



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

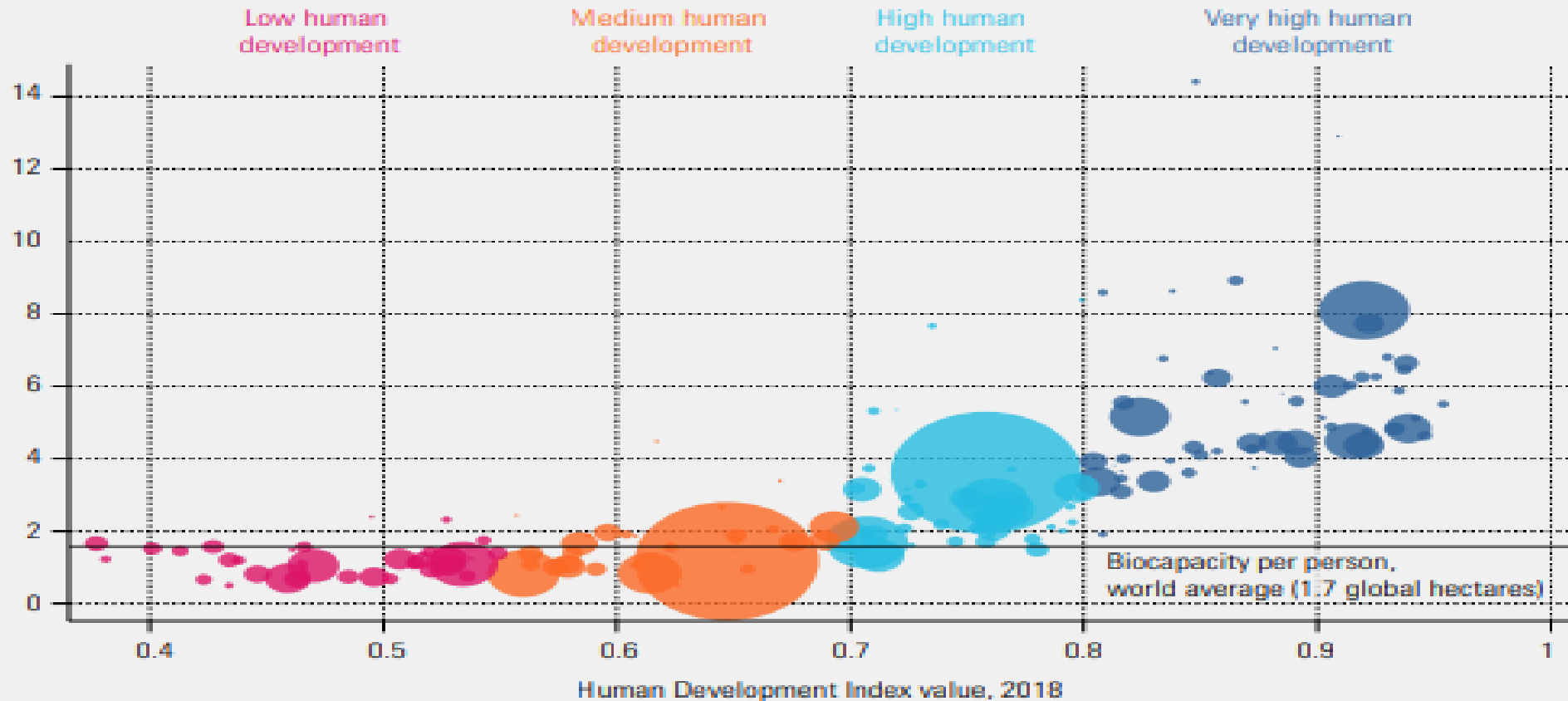
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Per capita ecological footprints increase with human development

Ecological footprint, 2016
(global hectares per person)



