TRAINING MATERIAL FOR PRODUCING NATIONAL HUMAN DEVELOPMENT REPORTS

Inequality-adjusted Human Development Index (IHDI) [1]

Purpose: To adjust the HDI for inequality, such that it better reflects the actual levels of HDI people enjoy.

Components: Four indicators belonging to three dimensions: Long and healthy life, knowledge and decent standard of living.

Versions of the Inequality-adjusted Human Development Index (IHDI):

1. **Inequality-adjusted Human Development Index:** The IHDI adjusts the Human Development Index (HDI) to account for the inequality of distribution in the dimensions of the HDI (long and healthy life, knowledge and a decent standard of living). The global IHDI was first presented in the 2010 *Human Development Report* (*HDR*), using the method described here.

2. **Regional or national IHDIs:** The IHDI may be adapted to regional or national realities by applying the same formula but using components that are particularly relevant, as well as technically appropriate.

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IHDI: CONTENTS

1. OVERVIEW

Since 1990, *Human Development Reports* (*HDR*s) have drawn attention to inequalities in different dimensions and sought to address them. Previous *HDR*s have released income-distribution adjusted Human Development Indices (HDIs) (annually from 1991 until 1994), reported income inequality in tables, and explored new measures (2006). But these exercises all reflected inequality in the income dimension alone.

The Inequality-adjusted Human Development Index (IHDI) is a new measure of the level of human development in a society that accounts for inequality in all dimensions of the HDI. Building on an innovation in the 2002 Mexico *HDR* (recently extended in the 2010 Regional *HDR* for Latin America), the IHDI is designed to be directly comparable to the Human Development Index (HDI), reflecting inequality in each of its dimensions for a large number of countries. The IHDI can be used for international comparisons (the global IHDI), as presented for the first time in the 2010 *HDR*, or can be modified for national-level exercises (more on this below).

The HDI represents a national average of human development achievements in three dimensions: long and healthy life, knowledge and decent standard of living. Like all averages, it conceals all disparities in human development across the population within the same country. The IHDI takes into account not only the average achievements of a country in these three dimensions but also how those achievements are distributed among its citizens. It does so by reducing or "discounting" each dimension's average value according to its level of inequality.

The IHDI is built around Atkinson's (1970) well-known concept of "equally distributed equivalent" (EDE) achievements. To understand this idea, it can help to think of each person in a society as having a "personal HDI." The IHDI for this society is the personal HDI that the average person would experience, given the country's current level of inequality. Thus the IHDI provides a more accurate approximation of the HDI levels that people actually experience in each country.

The IHDI will be equal to the HDI when there is hardly any inequality between people and will fall further below the HDI the more inequality there is. In comparison with the IHDI, the HDI can be viewed as an index of **potential** human development (the average HDI people **could** enjoy given today's overall achievements **if** there were low inequality). In contrast, the IHDI reflects the **actual** level of human development (accounting for inequality) that the average person experiences at present. The difference between the HDI and the IHDI measures is the "loss" in potential human development due to current levels of inequality.

It is important to stress that some inequality is inevitable and legitimate, because people's abilities and values differ; it can also be constructive in providing incentives. So the IHDI has a relatively mild penalization of inequality because of its chosen "inequality aversion factor." How strongly inequality is penalized can be adjusted by changing this factor. The inequality aversion factor sets strength of penalization. In other words, they can have some inequality and their IHDI will still be very close to their HDI.

The IHDI directly links inequalities in **each** dimension of the HDI to the resulting loss in human development, thus it can help inform policies towards inequality reduction and assist in evaluating their impact. Large HDI losses due to inequality indicate that society has much to gain from concentrating its efforts on equity-improving reforms. Also, the IHDI has been designed so that (data permitting) national IHDIs can be decomposed by sub-groups, such as regions or

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ethnic groups, to highlight differences between human development achievements for these groups (something that cannot be done accurately using the Gini coefficient, for example). More generally, a focus on the IHDI may prompt societies and governments to favour development strategies that promote all-encompassing growth. That is to say growth that improves average human development attainments and the distribution of those attainments in all three dimensions.

2. COMPONENTS OF THE GLOBAL IHDI

2.1 Dimensions and indicators

The main components of the global IHDI build upon those of the global HDI. Figure 1 lists the components of both indices and how they are measured. They have three dimensions: (i) long and healthy life, (ii) knowledge and (iii) decent standard of living.

In both the HDI and the IHDI, dimension indices are constructed using four indicators: health is measured by life expectancy at birth; knowledge is measured by mean years of schooling for adults aged 25 years and older[2] and expected years of schooling for children of school-going age[3]; and decent standard of living is measured by GNI per capita.[4]

