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Mark McGillivray and J. Ram Pillarisetti

Centre for Research in Economic Development and International Trade, University of Nottingham

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The Authors

Mark McGillivray is Associate Professor of International Development, School of Social Science and Planning, RMIT University, Melbourne, Australia and an External Fellow of CREDIT. J. Ram Pillarisetti is Lecturer in Economics at Monash University, Churchill, Australia.

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Abstract
This paper examines inter-country inequalities in human well-being evident from PPP GDP per capita and three composite indicators of development levels proposed and reported by the United Nation's Development Program (UNDP): the Human Development Index (HDI), the Gender-related Development Index (GDI) and the Gender Empowerment Measure (GEM). A number of inequality indices are calculated using data for the period 1992 to 1998. A special interest of the paper is whether the UNDP's composite indicators, the GDI and GEM in particular, tell different stories with respect to inequality than PPP GDP per capita. Results indicate that the answer to this question is a qualified yes, being dependent on how the latter is interpreted and measured. In particular, measuring it in logarithmic terms almost always yields lower inequality levels than each of the composite indicators. Other results indicate that the GEM and GDI exhibit slightly higher inequality than the HDI.

Outline

I. Introduction

Inter-country development or human well-being levels have received increased attention in recent years. This is in large part due to the work of the United Nations Development Programme (UNDP). In an attempt to shift development thinking back to core values, and away from what was seen as an excessive focus on income per capita, the UNDP proposed the now very well known Human Development Index (HDI) in its *Human Development Report 1990* (UNDP, 1990). A composite index, the HDI combines indicators of health, education and purchasing power. The UNDP has in later *Reports* introduced a number of new composite indicators, including the Gender-related Development Index (GDI) and the Gender Empowerment Measure (GEM). Introduced in 1995, these indices are intended by the UNDP to reflect gender inequalities in "human capabilities" and in "key areas of political and economic participation and decision making", respectively (UNDP, 1995). These three indices have received enormous attention from researchers and practitioners, much of which has been critical. The UNDP has seemingly responded to many criticisms (especially of the HDI) and has revised its indices, presenting modified versions in subsequent *Reports*.

The primarily purpose of the UNDP's indices, like income per capita, has been spatial, to compare development levels across countries. As those familiar with the *Human Development Reports* will know well, countries are ranked in terms of their composite indices and classified into high-, medium- and low-human development catogories (UNDP, 1990-99, 2000). Some use of the HDI has also been made to compare changes in development levels over time. Such comparisons have obvious and significant merit. But if development is to be associated with issues of social justice or equity, as it often is, then international inequalities in development levels are also important. Such is the focus of this paper, which looks at inter-country inequalities in not only the HDI, GDI and GEM but also in income per capita. A prime interest in the paper is inequality in the UNDP's composite indicators relative to not only each other but also to that in income per capita. To this extent the paper links with previous research by Ram (1992a, 1992b, 1982, 1980). It seeks to extend and improve upon Ram's important contributions to the literature on international inequality. The main departure of this paper is in its interpretation of income per capita, which is not so much seen as an indicator of income but as one of the quality of life or human well-being[1].

Adjusted values of this variable are used, therefore, to reflect diminishing returns in the conversion of income into well-being.

This paper consists of five sections in addition to the introduction. Brief outlines of the design and composition of the UNDP's indices are provided in Section II. Section III discusses the data, outlines the various inequality indices used in the paper and discusses issues raised by previous research. Results are reported and discussed in Section IV. Concluding remarks are provided in Section V.