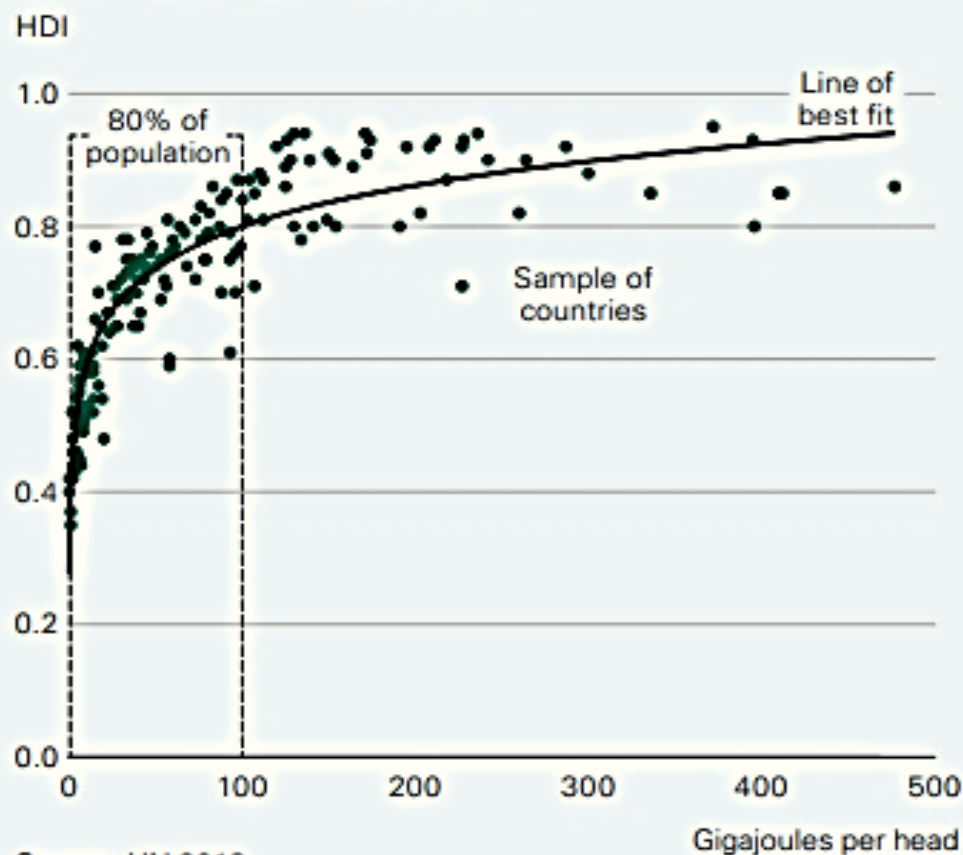
Note: Covers 175 countries in the Global Ecological Footprint Network database (www.footprintnetwork.org/resources/data/; accessed 17 July 2018). As used here, the ecological footprint is a per capita measure of how much area of biologically productive land and water a country requires, domestically 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: Cumming and von Cramon-Taubadel 2018.