Figure 1. Components of the global IHDI
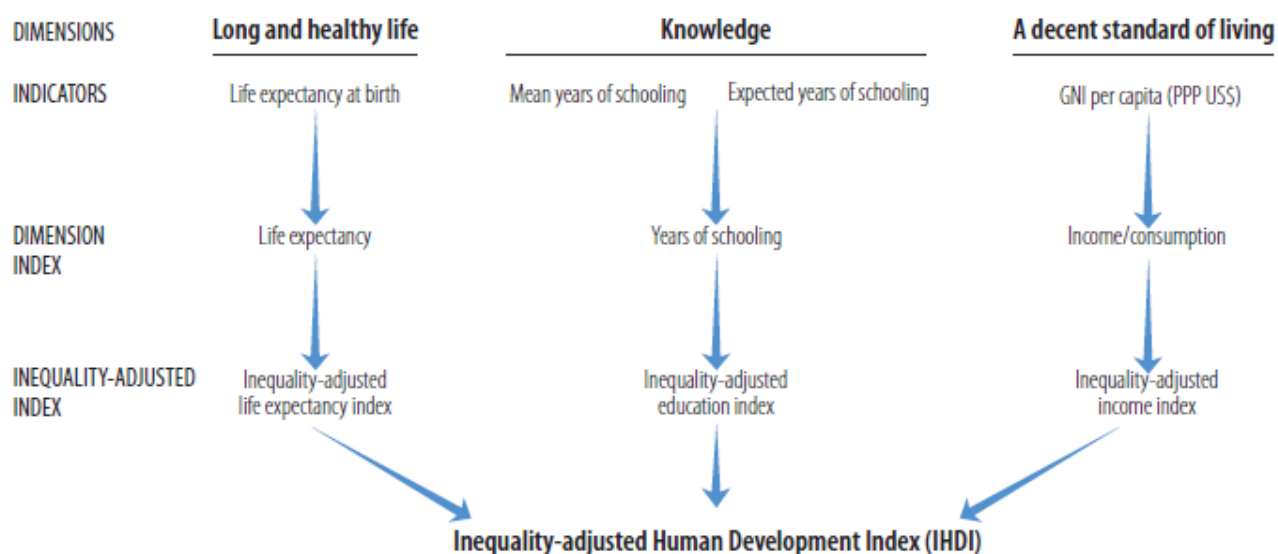
Source: *HDR* 2010, Statistical Annex, p. 215.

It would be natural to construct the IHDI using precisely the same indicators as the HDI while taking into account inequality in each of the variables. However, most HDI indicators do not reflect distribution. The GNI per capita figures are drawn from national accounts, and life expectancy and school life expectancy data are available for groups. Therefore the IHDI uses related indicators for each dimension. The assumption is that the inequality in each related

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[2] "Average number of years of education received by people aged 25 and older in their lifetime based on education attainment levels of the population converted into years of schooling based on theoretical durations of each level of education attended." (UNDP, 2010, p 224).
[3] "Number of years of schooling that a child of school entrance age can expect to receive if prevailing patterns of age-specific enrolment rates were to stay the same throughout the child's life." (UNDP, 2010, p 223).
[4] A detailed explanation of how the HDI is calculated is provided in the "Training material for Producing National Human Development Reports: The Human Development Index" section of this primer.

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variable across the population is a relevant proxy for inequality in each of the three HDI dimensions.

The IHDI adjusts the HDI for inequality across people using three indicators:

Health: measured using life expectancy for different age cohorts.[5]

Knowledge: measured using mean years of schooling of the adult population from household survey data.

Decent standard of living: measured using income per capita data from household surveys. Where income data are not available, consumption data, or incomes by population decile, or imputed incomes, are used to provide an estimate of income inequality. But these are not strictly comparable to IHDIs that use income data and are likely to underestimate inequality.

The global IHDI has been designed for international comparability thus its components are as comparable as data permit across countries. This is useful because it enables some comparison of the effects of inequality on human development between countries. This provides policy-relevant information for both national governments and the international community.

2.2 Data sources

In contrast to the HDI, the global IHDI uses data from the following sources to track inequality in distribution between dimensions.

Life expectancy (health dimension)
Data from abridged life tables is taken from the United Nations Department of Economic and Social Affairs (UN DESA) (2011) "World Population Prospects: The 2010 Revision." This distribution is available across age intervals of (0, 1), [1,5), [5,10),...,[85 and more),[6] with the mortality rates and average age at death specified for each interval. Note that as this is group-based data, all within-group observations are smoothed, hence health inequality in the population is underestimated.

Years of schooling (knowledge dimension)
Household survey data available in international databases include Eurostat's European Union Survey of Income and Living Conditions (EUSILC), the United Nations Children's Fund's Multiple Indicators Cluster Survey (MICS), the US Agency for International Development's Demographic and Health Survey (DHS), and the World Health Organization's World Health Survey (WHS).

Household income or consumption (standard of living dimension)

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[5] Note that the health component of the IHDI do not reflect socio-economic inequalities in life expectancy (e.g. whether multidimensionally poor people have lower life expectancy). Rather, it reflects inequality in anticipated life lengths, among age cohorts.

[6] The notation means that the first group is 0<age<1; the next group is 1≤age<5, etc. In other words, the symbol '(' is used if the age **excludes** the number and '[' is used if the age **includes** the number that is next to the symbol.

Household survey data harmonized in international databases include the Luxembourg Income Study, EUSILC, the World Bank's International Income Distribution Database, the United Nations University's World Income Inequality Database, DHS, and MICS.[7]

A list of data sources per country used to estimate inequality is provided in Kovacevic (2010).

3. MEASUREMENT

The IHDI adjusts the HDI for inequality in distribution of each dimension across the population (Alkire and Foster 2010). It is based on a distribution-sensitive class of composite indices proposed by Foster, Lopez-Calva and Szekely (2005), which draws on the Atkinson (1970) family of inequality measures (see box 1). Alkire and Foster (2010) further develop and generalize that methodology, specify its properties, and address particular considerations for the international IHDI.

