_{ede} / \overline{X})$. *Under the assumptions made on V(X) in the text, both E and I are mean-independent measures. Indeed, the constant elasticity marginal valuation form is both sufficient and necessary for E and I to be homogeneous of degree zero in (X_f , X_m).*

10. There is indeed strong evidence that the maximal potential life expectancy for women is greater than for men -- given similar care, including health care and nutritional

opportunities (see Holden 1987, Waldron 1983, and the references cited there). Indeed, in most of the "developed" countries, women tend to outlive men by typically six to eight years.

11. On this see Sen (1992a), Chapter 6.

12. The translation is from Nussbaum (1988), who also discusses the precise role that this qualification plays in Aristotle's "distributive conception" (pp. 146-15O; italics added).

13. On the other hand, for = 1, X_{ede} is given through the logarithmic functional form. These formulations are based on the presumption that there are the same number of women as of men — hence the half-and-half division. When this does not hold, the gross mean and the gender-equity-sensitive measure involve weighting the achievements of each group by their respective population shares p_f and p_m (see Appendix A.1).