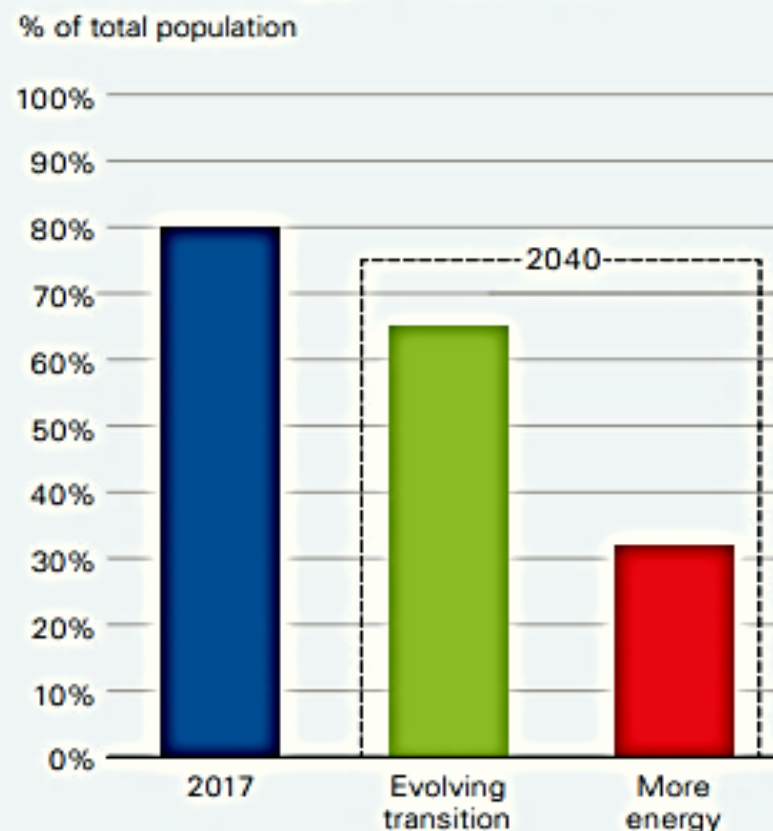
Alternative scenario: More energy

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



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

	HDI	Inequality Adj. HDI
GHI	0.74	0.70
SDGI	0.89	0.89
SPI	0.95	0.92
LPI	0.92	0.91
HPI	0.12	0.09
SDI	-0.53	-0.55

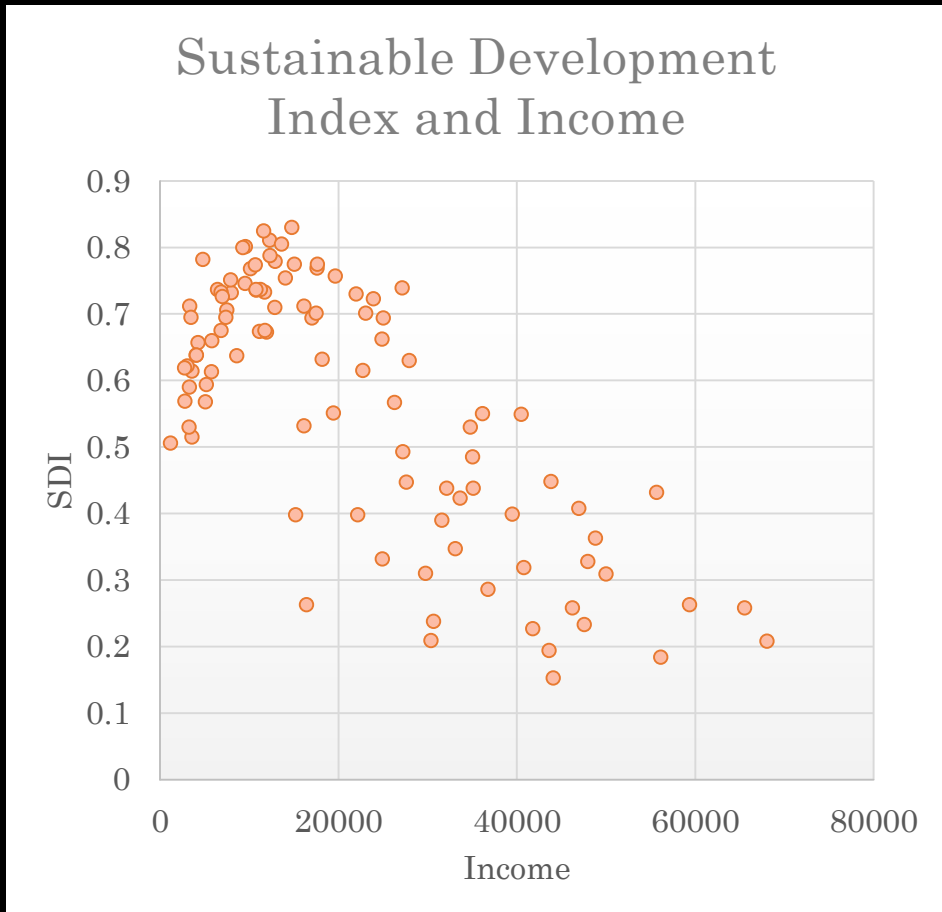
Happy Planet Index

- $HPI = \frac{(\text{Well-being}) \times (\text{Life Expectancy}) \times (\text{Inequality of Outcomes})}{(\text{Ecological Footprint})}$