II. The HDI, GDI and GEM

It is helpful from the outset to describe the composition and design of the HDI, GDI and GEM as these are issues to which we return later in this paper.[2] The HDI is defined as follows:

$$HDI_i = \frac{1}{k}\sum_{j=1}^{k} I_{j,i} \qquad (1)$$

where $I_{j,i}$ is the jth index of a specific dimension of human development in country i, and $i = 1, ..., p$. There are three dimensions and hence component indices: longevity ($I_{1,i}$), educational attainment ($I_{2,i}$) and income or (material) standard of living ($I_{3,i}$). Each of the variables comprising these indices are scaled within the range of zero to one using the equation:

$$X_{j,i} = \frac{x_{j,i} - x_j^{min}}{x_j^{max} - x_j^{min}} \qquad (2)$$

where $X_{j,k,i}$ is the ith component of $I_{j,i}$ for country i, $x_{j,i}$ is the value of that component prior to scaling, x_j^{max} is a so-called "maximum" value of $x_{j,i}$ and x_j^{max} is a so-called "minimum" value, although these values are fixed by the UNDP (UNDP, 1997).

The longevity index ($I_{1,i}$) is a linear function one variable only: the number of years a newborn infant would be expected to live based on current mortality patterns. The minimum and maximum values used to scale this variable are 25 and 85 years, respectively. The educational attainment index ($I_{2,i}$) is defined as follows:

$$I_{2,i} = a_1 X_{2,1,i} + a_2 X_{2,2,i} \quad (3)$$

where a_1 and a_2 are weights set at two-thirds and one-third respectively, $x_{2,1,i}$ is country i's adult literacy rate and $x_{2,2,i}$ is that county's combined primary, secondary and tertiary enrolment ratio. The maximum and minimum values of these variables used in scaling are 0% and 100% for each, respectively. The material standard of living index ($I_{3,i}$) is also based on a single variable ($x_{3,i}$) obtained by adjusting purchasing power parity (PPP) GDP per capita (y_i). In the 1995 to 1998 *Human Development Reports* the adjustment is as follows:

$$\begin{aligned} x_{3,i} &= y_i && \text{for } 0 < y_i \le y^*, \\ &= y^* + 2\left[(y - y^*)^{1/2}\right] && \text{for } y^* \le y \le 2y^* \quad \text{and} \\ &= y^* + 2\left[(y - y^*)^{1/2}\right] + 3\left[(y - 2y^*)^{1/3}\right] && \text{for } 2y^* \le y \le 3y^* \end{aligned} \quad (4)$$

and so on, where y^* is the average PPP per capita world income of $5,711. The minimum and maximum values of $x_{3,1}$ used to obtain $X_{3,1,i}$ are $100 and $6400, respectively (UNDP, 1997). In the 1999 and 2000 *Human Development Reports* $x_{3,1,i}$ is obtained by taking the logarithm of y_i (UNDP, 2000).

The GDI is defined as follows:

$$GDI_i = \frac{1}{k} \sum_{j=1}^{k} I_{j,i}^{g} \quad (5)$$

where $I_{j,i}^{g}$ is the jth gender-disparity adjusted indicator of human development in country I, $i = 1, \ldots, k$. These indicators are adjusted indices of longevity ($I_{1,i}^{g}$), educational attainment ($I_{2,i}^{g}$) and income ($I_{3,i}^{g}$) The adjusted longevity and educational attainment indices prior to scaling are defined as:

$$x_{j,i}^{g} = \left[p_i^{f}\left(I_{j,i}^{f}\right)^{1-g} + p_i^{m}\left(I_{j,i}^{f}\right)^{1-g}\right]^{\frac{1}{1-g}} \qquad j = 1, 2 \quad (6)$$

where p_i^f is the share of females in the total population of i, p_i^m is the male share of population in i, $I_{1,i}^{f}$ is the female value of the particular index of human development in i, $I_{1,i}^{m}$ is the male value of that index in i and g is an inequality aversion parameter set at

two. $I^{f}_{1,i}$ and $I^{m}_{1,i}$ are obtained in the same manner as their aggregate counterparts in the HDI. That is, the longevity index is based solely on life expectancy and educational attainment is defined on the basis of literacy and combined school enrolment rates and each of these variables are scaled with the range of zero and one. In the case of life expectancy, for women the maximum value is 87.5 years and the minimum is 27.5 years; for men the corresponding values are 82.5 and 22.5 years. In the case of school enrolment ratios the maximum and minimum values are 100 and zero percent, respectively, in all instances (UNDP, 1997).