The IHDI is computed as a geometric mean of geometric means, calculated across the population for each dimension separately. It is highly intuitive, because the measure is directly related to the idea of EDE income proposed by Atkinson (see box 2). Because the geometric mean is used ($\alpha = 0$), the IHDI is not sensitive to the upper bound (or maximum value) used to normalize the dimensional indices. It is, however, sensitive to the lower bound or minimum value. Further, any country or level can be taken as a "standard" and others compared to it very easily.

Box 1. The Atkinson family of inequality measures

Notation
x: Distribution of achievements across people
$1-\alpha$: The inequality aversion parameter
W: Inequality adjusted equivalent achievement
N: Total population
x_n: The achievement of the nth person, where n = 1, ..., N
g: Geometric mean

The Atkinson family of inequality measures can be found in Atkinson (1970) and is based on the concept of "equally distributed equivalent income." The reference to "income" is due to the initial concern for the way income was distributed in societies. But in the context of well-being measurement, the concept of EDE can be similarly applied to any variable denoting a well-being-enhancing attribute or a functioning. Now imagine that aggregate well-being in a society is measured by the following function:

$$W\left(x;\alpha\right) = \begin{cases} \dfrac{1}{N}\sum_{n=1}^{N} x_n^{\alpha} & \text{for } \alpha \leq 1 \ \& \ \alpha \neq 0 \\[2ex] \prod_{n=1}^{N} x_n^{\frac{1}{N}} & \text{for } \alpha = 0 \end{cases} ,$$

where W, i.e. aggregate social well-being, is a function of a vector x of an attribute of well-being in the population and of $(1-\alpha)$, which can be interpreted as a coefficient of relative inequality aversion.[8] The value of the attribute for individual n is x_n and society consists of N individuals.[9]

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[7] In 2010, for roughly 15 countries, income was imputed based on an assets index computed from DHS or MICS (Harttgen and Klasen 2010).
[8] The idea of relative inequality aversion is analogous to the notion of relative risk aversion in economics literature. Let us use the Greek letter ε to denote the inequality aversion parameter. There is a very straightforward relationship between ε and α. Epsilon is equal to one minus alpha (ε=1-α).

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EDE is the value of the attribute x that would yield the same social well-being, W, if the attribute were distributed evenly, with perfect equality. EDE is then equal to:

$$W\left(EDE;\alpha\right) \equiv \frac{1}{N}\sum_{n=1}^{N}EDE^{\alpha} = \frac{1}{N}\sum_{n=1}^{N}x_{n}^{\alpha} \rightarrow EDE\left(\alpha\right) = \left[\frac{1}{N}\sum_{n=1}^{N}x_{n}^{\alpha}\right]^{\frac{1}{\alpha}}$$

Note that well-being is equal to the mean value of the attribute when $\alpha = 1$: $W\left(x;1\right) = \overline{x}$. When α is less

than one and takes lower values, well-being becomes more sensitive to the lower values of the attribute, x. Hence any presence of inequality will reduce the value of EDE needed to attain the same level of well-being. Based on this idea, Atkinson proposed the following family of inequality indices:

$$I\left(\alpha\right) = 1 - \frac{EDE\left(\alpha\right)}{\overline{x}}.$$

The lower the value of α and/or the higher the degree of inequality aversion, then the higher the value of I will

be. The IHDI uses α equal to 0 (in other words, an inequality aversion parameter equal to one). When $\alpha = 0$,

the EDE is the geometric mean, g or $I\left(0\right) = 1 - \frac{g}{\overline{x}}$.

Box 2. Key definitions

Path independence: There are two concepts of path independence, one for traditional inequality measures (e.g. the mean log deviation) and another one for multidimensional well-being measures. The latter is relevant for the IHDI. For well-being measures, path independence means that we will get the same results in terms of well-being measurement if either: 1) we compute well-being for each individual and then aggregate across individuals to get social well-being; or 2) we compute well-being across individuals for each dimension separately, and then we aggregate across dimensions to get multidimensional social well-being.

Sub-group consistency: An inequality measure is sub-group consistent if it increases (or decreases) whenever inequality in any sub-group of the total population increases (or decreases), other things being equal. The IHDI is sub-group consistent. The Gini index is not.

Equally distributed equivalent income: The EDE is the income level which, if assigned to all individuals, produces the same social welfare as the observed distribution. It is the (equal) amount of HDI each person in a society would need to enjoy in order to produce the same level of overall IHDI as results from the actual distribution. The EDE depends on two factors: the actual distribution in a society and how intensely the measure penalises for inequality (the inequality aversion parameter). The IHDI uses the geometric mean, which imposes a mild penalty on inequality.

3.1 Computing the IHDI: step by step

There are three steps to computing the IHDI and its dimension indices. These are not difficult, and, even if you have not understood the Atkinson indices fully yet, you can easily compute and interpret the IHDI.

Step 1. Measuring inequality in underlying distributions

The basic formula is simple: the IHDI takes the ratio of the **geometric** mean and the **arithmetic** mean of a particular dimension. Because the geometric mean reflects inequality, this ratio is always less than 1, and it is smaller for distributions having greater inequality and closer to 1 for distributions with less inequality. The IHDI adjusts the dimensional HDI indices by this

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[9] In the case of a sample survey, the individual values x_i are weighted-up by the corresponding survey weights (w_i), practically replacing $1/N$ by w_i where w_i sum to 1."

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ratio, then takes the geometric mean across the adjusted indices to form the new IHDI. There are several different ways of writing the IHDI formulae which are equivalent.

