Measuring Economic and Human Development in the Anthropocene: Bringing Climate Change In?

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Per capita ecological footprints increase with human development

Ecological footprint, 2016
(gLOBAL hectares per person)

Low human development  Medium human development  High human development  Very high human development

Biocapacity per person, world average (1.7 global hectares)

Human Development Index value, 2018

Note: Covers 175 countries in the Global Ecological Footprint Network database (www.footprintnetwork.org/resources/data/; accessed 17 July 2018). As used here, the ecological footprint is a per capita measure of how much area of biologically productive land and water a country requires, domestically and abroad, to produce all the resources it consumes and to absorb the waste it generates. Each bubble represents a country, and the size of the bubble is proportional to the country’s population.

Source: Cramming and von Cramon-Taubadel 2018.
Alternative scenario: More energy

Alternative scenario: the world needs ‘more energy’ to allow global living standards to continue to improve

Human development index and energy consumption per head, 2017

Share of world population consuming less than 100 Gigajoules per head

Source: UN 2018
Enhanced Human Development Index (HDI) which adds sustainability to the existing HDI

Many of Sen’s original writings contained these broader themes

Sen (1999) Unfreedoms include hunger, famine, ignorance, an unsustainable economic life, unemployment, barriers to economic fulfilment by women or minority communities, premature death, violation of political freedom and basic liberty, threats to the environment, and little access to health, sanitation, or clean water.

As argued by Amartya Sen and Sudhir Anand (2000) over two decades ago, “There is in fact no basic difficulty in broadening the concept of human development [...] to accommodate the claims of future generations and the urgency of environmental protection.”
ALTERNATE MEASURES OF DEVELOPMENT: STRENGTHS AND WEAKNESSES

- GHI – Gross Happiness Index
- SDGI- Sustainable Development Goals Index
- SPI- Social Progress Index
- LPI- Legatum Prosperity Index
- HPI- Happy Planet Index
- SDI- Sustainable Development Index

<table>
<thead>
<tr>
<th>Index</th>
<th>HDI</th>
<th>Inequality Adj. HDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHI</td>
<td>0.74</td>
<td>0.70</td>
</tr>
<tr>
<td>SDGI</td>
<td>0.89</td>
<td>0.89</td>
</tr>
<tr>
<td>SPI</td>
<td>0.95</td>
<td>0.92</td>
</tr>
<tr>
<td>LPI</td>
<td>0.92</td>
<td>0.91</td>
</tr>
<tr>
<td>HPI</td>
<td>0.12</td>
<td>0.09</td>
</tr>
<tr>
<td>SDI</td>
<td>-0.53</td>
<td>-0.55</td>
</tr>
</tbody>
</table>
**Happy Planet Index**

- HPI = (Well-being) \( \times \) (Life Expectancy) \( \times \) (Inequality of Outcomes) \( \div \) (Ecological Footprint)

<table>
<thead>
<tr>
<th>Country</th>
<th>HDI Rank</th>
<th>HDI Score</th>
<th>HPI Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Rica</td>
<td>68</td>
<td>0.794</td>
<td>1</td>
</tr>
<tr>
<td>Mexico</td>
<td>76</td>
<td>0.767</td>
<td>2</td>
</tr>
<tr>
<td>Colombia</td>
<td>79</td>
<td>0.761</td>
<td>3</td>
</tr>
<tr>
<td>Australia</td>
<td>6</td>
<td>0.938</td>
<td>105</td>
</tr>
<tr>
<td>Canada</td>
<td>13</td>
<td>0.922</td>
<td>85</td>
</tr>
<tr>
<td>USA</td>
<td>15</td>
<td>0.92</td>
<td>108</td>
</tr>
<tr>
<td>Holland</td>
<td>10</td>
<td>0.933</td>
<td>18</td>
</tr>
<tr>
<td>Spain</td>
<td>25</td>
<td>0.893</td>
<td>15</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>126</td>
<td>0.651</td>
<td>7</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>135</td>
<td>0.614</td>
<td>8</td>
</tr>
</tbody>
</table>
Sustainable Development Index (SDI)

- SDI = Development Index / Ecological Impact Index.

- Development Index = Geometric Mean of Education * Life Expectancy * Income; Education Index is as in HDI; Life Expectancy Index is as in HDI.

- Income Index = there is no extra benefit for income above $20,000.

- Ecological Impact Index = is the average overshoot of CO2 emissions and material use over planetary boundaries.
Sustainable Development Index