The gender-disparity adjusted income index is defined as follows:

$$I^{g}_{3,i} = \frac{x^{g}_{3,i} y_i - x_3^{min}}{x_3^{max} - x_3^{min}} \tag{7}$$

where $x^{g}_{3,i}$ is an equally distributed equivalent income index, y_i is unadjusted PPP GDP per capita and x_3^{max} and x_3^{min} are "maximum" and "minimum" values of PPP GDP per capita, respectively, the corresponding values being those used to obtain the HDI's $X_{3,1,i}$. In the *Human Development Reports* for 1995 to 1998 PPP GDP per capita was adjusted according to equation (4), while in the 1999 and 2000 the logarithm of this value is used instead. $x^{g}_{3,i}$ is defined as follows:

$$x^{g}_{3,i} = \left(p_i^{f} \left[\frac{w_i^{f}}{w_i} a_i^{f} \frac{1}{p_i^{f}} \right]^{1-g} + p_i^{m} \left[\frac{w_i^{m}}{w_i} a_i^{m} \frac{1}{p_i^{m}} \right]^{1-g} \right)^{1-e} \tag{8}$$

where w^{f}_{i} and w^{m}_{i} denote average female and male wages, respectively, in i, w_i is the average wage in i and a^{f}_{i} and a^{m}_{i} denote the ratios of economically active females and males, respectively, to the economically active total population in i (UNDP, 1997, 2000).

The GEM is defined as:

$$GEM_i = \frac{1}{k_j} \sum_{1}^{k} G_{j,i} \tag{9}$$

where $G_{j,i}$ is the jth index of gender empowerment in country i and $i = 1, \ldots, q$.

Empowerment is defined in terms of indices of: economic participation and decision-making power ($G_{1,i}$), political decision-making power ($G_{2,i}$) and power over economic resources ($G_{3,i}$). The first of these indices is defined as follows:

$$G_{1,i} = ß_1 g_{1,1,i} + ß_2 g_{1,2,i} \tag{10}$$

where $ß_1$ and $ß_2$ are weights each set at 0.5 and

$$g_{1,1,i} = \frac{1}{50}\left[p_i^f\left(am_i^f\right)^{1-g} + p_i^m\left(am_i^m\right)^{1-g}\right]^{1-g} \quad \text{and} \tag{11}$$

$$g_{1,2,i} = \frac{1}{50}\left[p_i^f\left(pt_i^f\right)^{1-g} + p_i^m\left(pt_i^m\right)^{1-g}\right]^{1-g} \tag{12}$$

where am_i^f and am_i^m are the shares of administrative and managerial positions held by females and males, respectively, and pt_i^f and pt_i^m are the shares of professional and technical positions held by females and males, respectively. g has the same interpretation as in the GDI and is again set to two. As the maximum value of $g_{1,1,i}$ and $g_{1,2,i}$ (and $G_{1,i}$) are 50, which implies perfect equality between men and women, each is multiplied by $1/50$ to show the degree of inequality in empowerment (UNDP, 1997).

The political decision-making power index ($G_{2,i}$) is defined as:

$$G_{2,i} = \frac{1}{50}\left[p_i^f\left(pr_i^f\right)^{1-g} + p_i^m\left(pr_i^m\right)^{1-g}\right]^{1-g} \tag{13}$$

where pr_i^f and pr_i^m are the shares of total parliamentary seats held by women and men, respectively, in country i. The power over economic resources index ($G_{3,i}$) is defined as:

$$G_{3,i} = \frac{x_{3,i}^g y_i - y^{min}}{y^{max} - y^{min}} \tag{14}$$

where y^{min} and y^{max} are the minimum and maximum values of actual PPP GDP per capita, respectively. The corresponding values used by the UNDP are \$100 and \$40,000 respectively (UNDP, 1997).