The first step is to generate the inequality adjustment factor from the distributional data (to learn how to prepare the data, please see "data preparation" below). To calculate the inequality adjustment factor F_{IX} take the ratio of the geometric and arithmetic means across a distribution of a variable X (H for Health, E for Education, and Y for Income). Use the income values directly without taking a natural logarithm. This ratio will be exactly the same as taking $(1-A_X)$ – one minus the Atkinson index that uses an inequality aversion equal to one.

$$F_{IX} = \frac{g_x}{\mu_x} = (1 - A_x)$$

The overall IHDI can be computed directly using these three numbers. The simplest formula for IHDI is to multiply the HDI by the geometric mean of the three adjustment factors you have just created:

$$IHDI = (FIH \times FIE \times FIY)^{1/3} \times HDI$$

This gives the overall IHDI value accurately. But it is important to understand not only the overall construction of the IHDI, but also the contribution to inequality of each of the dimension. To do this, we also create the dimensional indices of the IHDI below. Before we come to those, a few more technical observations are required for the steps just introduced.

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Data preparation

The geometric mean cannot be computed with zero or negative values. So prior to taking the means, the distributional data for schooling and income are treated as follows:

- For mean years of schooling, add one year to all valid observations to compute the inequality; this reflects, imperfectly, that people without formal schooling already have knowledge.

- For individual data on income or consumption per capita, replace the negative and zero incomes with the minimum value of the bottom 0.5 percentile of the distribution of positive incomes; remember that sampling weights must be applied. How is this justified? Recall that income can have zero or negative values; however, when incomes are low, households often rely on wealth, farming for personal consumption, local barter, savings or credit – information which is missing from income data. So we provide all households with at least a residual income level. The adjustment factor must be checked for robustness to small changes in the replacement value.[10]

- In the case of income or consumption data, also truncate the top 0.5 percentile of the distribution to reduce the influence of extremely high incomes.

Atkinson index

For those who are already familiar with Atkinson's inequality indices, it might be easier to grasp the IHDI using notation that refers the Atkinson's inequality index, which is : $A = 1 - g/\mu$, where g is the geometric mean and μ is the arithmetic mean of the distribution. This can be equivalently written:

$$A_x = 1 - \frac{\sqrt[n]{X_1 \dots X_n}}{\bar{X}}$$

where $\{X_1, \dots, X_n\}$ denotes the underlying distribution in the dimensions of interest. A_x is obtained for each variable (life expectancy, years of schooling and disposable income or consumption per capita) using household survey data and the life tables.

Caveats

Note that inequality figures produced from income data are not strictly comparable with those from consumption data, nor with imputed income. Note also that Atkinson inequality measures were in some cases calculated using only decile level income figures in 2010 because individual-level data were not available. This will underestimate inequality because it ignores all inequality within each decile group.

Health inequalities, meanwhile, are measured by comparing the mortality of different age cohorts using life tables, mainly because direct data on central health indicators —such as child malnutrition —are not available across all countries. In many cases these might be preferred.
Finally, note that the IHDI requires the very strong assumptions that the variables are ratio scale and have natural zeros. For more details see Alkire and Foster (2010) and Kovacevic (2010).

Step 2. Adjusting the dimension indices for inequality

The (inequality-adjusted) dimension indices, I_{IX}, are obtained from the HDI dimension indices by multiplying them by this adjustment factor F_{IX}.

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[10] See Kovacevic (2010).

$$I_{I_X} = I_X(F_{IX}) = I_X(1 - A_X)$$

This simple multiplication creates the three IHDI dimension indices reported in the 2010 *HDR*. As mentioned above, the IHDI methodology adds one new twist, in that unlogged income is used to calculate the inequality adjustment for the IHDI. This is because a distribution of the natural logarithm of income underestimates inequality in income, whereas the IHDI should reflect income inequality as accurately as it reflects inequality in the other dimensions.

Note that the IHDI can be **equivalently** calculated by taking the geometric mean of the three inequality-adjusted dimensional indices.

$$IHDI = \left[\sqrt[3]{(F_{IH} \times F_{IE} \times F_{IY})}\right] \times HDI = \left[\sqrt[3]{(I_{IH} \times I_{IE} \times I_{IY})}\right]$$

Step 3. Computing percentage loss

The most powerful message from the IHDI is to show how much of the HDI is being "lost" in the eyes of the average citizen, due to inequality. The percentage loss to the HDI due to inequality is calculated as:

$$Loss = 1 - \frac{IHDI}{HDI}$$

Similarly, the percentage loss in each dimension due to inequality is calculated as one minus the ratio of the inequality-adjusted dimension indices I_{IX}, and the HDI dimensional indices I_X:

$$Loss = 1 - \frac{I_{IX}}{I_X}$$

3.2 Methodological issues

The IHDI is based on a methodology that satisfies sub-group consistency (explained further in box 2). This ensures that improvements or deteriorations in the distribution of human development within a certain region or social group (while human development remains constant in the other groups) will be reflected in changes of the same direction in the overall measure of human development. This index is also path independent (see box 2), which means that the order in which data are aggregated across individuals, or groups of individuals, and across dimensions yields the same result—so there is no need to rely on a particular sequence or a single data source. This allows estimations for a large number of countries.

3.3 Examples

This section gives real and hypothetical examples of IHDI calculations to show how these formulae work in practice.

