Multidimensional poverty measurement and analysis

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Motivation:


- **Empirical Puzzle: Mis-match**


Alternative Methods (no joint distribution)

- **Dashboard:** – SDG indicators; MDG Indicators –

- **Composite:** – Human Development Index HDI; etc –
Alternative Methods (can reflect joint distribution)


Direct Antecedents: Axiomatic & Counting; Policy Motivation


Notation:

Consider a population of \( n \) persons whose well-being is evaluated by \( d \) indicators. Let us denote the achievement of person \( i \) in indicator \( j \) by \( x_{ij} \in \mathbb{R} \) for all \( i = 1, \ldots, n \) and \( j = 1, \ldots, d \). The achievements of \( n \) persons in \( d \) indicators are summarized by an \( n \times d \) dimensional achievement matrix \( X \), where rows denote persons and columns denote indicators. The weight or deprivation value attached to each indicator \( j \) is the same across all persons and is denoted by \( w_j \), such that \( w_j > 0 \) and \( \sum_{j=1}^{d} w_j = 1 \). The weights are summarized by vector \( w \).

We denote the deprivation cutoff for indicator \( j \) by \( z_j \), and the deprivation cutoffs are summarized by vector \( z \). Any person \( i \) is deprived in any indicator \( j \) if \( x_{ij} < z_j \) and non-deprived, otherwise.

We create an \( n \times d \) dimensional deprivation matrix and assign a deprivation status score \( g_{ij} \) to each person in each indicator based on the deprivation status. If person \( i \) is deprived in indicator \( j \), then \( g_{ij} = 1 \); and \( g_{ij} = 0 \), otherwise.

An overall deprivation score \( c_i \in [0,1] \) is computed for each person by summing the deprivation status scores of all \( d \) indicators, each multiplied by their corresponding weights, such that \( c_i = \sum_{j=1}^{d} w_j g_{ij} \).

A person is identified as poor if \( c_i \geq k \), where \( k \in (0,1] \), and non-poor, otherwise.

We create the censored deprivation matrix \( g_0(k) \) such that \( g_{ij}(k) = g_{ij} \) if \( c_i \geq k \) and \( g_{ij}(k) = 0 \) otherwise, and a censored score vector \( c(k) \), such that \( c_i(k) = c_i \) if \( c_i \geq k \) and \( c_i(k) = 0 \), otherwise.
Measurement: Adjusted Headcount Ratio

The MPI is the mean of the censored deprivation score vector.

\[ M_0 = MPI = \frac{1}{n} \sum_{i=1}^{n} c_i(k) \]

or, equivalently MPI is the product of incidence (H) and intensity (A):

\[ M_0 = MPI = \frac{q}{n} \times \frac{1}{q} \sum_{i=1}^{n} c_i(k) = H \times A \]

or, equivalently MPI is the sum of the weighted censored headcount ratios:

\[ M_0 = MPI = \sum_{j=1}^{d} w_j h_j = \sum_{j=1}^{d} w_j \left[ \frac{1}{n} \sum_{i=1}^{n} g_{ij}(k) \right] \]
Some Official National MPIs

2009: **Mexico**; 2010: **Bhutan**; 2011: **Colombia**
2015: **Chile, El Salvador, Costa Rica and Viet Nam**
2016: **Ecuador, Pakistan, Honduras, Mozambique and Armenia**
2017: **Panama, Dominican Republic, Nepal, USA**
2018: **Nigeria, Philippines and Rwanda**
2019: **Guatemala, Afghanistan, Sierra Leone, Angola, Thailand**
2020: **Seychelles, Maldives, Palestine and Ghana**
2021: **Namibia, Paraguay, S Africa, India, Sri Lanka, Malawi**
2022: **Uganda, Samoa (forthcoming)**

**MPPN.org Website:**
- Magazine *Dimensions*
  - Links to each country’s MPI
- Coverage of UNGA / UNSC
- Quarterly conference calls
- Annual Meetings (Egypt 2023)