III. Data and Methods

Three inequality indices are used to identify differences in inter-country development levels: the Theil-Bourguignon index (L), Theil's Entropy index (T) and

Wolfson's exponential index (*W*). These indices satisfy several desirable properties of inequality.[3] They are defined as follows:

$$L = \sum_{i=1}^{n} p_i \ln\left(\frac{p_i}{d_{r,i}}\right), \tag{15}$$

$$T = \sum_{i=1}^{n} d_i \ln\left(\frac{d_{r,i}}{p_i}\right) \quad \text{and} \tag{16}$$

$$W = \sum_{i=1}^{n} p_i e^{\left(\frac{\&D_{r,i}}{\mu_j}\right)} \tag{17}$$

where p_i is the ratio of the population of country i to total population, $D_{r,i}$ is the rth human development indicator (PPP GDP per capita, the HDI, the GDI and the GEM) for country i, $d_{r,i}$ is that country's share of the world (or country group) value of indicator r and μ_r is the world (or country group) average of indicator r.

The data are taken from the *Human Development Reports* for each of the years 1995 to 2000 (UNDP, 1995-2000). We do not use data from *Human Development Reports* prior to 1995 as they do not contain information on the GDI and GEM. The 1995 to 1998 reports contain data on each of the indicators under consideration for 1992 to 1995 respectively. The 1999 and 2000 reports contain data for the years 1997 and 1998, respectively. It follows that data for 1996 are not available. Three samples are employed, each determined by data availability, as follows: (i) a sample of 97 countries covering data for PPP GDP per capita (y_i) and the HDI, GDI and GEM (HDI_i, GDI_i, and GEM_i, respectively); (iii) a sample of 148 countries covering data for y_i, HDI_i, and GDI_i; and (iii) a sample of 170 countries covering data for y_i and HDI_i.

A number of comments are at this point warranted, many of which relate to the work of Ram (1992a, 1992b, 1982, 1980). Ram (1992a) concluded that inequalities in the HDI are understated given much higher cross country inequalities in PPP GDP per capita and in several other measures. This was based on Theil-Bourguignon and Theil Entropy indices of 0.51 and 0.50, respectively, for y_i and 0.07 and 0.06, respectively, for HDI_i.[4] Similar conclusions for a range of other non-income-based development indicators were drawn in Ram (1992b, 1982, 1980). In Ram (1992a) it was also shown that, surprisingly, the inequality indices were inconsistent with the high correlations between

the two variables.

While Ram's work is important and informative, we believe it can be improved in two respects. The first relates to the choice of inequality index. Pillarisetti (1997) demonstrates that Ram's findings with respect to income per capita and the HDI are not robust with respect to this choice. As mentioned, these findings were based on the Theil-Bourguignon and Theil Entropy indices. Pillarisetti showed that the Wolfson index is advantageous in comparing inequalities in absolute and composite indicators and, in the specific cases of y_i and HDI_i, provides inequality levels which more closely reflect the extent of correlation between the two. We therefore rely primarily on the Wolfson index in making these comparisons. The second relates to the interpretation of income per capita. Both Ram and Pillarisetti compare inequality in a measure of income with inequality in measures of the quality of life or human well-being. Yet it is well-known that there are diminishing returns in the conversion of income into well-being and as shown above this is reflected in the construction of the HDI and GDI. It is not income which is the concern but what it generates. As such international levels of well-being should not be linearly related to those in income per capita and inequality indices should be based on transformed values of this variable.[5]

This study therefore compares inequality in the UNDP's composite indices with both discounted and non-discounted values of y_i. The following well-known and frequently applied Atkinson formulation is used:

$$W(y_i) = \frac{1}{1-\varepsilon} y_i^{1-\varepsilon}$$

where $W(y_i)$ is the utility or well-being derived from income and ε measures the extent of diminishing returns.[6] If $\varepsilon=0$ there are no diminishing returns and $W(y_i)$ reduces to y_i. As ε approaches one $W(Y_i)$ becomes the logarithm of y_i. While the case for discounting income, and the Atkinson formulation, are accepted widely the value of ε is not. One and zero can be considered extremes, and the appropriate value arguably lies somewhere in between. Reported below are inequality indices based on ε values of zero (y_i), 0.5 ($W(y_i)$) and approaching one ($\ln y_i$).