Example 1: Slovenia (real data)

	Indicator	Dimension index I_x	Inequality adjustment factor F_{IX}	Inequality-adjusted index I_{IX}
Life expectancy	78.8	0.930	0.957	(0.957)*(0.930)=0.890
Mean years of schooling	9	0.682		

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Expected years of schooling	16.7	0.811		
Education dimension index		0.782	0.960	0.960*0.782=0.751
GNI (ln)	10.16	0.780	0.878[11]	0.780*0.878=0.685
HDI	$= \sqrt[3]{0.930 \times 0.782 \times 0.780} = \mathbf{0.828}$			
IHDI	$= 0.828 \times \sqrt[3]{0.957 \times 0.960 \times 0.878} = \sqrt[3]{0.890 \times 0.751 \times 0.685} = \mathbf{0.772}$			
Percentage loss	HDI	Health	Education	Income
	$= 1 - \frac{0.772}{0.828}$ $=0.068 = 6.8\%$ loss	$= 1 - \frac{0.890}{0.930}=0.043 =$ 4.3% loss	$= 1 - \frac{0.751}{0.782}=0.040 =$ 4.0% loss	$= 1 - \frac{0.685}{0.780}=0.122$ $= 12.2\%$ loss

Example 2: U.S and Finland (hypothetical data)

Suppose we have the following information for the U.S. and Finland:

Country	Dimension indices			Adjustment factors		
	Life expectancy	Education	Income	Life expectancy	Education	Income
Finland	0.951	0.845	0.821	0.96	0.953	0.866
U.S.	0.943	0.891	0.872	0.94	0.968	0.765

       Step 1. Compute the inequality-adjusted dimension indices:

Country	Life expectancy	Education	Income
Finland	0.951*(0.96)=0.913	0.845*(0.953)=0.805	0.821*(0.866)=0.711
U.S.	0.943*(1-0.940)=0.886	0.891*(0.968)=0.863	0.872*(0.765)=0.667

       Step 2. Compute the HDI taking the geometric mean from the dimension indices that are not adjusted by inequality:

$$Finland\ HDI = \sqrt[3]{0.951 \times 0.845 \times 0.821} = 0.871$$

$$U.S.\ HDI = \sqrt[3]{0.943 \times 0.891 \times 0.872} = 0.902$$

       Step 3. Take the geometric mean of the three inequality-adjusted dimension indices in order to compute the total IHDI:

$$Finland\ IHDI = \sqrt[3]{0.913 \times 0.805 \times 0.711} = 0.871 \times \sqrt[3]{0.96 \times 0.953 \times 0.866} = 0.806$$

$$U.S.\ IHDI = \sqrt[3]{0.886 \times 0.863 \times 0.667} = 0.902 \times \sqrt[3]{0.94 \times 0.968 \times 0.765} = 0.799$$

Notice the reversal in ranks between the U.S. and Finland when inequality is brought into the picture.

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[11] Recall that the income inequality adjustment factor is based on unlogged income.

Step 4. Compute the percentage loss:

Once we have both the IHDI and the HDI we can compute the losses attributable to inequality for both countries:

$$Percentage\ Loss = 1 - \frac{IHDI}{HDI}$$

$$Finland\ Loss = 1 - \frac{0.806}{0.872} = 7.5\%$$

$$U.S.Loss = 1 - \frac{0.799}{0.902} = 11.4\%$$

3.4 Interpreting IHDI results

As discussed previously, the HDI can be viewed as an index of "potential" human development that would be obtained if existing achievements were distributed equally. This can be quite a helpful way of looking at things, for the HDI averages the achievements of all people, without regard to inequality. In contrast, the IHDI reflects the level of human development that the average person experiences, given the inequality in the distribution of achievements across people. It is thus a more accurate reflection of the level of human development people enjoy.

The IHDI is precisely equal to the HDI when there is no inequality in the distribution of achievements between people in society, and will fall below the HDI as inequality rises. The loss in potential human development due to inequality is the difference between the HDI and IHDI, and is often expressed as a percentage.

4. POTENTIAL INNOVATIONS

The global IHDI can be used for international comparisons. But in many cases, other indicators may be more relevant to a country context. So a national team may use alternative dimensions and indicators to capture context-specific inequalities in a national IHDI. National-level exercises may provide more accurate information in certain areas when the limitations imposed by international comparability do not apply, such as work, violence or empowerment. National-level adaptations of the global IHDI might also be used to compare the inequalities in different sub-populations within a country (provided that the appropriate data are available).

The IHDI is easy to adapt (if data are available and as long as calculations adhere to sound statistical principles) as the functional form underpinning the index can easily incorporate more indicators and dimensions (in line with modifications of the HDI for national contexts). Below are some examples.

4.1 Regional adaptation: Latin America Regional *HDR* 2010

The *Regional Human Development Report for Latin America and the Caribbean* (RBALC) 2010[12] shows clearly how the IHDI can be adapted to incorporate regionally important concepts. Significant and persistent inequality, accompanied by low social mobility, has led the region to fall into an "inequality trap"—a vicious circle that is difficult to break. Focusing on the intergenerational transmission of inequality, the report champions a new approach to understanding and tackling

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[12] "Acting on the future; Breaking the intergenerational transmission of inequality," UNDP. Latin America and Caribbean. 2010: http://hdr.undp.org/en/reports/regional/latinamericathecaribbean/idhalc_en_2010.pdf

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the prevailing inequality in terms of human development in Latin American and Caribbean countries.

Produced after several years of consultation, the report adapts the IHDI methodology used in the 2010 *HDR*. National and international agencies, universities, think tanks and civil society organisations were all consulted and a common thread emerged: the desire to understand persistent inequality in the region and determine the policy efforts required to fight it.