Country	HDI Rank	HDI Score	HPI Rank
Costa Rica	68	0.794	1
Mexico	76	0.767	2
Colombia	79	0.761	3
Australia	6	0.938	105
Canada	13	0.922	85
USA	15	0.92	108
Holland	10	0.933	18
Spain	25	0.893	15
Nicaragua	126	0.651	7
Bangladesh	135	0.614	8

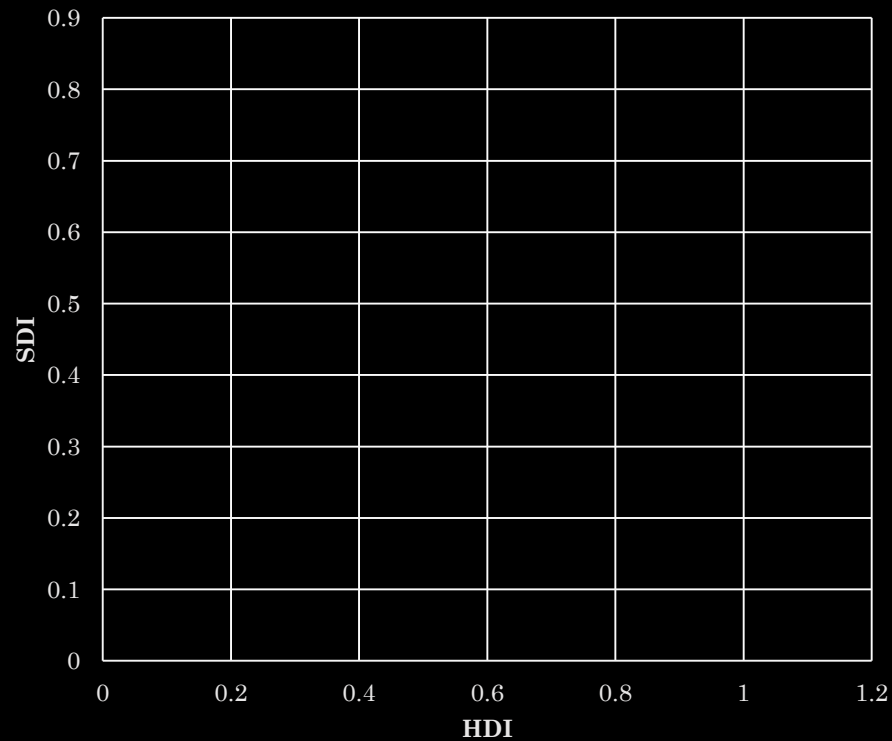
Sustainable Development Index (SDI)

- $SDI = \text{Development Index} / \text{Ecological Impact Index}$.
- $\text{Development Index} = \text{Geometric Mean of Education} * \text{Life Expectancy} * \text{Income}$; Education Index is as in HDI; Life Expectancy Index is as in HDI.
- $\text{Income Index} =$ there is no extra benefit for income above \$20,000.
- $\text{Ecological Impact Index} =$ is the average overshoot of CO2 emissions and material use over planetary boundaries.



Sustainable Development Index

Sustainable Development Index and HDI



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

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.