Four additional comments are also warranted. First, it is not entirely surprising

that income per capita would display substantially higher inequality than the other indicators, irrespective of the choice of inequality index. Ram (1992) and Pillarisetti (1997) note this in passing, but the extent to which one would expect income per capita to display very much greater international inequality needs emphasising further. Income per capita is an upwardly continuous variable in the sense that it has no statistical upper limit. This is not the case with most social indicators. Life expectancy has an upper biological limit and many other social indicators are expressed as percentages and as such have an upper theoretical limit of 100. Many countries are as close to reaching this limit as one could reasonably expect. These comments apply directly to the HDI. As already shown, two of its components are life expectancy and an indicator of educational attainment, the latter being a percentage. Its third component is PPP GDP per capita. This variable has been variously transformed, as shown above, and results in the HDI increasingly negligibly with increases in PPP GDP per capita. McGillivray and White (1993) demonstrate explicitly this relationship with respect to early versions of the HDI; their demonstration is applicable to all but the most recent versions of this index.[7] These statistical characteristics and the composite nature of the UNDP's indices combine to suggest that there is far greater scope for differences among countries in income per capita than in the HDI, GDI and GEM. We return to this issue below.

Second, it was noted above that the UNDP changed the formulation of the income components of the HDI and GDI, using the logarithm of PPP GDP per capita from 1999. We therefore adjusted HDI values taken from the 1998 and earlier *Human Development Reports*, by recalculating them using this transformation rather than those shown in equation (4) above, to ensure comparability over the time period under consideration. We did not attempt to adjust GDI values owing to the non-availability of male and female population share data. It is unlikely that affects significantly comparisons of inequalities in1997-98 with those for 1996 and earlier, although one should still note a degree of caution over these comparisons.

Third, while we report observed inequalities based on data for the six years under consideration, one needs to be careful in comparing inequalities in 1997 and 1998 with those for the earlier years. The reason for this is that the data for these years are of a better quality, following work undertaken by the United Nations Population Division, UNESCO and the World Bank (UNDP, 1999). It follows that heavier than usual caveats

need to be placed on comparisons in observed inequalities between 1997 and 1998 and the earlier years.

Fourth, we report inequalities based on samples containing all countries for which data are available. It is tempting to refer to this as world inequality, although emphasise that this is a rather loose usage of the term "world" as it does not take into account inequality within nations, only between them (Ram, 1992a).

IV. Results

Inequality indices based on PPP GDP per capita and the HDI, GDI and GEM are shown in Tables 1 to 3. These tables show Wolfson (W), Theil-Bourguignon (L) and Theil Entropy (T) indices, respectively.

All inequality indices provide a reasonably consistent picture with respect to the three composite indicators. That is, while each indicator exhibits reasonably similar inequalities, in absolute terms the GEM displays slightly higher inequality than the GDI, and the GDI displays slightly higher inequality than the HDI. In terms of changes over the seven years under consideration, the overall picture is one of slight declines in most inequality indices. Declines in inequality in non-discounted real income (y_i) appear to be the largest, especially based on the Theil-Bourguignon and Theil Entropy indices for the 97 country sample. The exception is the GEM, which exhibits slight declines in inequality based on the Wolfson and Theil Entropy indices.

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Depending on the country sample, year and choice of index, inequality in non-transformed PPP GDP per capita (y_i) hoovers between and index value of 0.49 to 0.61.