Though inequality has been explored in the region before, the IHDI provided an innovative technology with a new set of insights. Since the IHDI allows societies to set the level of inequality they consider important, this report set a parameter of aversion to inequality of $\alpha = -1$, reflecting a high concern for inequality in the societies considered.

The report used household survey indicators for 18 countries in the region, including per capita annual household income and literacy of household members. But different indicators to those used in the *HDR* 2010 were also incorporated. For instance, enrolment rates were not used, and data on accumulated years of schooling for household members age seven or older was used instead. Additionally, information on life expectancy was not available at the household level, so the health index used household access to toilet and drinking water as indicators of adequate sanitation and health.

The report then breaks down inequality in the region to examine gender, ethnicity, age, geographical areas, income distribution and public social spending. The report is also innovative in bringing to the table new dimensions of inequality: autonomy and agency of individuals. In terms of findings, Bolivia, Nicaragua and Honduras were the countries found to be most greatly penalized due to inequality in the report.

The challenge of inequality is, of course, not the same across all Latin American and Caribbean countries. But the intense debate stimulated by RBLAC helped build capacity in analysing the region and paved the way for a common understanding of how human development is undermined by inequality.[13]

4.2 National adaptation: Mexico National *HDR* 2010

The 2010 Mexico *NHDR*[14] provides an alternative picture of how the IHDI can be adapted—in this instance to focus on the achievements of the indigenous population. For this purpose, the team created HDIs for each municipality. Each state was treated like a country and the municipalities treated as individuals. Each municipality in this example has in effect two "people" within it—one representing the indigenous population and one representing the non-indigenous population. And a HDI was computed for each. For each Mexican state an IHDI was then computed so that the state HDI would be penalized by inequalities in human development across the state's municipalities.

For the long and healthy life dimension, this report used the probability of surviving the first year, instead of life expectancy. For knowledge, the municipal-level enrolment and literacy rates were considered, and for decent standard of living, the average yearly per capita purchasing power parity (PPP) income was used as a municipal equivalent to per capita GDP.[15]

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[13] Further examples can be found on page 132 of the regional report.

[14] "Informe sobre Desarrollo Humano de los Pueblos Indígenas en México," UNDP. Mexico. 2010: http://hdr.undp.org/en/reports/national/latinamericathecaribbean/mexico/name,15333,en.html

[15] Per capita GDP was used to calculate the standard of living dimension of the HDI until the 2010 HDR. Thus, when the Mexico team decided to replace it with an alternative income measure, the exercise was innovative. See the "Training material for

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Another innovation of the Mexican report was that, unlike the global IHDI, the authors chose three inequality aversion parameters and used them to create three inequality measures from the Atkinson family (further details on this can be found in Section 3 on measurement above). For instance, instead of setting the inequality aversion parameter at $(1-\alpha) = 1$ (corresponding to the geometric mean) they used parameters of $\alpha = -1$ and $\alpha = -2$.[16] These penalize inequality more strongly. All of these measures can be used to measure the loss in average human development due to the presence of inequalities.

4.3 Potential data sources

National-level IHDIs that estimate sub-national distributions of achievements are likely to need different data sources than the global IHDI. Often the health data used for national estimations may not be available for sub-national samples. In that case alternative health indicators which are measured as continuous variables are needed. One such candidate is the Body-Mass-Index (BMI), which proxies for health problems related to being both underweight and overweight (yet BMI does not always indicate presence of malnutrition in adults). Alternative indicators at the household level could be drawn from Demographic and Health Surveys or Multiple Indicator Cluster Surveys (for instance, under-5 child mortality rate by geographic region).

Education data, in turn, could be obtained from municipal-level enrolment and literacy rates. Finally, the average yearly per capita income can be used as income data. All of these variables need to be prepared properly for distributional analysis (see section on data preparation in 3.1, above).

5. ANALYSIS AND DATA PRESENTATION

The IHDI provides important information that can help inform inequality reduction policies. This information can also be used to evaluate the impact of such polices. The global IHDI uses national level data. It can be used to compare inequality between countries or international regions; the dimension-specific inequalities can also be analyzed, as can the relationship between the level of HDI and the levels of inequalities both in one period and across time. If the data are representative by sub-national regions or other groups, then different IHDIs can be constructed for each within-country region, and inequality losses can be compared across regions.

The IHDI does not consider whether it is the same or different people who find themselves at the bottom of the distribution in the dimension indices. This is of course because different data sources are used for each of the dimension indices.

5.1 Potential analysis

The following examples help to illustrate some of the analysis that can be performed using information provided by the IHDI.

First, one can report the average loss in the HDI due to inequality. For example, in 2010 the world's average loss to potential HDI value due to inequality in the distribution of achievements in the dimension indices was about 22 per cent. That is, adjusted for inequality, the global HDI

Producing National Human Development Reports: The Human Development Index" section in this primer for an account of the changes introduced in HDI in the 2010 HDR.

[16] For a more in-depth discussion on general means, and the geometric mean in particular, see box 1 in the "Training material for Producing National Human Development Reports: The Human Development Index" section in this primer.

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of 0.624 in 2010 would fall to 0.489, which represented a drop from the high to the medium HDI category.

Second, one can identify **regions or nations with lower and greater percentage losses** due to inequality. For example, in 2010, HDI losses due to inequality range from 6 per cent (Czech Republic) to 45 per cent (Mozambique), with four out of five countries losing more than 10 per cent, and almost two out of five countries losing more than 25 per cent.