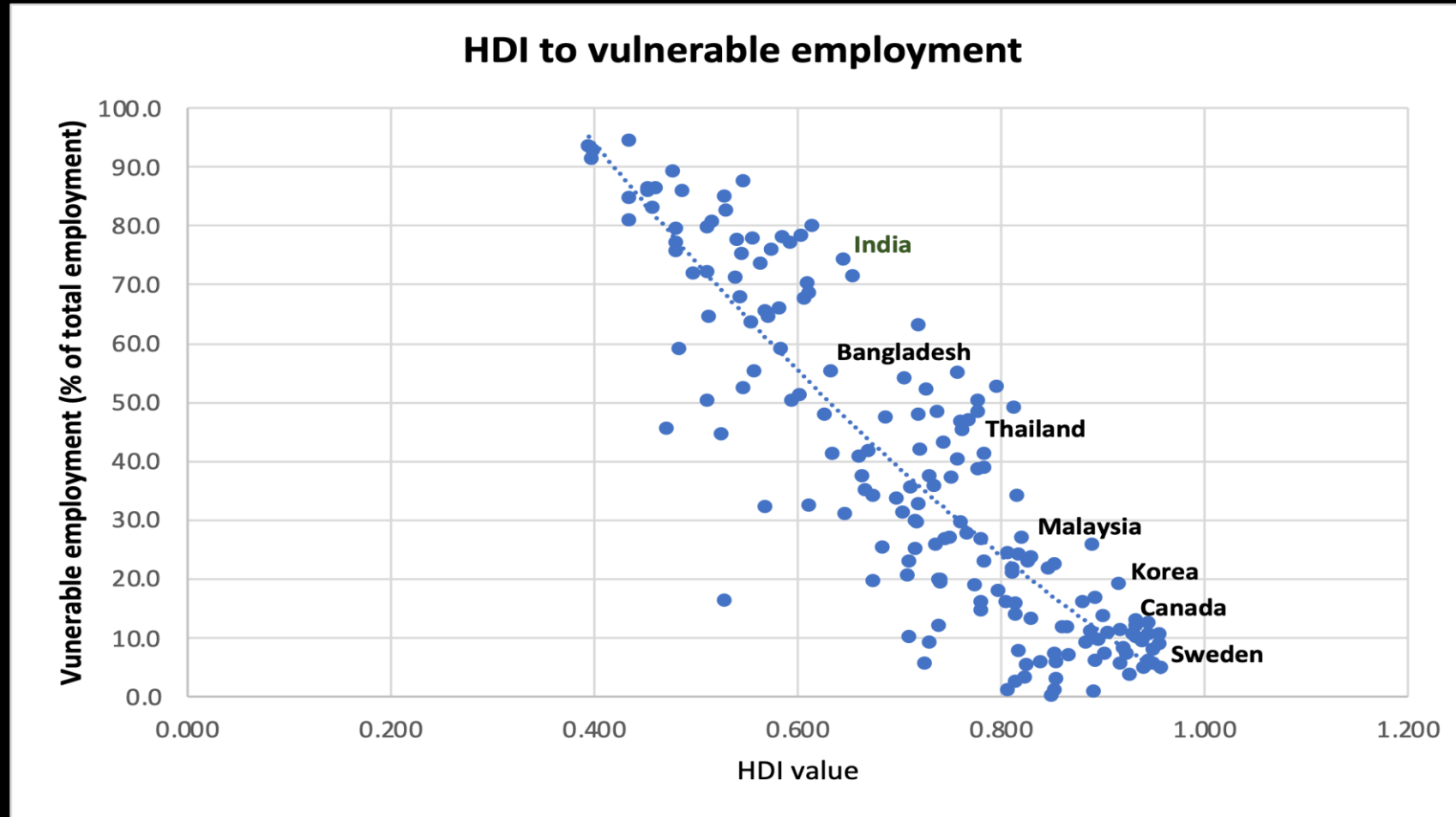
UNEP Measure of Inclusive Wealth is better : Strong Sustainability

- 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

• Norway	-15	Spain	11
• Australia	-72	France	16
• Singapore	-92	UK	10
• Canada	-40	Italy	12
• USA	-45	Argentina	20
• Korea	-19	Panama	30
• Saudi Arabia	-33	Costa Rica	37
• China	-16	India	8
• T&T	-54	Colombia	26

Vulnerable Employment and the Human Development Index



Vulnerability Adjusted HDI

No. of Countries In HDI Category	HDI	Inequality-Adjusted HDI	Vulnerability Adjusted HDI (2% shock)	Vulnerability Adjusted HDI (5% shock)	Extended HDI with Notre-Dame Vulnerability Index added
Very High	47	25	38	29	30
High	32	21	18	13	34
Medium	18	35	29	24	31
Low	5	21	17	36	7
Total	102	102	102	102	102

HDI Measures for India 2019

HDI 2019	Inequality Adjusted HDI	Vulnerability Adjusted HDI (1% shock)	Vulnerability Adjusted. HDI (2% shock)	Vulnerability Adjusted HDI (5% shock)	Adding Disaster Vulnerability to HDI
0.647	0.477	0.5703	0.4936	0.2635	0.606

Thank You