**Other OPHI activities:**
- 2-week intensive Summerschool in Stata
- 1-week Executive Education on policy uses of MPI
  (budgeting, targeting, coordination, M&E etc)

**Some External Assessments**

*World Bank 2017 Monitoring Global Poverty*

*Atkinson 2019 Measuring Poverty Around the World*
Poverty cutoff = 33.33%

Indicator weights: equal nested (visually depicted)

Data used for the global MPI 2022

111 datasets covering 6.1 billion people

Multiple Indicator Cluster Surveys (54)
Demographic and Health Surveys (45)
National Surveys & PAPFAM (13)

Updated Countries (12)
introduced Countries (3)

All data are 2010-2021.

For 83 countries, home to 81.3% of poor people, data were fielded in **2016 or later**.

Of these, 35 countries, home to 37.1% of poor people, have data fielded in **2019 or later**.
Results: Global MPI (levels)

1.2 billion people out of the 6.1 billion people covered are poor (19.1%) for a cutoff of 33.33% and average MPI value is 0.094

Poverty Incidence ranges from 0-92% across 111 countries; 0-95% across female headed households; 0-95% across children aged 0-9; 0-97% across rural areas, and 0-99% across 1287 subnational regions.

Half of all poor people are children (593 million). One in three children are poor; one in seven adults.

Two-thirds of poor people live in middle income countries.

For the first time since 2010, we find significantly more poor people in Sub-Saharan Africa (579 million) than South Asia (385 million) – but data are on avg 2.5 years older in Sub-Saharan Africa.

Other cutoffs are applied (4.2 billion have at least one deprivation; 4.2 million have all deprivations)

Globally, 146 million poor people are deprived in child mortality, 1 billion in cooking fuel, 682 million in nutrition, 595 million in schooling.

Results: Global MPI (trends)

Strictly Harmonised trend data are available for 84 countries and 205 datasets. 48 countries cover one period of time; 35 countries have two periods, and Gambia has three periods. Trends are disaggregated by rural/urban area, age cohort, and subnational region.

Of the 121 country-periods covered, 97 had statistically significant reductions (95%).

Over 15 years, from 2005/6 to 2015/16 to 2019/21, 415 million people exited poverty in India.

The MPI decreased from 0.283 to 0.122 to 0.069; Incidence decreased from 55.1% to 27.7% to 16.4%; Intensity decreased from 51.3% to 44.0% to 42.0%; All 10 indicators had significant reductions, led by SA CF NU; The poorest states, children, rural areas, castes, had the fastest absolute reduction. E.g. Bihar 77% to 35%; Severe poverty (k=50%) fell; Vulnerability (20%) stable.

The global MPI shows the weighted indicator composition of poverty for the 229 million poor people in India in 2019/21, to inform state- and group- specific policy interventions.
Results: 2022 Theme ~ Unpacking Deprivation Bundles of the poor

### Table A: All deprivation pairs and the number of poor people experiencing each pair across 111 developing countries (millions)