Wolfson index values based on this variable are either 0.60 or 0.61 for the 97 country

Table 1: International Inequality based on Wolfson Index (*W*)

	n=97						*n*=148					*n*=170			
	y_i	lny_i	$W(y_i)$	HDI_i	GDI_i	GEM_i	y_i	lny_i	$W(y_i)$	HDI_i	GDI_i	y_i	lny_i	$W(y_i)$	HDI_i
1992	0.61	0.39	0.48	0.40	0.42	0.41	0.59	0.38	0.46	0.39	0.40	0.57	0.38	0.45	0.39
1993	0.61	0.39	0.48	0.40	0.42	0.41	0.59	0.38	0.46	0.39	0.40	0.57	0.38	0.45	0.38
1994	0.61	0.39	0.48	0.40	0.41	0.41	0.59	0.38	0.46	0.38	0.40	0.58	0.38	0.45	0.38
1995	0.60	0.39	0.47	0.39	0.41	0.42	0.59	0.38	0.45	0.38	0.39	0.57	0.38	0.45	0.38
1997	0.60	0.39	0.47	0.39	0.40	0.42	0.59	0.38	0.45	0.38	0.38	0.57	0.38	0.44	0.38
1998	0.60	0.38	0.47	0.39	0.39	0.43	0.58	0.38	0.45	0.38	0.38	0.57	0.38	0.44	0.38
Average	0.61	0.39	0.48	0.40	0.41	0.42	0.59	0.38	0.46	0.38	0.39	0.57	0.38	0.45	0.38

Table 2: International Inequality based on Theil-Bourguignon Index (*L*)

	n=97						*n*=148					*n*=170			
	y_i	lny_i	$W(y_i)$	HDI_i	GDI_i	GEM_i	y_i	lny_i	$W(y_i)$	HDI_i	GDI_i	y_i	lny_i	$W(y_i)$	HDI_i
1992	0.57	0.01	0.14	0.03	0.05	0.07	0.57	0.01	0.14	0.03	0.05	0.57	0.01	0.14	0.03
1993	0.54	0.01	0.13	0.02	0.05	0.07	0.56	0.01	0.14	0.03	0.05	0.56	0.01	0.14	0.03
1994	0.53	0.01	0.13	0.02	0.05	0.07	0.55	0.01	0.13	0.03	0.03	0.55	0.01	0.13	0.03
1995	0.51	0.01	0.12	0.02	0.04	0.07	0.54	0.01	0.13	0.03	0.05	0.54	0.01	0.13	0.03
1997	0.52	0.01	0.13	0.02	0.02	0.07	0.55	0.01	0.13	0.03	0.03	0.55	0.01	0.13	0.03
1998	0.49	0.01	0.12	0.02	0.02	0.07	0.53	0.01	0.13	0.03	0.03	0.54	0.01	0.13	0.03
Average	0.53	0.01	0.13	0.02	0.04	0.07	0.55	0.01	0.13	0.03	0.04	0.55	0.01	0.13	0.03

Table 3: International Inequality based on Theil Entropy Index (*T*)

	n=97						*n*=148					*n*=170			
	y_i	$\ln y_i$	$W(y_i)$	HDI_i	GDI_i	GEM_i	y_i	$\ln y_i$	$W(y_i)$	HDI_i	GDI_i	y_i	$\ln y_i$	$W(y_i)$	HDI_i
1992	0.56	0.01	0.15	0.03	0.05	0.06	0.56	0.01	0.15	0.03	0.05	0.57	0.01	0.15	0.03
1993	0.54	0.01	0.14	0.02	0.04	0.06	0.56	0.01	0.14	0.03	0.05	0.56	0.01	0.14	0.03
1994	0.53	0.01	0.14	0.02	0.04	0.06	0.55	0.01	0.14	0.03	0.05	0.55	0.01	0.14	0.03
1995	0.51	0.01	0.13	0.02	0.04	0.07	0.54	0.01	0.14	0.03	0.05	0.54	0.01	0.14	0.03
1997	0.52	0.01	0.13	0.02	0.02	0.07	0.55	0.01	0.14	0.02	0.03	0.56	0.01	0.14	0.03
1998	0.51	0.01	0.13	0.02	0.02	0.07	0.54	0.01	0.14	0.02	0.03	0.54	0.01	0.14	0.02
Average	0.53	0.01	0.14	0.02	0.04	0.07	0.55	0.01	0.14	0.03	0.04	0.55	0.01	0.14	0.03