<table>
<thead>
<tr>
<th>SDI Rank</th>
<th>Country</th>
<th>SDI</th>
<th>Life Expect. (years)</th>
<th>Education Index</th>
<th>GNI per capita (PPP)</th>
<th>Material Footprint (tns/cap)</th>
<th>CO2 emissions (tns/cap)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cuba</td>
<td>0.859</td>
<td>79.6</td>
<td>0.768</td>
<td>21,000</td>
<td>8.04</td>
<td>3.42</td>
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<tr>
<td>2</td>
<td>Costa Rica</td>
<td>0.830</td>
<td>79.6</td>
<td>0.713</td>
<td>14,086</td>
<td>8.08</td>
<td>2.66</td>
</tr>
<tr>
<td>3</td>
<td>Sri Lanka</td>
<td>0.825</td>
<td>75.1</td>
<td>0.751</td>
<td>10,791</td>
<td>3.88</td>
<td>1.03</td>
</tr>
<tr>
<td>4</td>
<td>Albania</td>
<td>0.811</td>
<td>78.2</td>
<td>0.733</td>
<td>11,083</td>
<td>10.92</td>
<td>2.32</td>
</tr>
<tr>
<td>5</td>
<td>Panama</td>
<td>0.808</td>
<td>77.8</td>
<td>0.681</td>
<td>18,167</td>
<td>7.85</td>
<td>3.77</td>
</tr>
<tr>
<td>6</td>
<td>Algeria</td>
<td>0.805</td>
<td>75.9</td>
<td>0.662</td>
<td>13,338</td>
<td>3.03</td>
<td>1.96</td>
</tr>
<tr>
<td>7</td>
<td>Georgia</td>
<td>0.801</td>
<td>73.1</td>
<td>0.831</td>
<td>8,766</td>
<td>9.12</td>
<td>3.07</td>
</tr>
<tr>
<td>8</td>
<td>Armenia</td>
<td>0.800</td>
<td>74.4</td>
<td>0.746</td>
<td>8,517</td>
<td>7.63</td>
<td>1.99</td>
</tr>
<tr>
<td>9</td>
<td>Azerbaijan</td>
<td>0.798</td>
<td>71.9</td>
<td>0.709</td>
<td>16,334</td>
<td>5.91</td>
<td>3.24</td>
</tr>
<tr>
<td>10</td>
<td>Peru</td>
<td>0.788</td>
<td>74.7</td>
<td>0.686</td>
<td>11,420</td>
<td>9.38</td>
<td>2.14</td>
</tr>
</tbody>
</table>
World Bank Adjusted Net Savings and UNEP Inclusive Wealth Index

• ANS is calculated as: ANS = GNS – CFC + EDU – NRD – GHG – POL

• where ANS = Adjusted Net Saving; GNS = Gross National Saving, calculated as the difference between Gross National Income (GNI) and public and private consumption, a standard item in the system of national accounts; CFC = Consumption of fixed capital, the replacement value of capital used up in the process of production, also a standard item in the system of national accounts; EDU = Current public expenditure on education. NRD Net resource depletion, GHG green house gas emissions POL air pollution

• The UN’s Environment Programme (UNEP) has also created a wealth index – similar in concept to the World Bank’s Adjusted Net Savings – but with some differences. First, it measures education capital not through education expenditures but as returns to education and secondly it recognizes additions to natural capital coming from increases in agricultural land, non-renewable capital, and capital gains to existing stocks of natural capital. In the World Bank calculations urban land is classified as produced capital and protected land is included in natural capital whereas IWI includes estimate of fish stocks and their changes.
One advantage of the UNEP report is that it provides separate estimates of the different types of capital – so one can study weak vs strong sustainability.

In the case of IWI correlations are possible only between changes in IWI per capita and HDI and are provided in the UNEP report and show very low correlation. But they do show that there is a very large number of countries (almost 40% of the countries included) where HDI growth is positive, but IWI per capita growth is negative. This result holds under different measures of IWI per capita.

But surprisingly, for both China and India – the two largest countries in the world show very positive growth in HDI and IWI per capita despite huge CO2 emissions and massive environmental problems in both air and water quality.

But the results do provide yet another compelling reason why sustainability must be included in an expanded HDI.
## Change in Country Rankings with PP Adjusted HDI

<table>
<thead>
<tr>
<th>Country</th>
<th>Change</th>
<th>New Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>-15</td>
<td>15</td>
</tr>
<tr>
<td>Australia</td>
<td>-72</td>
<td>72</td>
</tr>
<tr>
<td>Singapore</td>
<td>-92</td>
<td>92</td>
</tr>
<tr>
<td>Canada</td>
<td>-40</td>
<td>40</td>
</tr>
<tr>
<td>USA</td>
<td>-45</td>
<td>45</td>
</tr>
<tr>
<td>Korea</td>
<td>-19</td>
<td>19</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>-33</td>
<td>33</td>
</tr>
<tr>
<td>China</td>
<td>-16</td>
<td>16</td>
</tr>
<tr>
<td>T&amp;T</td>
<td>-54</td>
<td>54</td>
</tr>
<tr>
<td>Spain</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Panama</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Costa Rica</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>
Vulnerable Employment and the Human Development Index

[Graph showing the relationship between HDI value and vulnerable employment as a percentage of total employment, with points labeled for India, Bangladesh, Thailand, Malaysia, Korea, Canada, and Sweden.]
<table>
<thead>
<tr>
<th>No. of Countries In HDI Category</th>
<th>HDI</th>
<th>Inequality-Adjusted HDI</th>
<th>Vulnerability Adjusted HDI (2% shock)</th>
<th>Vulnerability Adjusted HDI (5% shock)</th>
<th>Extended HDI with Notre-Dame Vulnerability Index added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>47</td>
<td>25</td>
<td>38</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>High</td>
<td>32</td>
<td>21</td>
<td>18</td>
<td>13</td>
<td>34</td>
</tr>
<tr>
<td>Medium</td>
<td>18</td>
<td>35</td>
<td>29</td>
<td>24</td>
<td>31</td>
</tr>
<tr>
<td>Low</td>
<td>5</td>
<td>21</td>
<td>17</td>
<td>36</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>102</td>
</tr>
</tbody>
</table>
## HDI Measures for India 2019

<table>
<thead>
<tr>
<th>HDI 2019</th>
<th>Inequality Adjusted HDI</th>
<th>Vulnerability Adjusted HDI (1% shock)</th>
<th>Vulnerability Adjusted HDI (2% shock)</th>
<th>Vulnerability Adjusted HDI (5% shock)</th>
<th>Adding Disaster Vulnerability to HDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.647</td>
<td>0.477</td>
<td>0.5703</td>
<td>0.4936</td>
<td>0.2635</td>
<td>0.606</td>
</tr>
</tbody>
</table>
Thank You