<table>
<thead>
<tr>
<th></th>
<th>Nutrition</th>
<th>Child mortality</th>
<th>Years of schooling</th>
<th>School attendance</th>
<th>Cooking fuel</th>
<th>Sanitation</th>
<th>Drinking water</th>
<th>Electricity</th>
<th>Housing</th>
<th>Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrition</td>
<td>—</td>
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<td>—</td>
<td>—</td>
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<td>—</td>
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<tr>
<td>Child mortality</td>
<td>82.9</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<td>—</td>
<td>—</td>
<td>—</td>
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<td>—</td>
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<tr>
<td>Years of schooling</td>
<td>279.7</td>
<td>55.3</td>
<td>—</td>
<td>—</td>
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<td>—</td>
<td>—</td>
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<tr>
<td>School attendance</td>
<td>259.1</td>
<td>54.1</td>
<td>242.2</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<td>—</td>
</tr>
<tr>
<td>Cooking fuel</td>
<td>592.3</td>
<td>119.5</td>
<td>536.1</td>
<td>416.8</td>
<td>—</td>
<td>—</td>
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<td>—</td>
</tr>
<tr>
<td>Sanitation</td>
<td>470.1</td>
<td>100.3</td>
<td>447.9</td>
<td>339.4</td>
<td>808.4</td>
<td>—</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td>Drinking water</td>
<td>286.2</td>
<td>62.3</td>
<td>263.3</td>
<td>219.8</td>
<td>507.1</td>
<td>437.1</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td>Electricity</td>
<td>317.8</td>
<td>72.4</td>
<td>326.6</td>
<td>266.0</td>
<td>593.3</td>
<td>522.9</td>
<td>381.4</td>
<td>—</td>
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</tr>
<tr>
<td>Housing</td>
<td>506.7</td>
<td>101.5</td>
<td>485.5</td>
<td>368.1</td>
<td>862.2</td>
<td>735.3</td>
<td>444.9</td>
<td>547.4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Assets</td>
<td>247.4</td>
<td>44.1</td>
<td>299.6</td>
<td>187.6</td>
<td>491.0</td>
<td>421.1</td>
<td>279.3</td>
<td>353.1</td>
<td>455.9</td>
<td>—</td>
</tr>
<tr>
<td>Total number of poor people deprived in indicator</td>
<td>681.5</td>
<td>145.7</td>
<td>595.4</td>
<td>474.2</td>
<td>1,035.4</td>
<td>860.7</td>
<td>532.7</td>
<td>608.2</td>
<td>913.7</td>
<td>513.2</td>
</tr>
</tbody>
</table>

**Note:** Each cell indicates the number of people who experience each deprivation pair. Dark green shading indicates the lowest numbers, yellow the middle numbers and dark red the highest numbers.

**Source:** Authors’ calculations based on Alkire, Nogales and Suppa (2022) and microdata underlying the Multidimensional Poverty Index computations in table 1 at the end of the report.
Results: 2022 Theme

[Graph showing distribution of poor people by region and various factors such as cooking fuel, sanitation, housing, etc.]
Deprivation Bundle: some combination of indicators in which a person is deprived – e.g. pairs, triplet. Selective

Deprivation Profile: shows in which of the 10 indicators a person is deprived – e.g. ‘all living standards indicators’. Exhaustive

Reported in terms of the number or percentage of poor people experiencing that bundle / profile.

Results: 2022 Theme ~ Unpacking Deprivation Bundles of the poor

Suppa, N., Alkire, S., and Nogales, R., (2022). 'The many forms of poverty: Analyses of deprivation interlinkages in the developing world,' OPHI Research in Progress 63a, Oxford Poverty and Human Development Initiative (OPHI), University of Oxford
Results: 2022 Theme for India 2019/21

Deprivation Profiles for 50% of poor

Co-deprivations to school attendance for rural vs urban areas

Revising the Global Multidimensional Poverty Index: Empirical Insights and Robustness

Sabina Alkire, Usha Kanagaratnam, Ricardo Nogales, Nicolai Suppa

First published: 15 March 2022 | https://doi.org/10.1111/roiw.12573 | Citations: 1
The global MPI specifications were revised in 2018 to align with the SDGs (Alkire & Kanagaratnam 2020).

This paper uses the global MPI dataset to address the following questions:
(1) What novel insights about interlinkages among poverty-related indicators in the developing world do we gain from the revised global MPI?
The global MPI specifications were revised in 2018 to align with the SDGs (Alkire & Kanagaratnam 2020).

This paper uses the global MPI dataset to address the following questions:

(1) What novel insights about interlinkages among poverty-related indicators in the developing world do we gain from the revised global MPI?

   (1) Our results suggest that 81–99% of the population in the developing world who are deprived in one indicator experience one or more additional deprivations. To uncover heterogeneities, we also disaggregate the poverty measures by world region, rural-urban areas, and age groups.