Third, one can identify any **associations between overall HDI level and inequality losses**. For example in 2010, countries with lower HDI scores tended to have greater inequality in more dimensions—and thus larger losses in human development—although there was much variation. For instance, among the low HDI countries, Mozambique lost more than 45 per cent of its HDI value, whereas Ghana lost 25 per cent. Among the high HDI countries, Peru lost 31 per cent compared with 8 per cent for Ukraine. The highest loss among developed countries was for South Korea, which lost almost 17 per cent.

Fourth, one can identify which **countries suffer large losses in all dimensions**. In 2010, Sub-Saharan African countries had substantial inequality in all three dimensions. South Asia shows high inequality in health and education: India's loss in HDI is 41 per cent in education and 31 per cent in health and income. Considerable losses in the Arab States can generally be traced to the unequal distribution of education. Egypt and Morocco, for example, each lose 28 per cent of their HDI largely because of inequality in education. In other regions the losses are more directly attributable to inequality in a single dimension.

Meanwhile, people in high and very high human development countries experienced the **least inequality in human development**. East Asia and the Pacific also does well, particularly in access to healthcare and education, and formerly socialist countries in Europe and Central Asia still have relatively egalitarian distributions across all three dimensions.

Fifth, by calculating the IHDI at different points in time, **changes in different aspects of inequality can be estimated and compared**. For example, between 2000 and 2005 Brazil's HDI losses due to inequality fell from about 31 per cent to 28.5 per cent, given declines in inequality across all the dimensions, and fell by 3 percentage points in health and 2 percentage points in education and income. Note that such comparisons will be influenced by the comparability of the data used to compute inequality.

Sixth, **inequality losses from standard of living can be compared to those in health or education, for different countries or groups of countries**. Here, however, the comparisons must adequately incorporate into the analysis the differential treatment of income.

Seventh, if the survey data are representative for different social or cultural groups, then the IHDI can be used to **complement analyses of horizontal inequalities** (inequalities between culturally formed groups—ethnic, racial, regional, etc., instead of between individuals).[17] The IHDI penalises the HDI for the degree of inequality in each and every dimension across the whole population without dividing it into different sub-groups. Comparisons of IHDI computed for different population groups (e.g. defined by location, region, ethnicity, etc.) reflect differences in human development that take into account both group-specific average attainment and within-group inequality.

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[17] Stewart (2008).

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If one is solely concerned with horizontal inequalities on average attainments, and does not want within-group inequalities to play a role in the comparison, then a simple comparison of sub-group HDIs would be more appropriate. A comparison of sub-group HDIs compresses within-group inequalities and focuses on between-group inequalities of group-specific human development, as measured by the HDI. These two options are discussed, for instance, in the 2010 Mexico *HDR* focused on indigenous populations. Note that to compute HDI and IHDI for population sub-groups, some health variable other than life expectancy must normally be used—such as under-5 child mortality.

5.2 Creative data presentation

For all of the seven comparisons above, creative graphics can transform even sophisticated comparisons into powerful policy messages. For example, in 2010, the IHDI results were presented alongside the HDI results to highlight losses due to inequality. Interesting comparisons involve cases in which different levels of HDI come along with different levels of IHDI. For instance, in figure 2 below, taken from the 2010 *HDR*, pairs of countries with similar HDI but different IHDIs were compared so that the reduction of human development due to inequality stands out.

**Figure 2. Inequality has large impacts on human development**
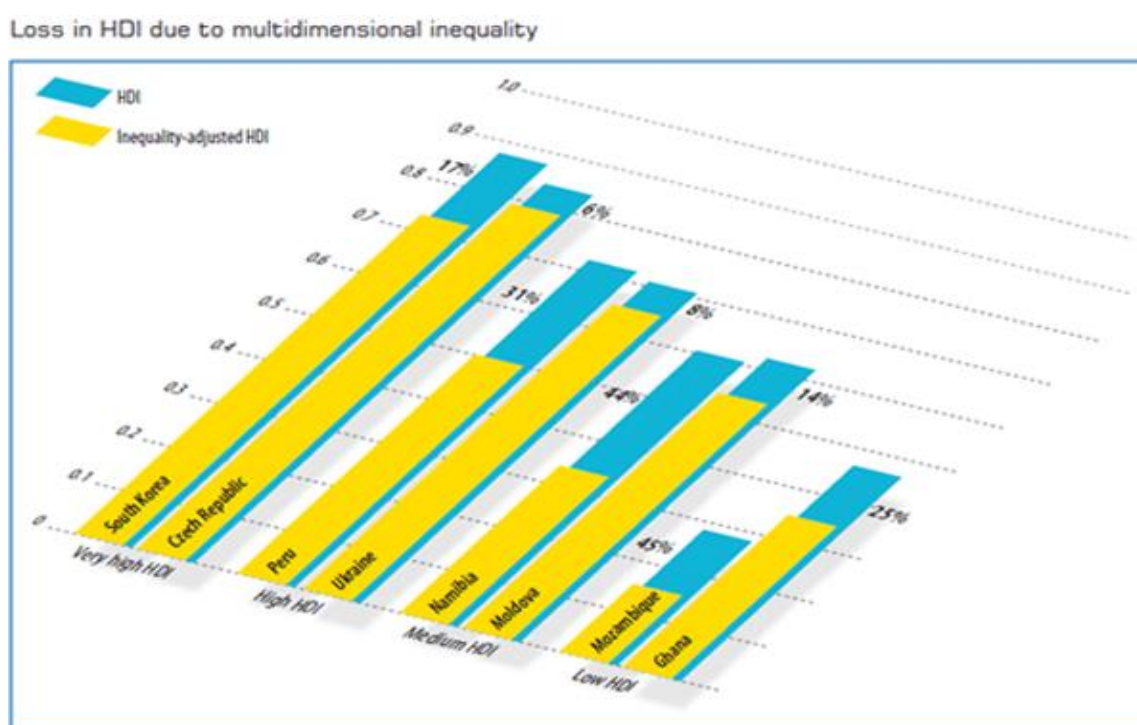
Source: *HDR* 2010, Figure 5.1, p. 88