sample and vary between 0.57 and 0.59 for the 148 and 170 country samples. These values are similar to those reported in Ram (1992a) and Pillarisetti (1997). As expected, these values are much higher than those based on the UNDP's composite indicators, which based on the Wolfson index have period averages of 0.40, 0.41 and 0.43 for the HDI, GDI and the GEM, respectively, for the sample of 97 countries. Slightly lower values for the HDI and GDI are recorded for the samples of 148 and 170 countries. Treating income as an indicator of human well-being, and therefore discounting PPP GDP per capita, produces a very different picture. While it is obvious that discounting this variable must result in lower inequality index values, the results are quite interesting. If one uses the logarithm of PPP GDP per capita ($\ln y_i$), and hence allows ε to approach one, the corresponding Wolfson index value is broadly similar to those for the composite indices. However, a closer examination reveals that the Wolfson indices for $\ln y_i$ are often lower than those for the HDI_i and without exception lower than those based on GDI_i and GEM_i. The corresponding Wolfson indices with ε is set to 0.5 ($W(y_i)$) range between 0.44 and 0.48. While higher than the corresponding indices for the composite indicators, the absolute gaps are less than those with respect to y_i. More precisely, the Wolfson index values for $W(y_i)$ at greatest exceed those for the composite indicators by an absolute margin of 0.9, whereas the corresponding gap with respect to y_i is 0.12.

V. Conclusion

This paper empirically examined inter-country differences in human well-being evident from PPP GDP per capita, the Human Development Index (HDI) , the Gender-related Development Index (GDI) and the Gender Empowerment Measure (GEM). Wolfson, Theil-Bourguignon and Theil Entropy inequality indices were calculated for each of these indicators for the period 1992 to 1998. A special interest of the paper was whether PPP GDP per capita, as a measure of not so much of income *per se* but of human well-being, exhibits inequalities which are substantially different to those in the HDI, GDI and GEM. Results indicate that the answer to this question is a qualified yes, being dependent on how the latter is measured. If it is discounted to reflect diminishing returns to the conversion of income to human well-being, broadly similar inequality levels are displayed. The paper also found that the HDI, GDI and GEM exhibit broadly similar inequality levels, although the GEM shows in absolute terms slightly greater inequality.

Notes

1. Terms such as "quality of life", "human welfare", "human well-being" and "human development" are treated as synonymous for the purposes of this paper.

2. While the aim of this paper is not to critique the UNDP's indicators, it is not blind to the various limitations identified in the literature. Relevant studies include McGillivray (1991), Dasgupta (1992), McGillivray and White (1992), Ogwang (1994), Gormely (1995), Streeten (1995), Hicks (1997), Noorbakhsh (1998a, 1998b), Pillarisetti and McGillivray (1998), Bardhan and Klasen (1999) and Saith and Harris-White (1999). One should not forget these limitations, and the various caveats emerging from them, in interpreting the results reported below.

3. For further descriptions of these indices, see Theil (1967), Cowell (1977), Wolfson (1986 and 1994), Ram (1992a) and Pillarisetti (1997). These indices are considered to be positive measures of inequality as unlike normative ones they do not require explicit consideration of a social welfare function. Such functions need to contain inequality aversion parameter values. These values would presumably need to differ across development indicators; given this the inequalities obtained from normative indices may not be comparable among them.

4. These indices are based on a sample of 130 countries and 1987 data. Corresponding indices for a smaller sample of non-Socialist countries ($n=116$) are 0.66 and 0.58 and 0.09 and 0.08, respectively.

5. Note that there is also a case for similarly transforming indicators such as life expectancy and literacy. This case is though far less compelling than that which applies to income per capita.

6. As Anand and Sen (2000) point out, the HDI's 1995-98 treatment of income adopts the Atkinson transformation, but allows g to rise with income. This is made clear by equation (4) above.

7. McGillivray and White show that for the 1990 and 1991 versions of the index that the transformation effectively caps PPP GDP per capita at an international poverty line well below that actual incomes per capita of many countries.

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