(2) How robust is the revised specification to changes in poverty lines and weights?

   (1) Across the entire set of countries, 94–95% of country pairwise orderings by MPI and H are robust for poverty lines from 20 to 50%, and almost 90% of country pairwise comparisons for MPI (88% for H) are robust across the weighting scheme of 25–50% per dimension.

(3) What are the empirical consequences of the revision for the way we understand poverty in light of the global MPI?

   (1) 93.02% of the possible country pairwise comparisons are identical in both MPI versions

https://doi.org/10.1111/roiw.12573
Empirically Salient Extensions: Global MPI

**Destitution:** a subset of the poor who are ‘ultra poor’ – the deprivation cutoffs vary, but the weights and poverty cutoff are the same. The Global MPI has reported a linked measure of destitution since 2014, and updated its revision after 2018. The paper articulating the link is:


**Inequality among the poor:** Absolute inequality among the poor using variance has been reported for the global MPI since 2014 and updated after 2018.


---We also found no measure can simultaneously respect dimensional breakdown and dimensional transfer.


**Gender and Intrahousehold Inequality:** By indexing eligible persons within each household, we analyse ‘individual indicators’ (e.g. years of schooling, nutrition, school attendance) by gender. We can also identify within each household whether none or all eligible members are deprived, or just a subset.


Other studies analyse disaggregations by disability status or ethnicity, or growth elasticity of the global MPI, or extending MPI using geospatially merged environment data (air, forest, fire, cyclone)
All information behind this presentation & more is available online on UNDP and OPHI websites.

Global MPI Report – joint with UNDP’s HDRO

Dofiles – to run on NFHS datasets
Download the technical files (or Stata do-files) for each country survey

Methodological Notes – MPI methodology and country-specific adjustments for level, trend and disaggregation
Alkire, S., Kanagaratnam, U., and Suppa, N. (2022). ‘The global Multidimensional Poverty Index (MPI) 2022 country results and methodological note’, OPHI MPI Methodological Note 52, Oxford Poverty and Human Development Initiative (OPHI), University of Oxford. – see also same authors, notes 53 and 54

Computational Programmes – to create the MPI

Deprivation Bundles Analysis – summarized in the report

Data Tables – for all global MPI countries
Table 1 National Results MPI 2022
Table 2 Other k Values MPI 2022
Table 3 Age Results MPI 2022
Table 4 Area Results MPI 2022
Table 5 Subnational Results MPI 2022
Table 6 Trends Over Time MPI 2022
Table 7 Headship Results MPI 2022
Table 8 All MPI Data 2010-2022

PDF Country Briefings – for all countries
Global multidimensional poverty and COVID-19: A decade of progress at risk?

Sabina Alkire a, Ricardo Nogales a,b, Natalie Naïri Quinn c, Nicolai Suppa a,d,e,*
Challenges

• Justification and implementation of simulations
• Most recent surveys do not refer to current margin
  1) Most recent progress ignored
  2) Simulations may depend on initial level
• Evidence for non-linear (quadratic) relationship between shock and initial level of poverty
Fig. 3. Translation Model for Simulated Impact of COVID-19 on Multidimensional Poverty Simulated impact on incidence ($H$). Notes: Simulated increase in multidimensional poverty incidence ($H$) under microsimulations implementing the moderate nutrition (20%) and school attendance (50%) scenario. Heavy line represents the estimated cross-country translation model (3). Fine lines represent the country-specific calibrations (5). Selected countries labelled: China (CHN), India (IND), Sierra Leone (SLE) and Ethiopia (ETH). Markers indicate countries’ world region: • Arab States; ◊ East Asia and the Pacific; △ Europe and Central Asia; □ Latin America and the Caribbean; + South Asia; × Sub-Saharan Africa.
Our approach

1) we use our harmonised data to obtain now-casts for each country (using custom projection techniques)
2) we simulate our scenarios in the most recent survey for each country
3) fit a cross-country model which explains simulated change with initial levels (translation model)
4) feed nowcasted value for each country into translation model to predict the simulated shock for each country at current margin
5) we aggregate across countries and report (i) increase in global multidimensional poverty and (ii) global poverty reduction potentially undone.
Fig. 4. Setbacks in multidimensional poverty reduction due to COVID-19.
How about covariates of MPIs?