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Another interesting graphical presentation is that of the total inequality losses (by country or by region) decomposed by dimension-specific losses due to inequality. The decomposition is easy to compute relying on the fact that the total loss (see equation in Step 3 of Section 3.1 on measurement above) can be reasonably approximated by the arithmetic sum of the dimension-specific losses, each of which is reflected in the percentage loss per dimension, as shown in the Slovenia example. But note that the percentage loss can also be obtained directly, because its value is one minus the Inequality Adjustment Factor, which is equal to the Atkinson measure, A_X, for each specific dimension.

Figure 3 taken from the 2010 *HDR* provides a good example of total losses due to inequality as decomposed in terms of losses by dimensions of human development. Interestingly, the main sources of total inequality loss vary by region. For instance, while education is a more important source of loss in the Arab States and in South Asia, living standards are more important in Latin America and the Caribbean, and health is more important in Sub-Saharan Africa. The same data can also be presented through other graphics such as pie charts.

Figure 3. People in Sub-Saharan Africa, South Asia and Arab States lose most from inequality in human development
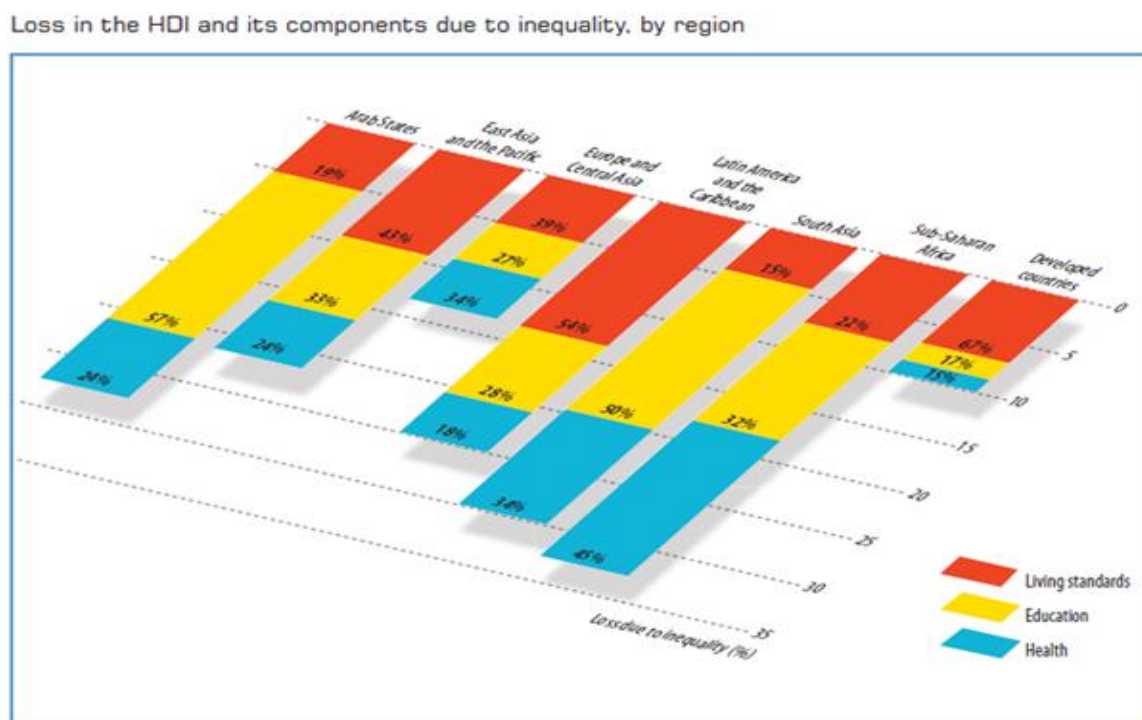
Source: *HDR* 2010, Figure 5.2, p. 88

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6. LIMITATIONS OF THE IHDI

The IHDI captures the inequality in distribution within the HDI dimensions, as well as (like the HDI) across the dimensions. However, there are a number of caveats, such as:

- The IHDIs prepared with income data are not strictly comparable with those prepared with consumption data, imputed data or quantile data.
- The IHDI value is sensitive to the lower bound. Thus it is sensitive to the values used to replace zero or negative values in income and education. The replacement values (the lower bound) needs to be justified as a natural zero, and sensitivity tests need to be performed.[18]
- The IHDI reflects inequalities across the distribution, but does not indicate which people are at the lower end of the distribution in all three dimensions at the same time.
- The same variables could not be used for HDI and IHDI; hence the IHDI assumes that the inequality in the variables used are good proxies for the inequality in the HDI dimensional variables.

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[18] See Kovacevic (2010) for a discussion on sensitivity analysis of the IHDI.

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