Challenges

1. data availability (macro and micro perspective)
2. methodological
   - outcome variable reflects joint distribution of several well-being dimensions
   - (intentional) censoring process
   - related research
     1. global MPI and growth (Santos et al, 2019) https://doi.org/10.1080/00220388.2017.1393520
     2. governance and global MPI (Jindra & Vaz, 2019) https://doi.org/10.1111/gove.12394
     3. treatment Seth & Tutor https://doi.org/10.1111/roiw.12504
large-scale project (111 countries, 230+ micro datasets)

\( N: 5k–2.7m \text{ with } N_{\text{med}} \approx 50k \)

\# of level estimates \( \approx 500k \); \# of change estimates \( \approx 100k. \)

many reasons for a good workflow
(replicable results, efficient and flexible estimation)
The Basic Workflow

1. raw micro data
2. data prep
3. micro data
   - estimation
   - storing results
   - result chunks
   - compiling results
   - results file
      - graphs
      - country briefings
      - data export
      - data viz
   - reference sheet
      - external data prep
      - map prep
      - external data
      - maps
1. Single comprehensive results file

- well-defined structure and arbitrarily extendible
- Main principle: each estimate is an observation
- Created from “result chunks”: small subsets of estimates
2. Certification script (for micro data)

• Objective:
  • Fail early and loud; reduce code complexity; easy to extend

• Examples
  • variables are existing and numeric ... *conf numeric v ‘v’*
  • variables have valid values ... *assert inlist(‘v’,0,1)if !mi(‘v’)*
  • variables are not entirely missing
    ... *qui count if !mi(‘v’)*
    if ‘r(N)’ == 0 { ... 
  • data characteristics are not empty ... *assert "’_dta[‘c’]’"!= ""*
3. Quality checks

• At various stages
• Automation saves time, but manual screening remains vital

1. Cross-check between different sources
   • Different estimation routines, different releases
     ▶ assert float(b)== float(b_dp) if !mi(b_dp)
     ▶ gen diff = abs(b - b_dp)> 1e-07 if !mi(b_dp)

2. Timestamps
mpitb: A toolbox for multidimensional poverty indices

Nicolai Suppa

Spanish Stata Conference
Madrid, October 2022

• Developed in tandem with global MPI workflow,
• May help researchers and practitioners more generally
• Paper here: https://ophi.org.uk/rp-62a/
Features

- Easy to estimate key quantities out of the box including ...
  - Standard errors
  - Disaggregation by subgroups (e.g. regions)
  - For parameter sets (weights, cutoffs, indicators)
  - Changes over time (absolute, relative, annualised or raw)
- Facilitates generation of weights
- Avoid unnecessary estimations
- Produces structured results files
- Facilitates cross-country analysis
- ...
mpitb set

mpitb set [], name(mpiname)
    d1(varlist, subopts) ... d5(varlist, subopts)
    _description(text) clear replace

mpitb est

mpitb est, name(mpiname)[...]
    klist(numlist) weights(wgts sopts)
    measures(mlist) indmeasures(imlist) aux(auxlist)
    lframe(name [,sopts]) lsave(filename [,sopts])
    over(varlist [,sopts])
    ...]
Questions, comments and suggestions are always welcome!

Feel free to get in touch under

ophi@geh.ox.ac.uk          nsuppa@ced.uab.es

Or follow us on twitter

@ophi_oxford               @nicolaisuppa
All information behind this presentation & more is available online on UNDP and OPHI websites.

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