Sensitivity analyses in poverty measurement.
The case of the global multidimensional poverty index.

Sabina Alkire, Usha Kanagaratnam, Ricardo Nogales, Nicolai Suppa

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Abstract

This paper provides an extensive sensitivity analyses of the global multidimensional poverty index (MPI), which is a counting-based measure of acute poverty covering over 100 developing countries. Empirically, the paper probes the sensitivity of poverty measures and comparisons to modifications in key parameters. Outcomes studied include the adjusted headcount and headcount ratios and their subnational rankings, as well as the exact set of people who are identified as poor. Parameters that are adjusted include the poverty cutoff, weights or deprivation values, and indicators. Finally, the present paper also suggests 'second-order' sensitivity analyses to deepen the understanding of the underlying methods by varying poverty cutoffs and indicators simultaneously.

Introduction

Background

- Poverty measurement inescapably entails **value judgments**. Even after the important question of a methodology (entailing decisions on axioms) is settled, no less momentous value judgements remain.
- **Parametric value judgements**, however, frequently attract the lion share of criticism, whether the World Bank's dollar-a-day, or the 2010 global MPI.
- The most general strategy for both unidimensional and multidimensional poverty is **dominance analysis**. However empirically dominance results may or may not emerge and thus potentially leaving policy makers without counsel.
- **Sensitivity analyses** are common in poverty measurement and have been carried out for various parameter-outcome combinations. Outcomes frequently explored include (FGT-) measures, number of poor, subnational rankings, time trends.

This paper

1. … provides a **conceptual integration** into social choice framework and presents considerations for sensitivity analyses in poverty measurement (only previewed)
2. … includes a focus on **poverty sets** as key element of any sensitivity analysis
3. … assesses both **plausible and general parameters ranges** more intensively. Moreover, parameters are changed incrementally to identify critical values.
4. robustness to the **inclusion or omission of indicators** is assessed
5. the robustness of **subnational** rankings is assessed.
6. introduces **'second-order' sensitivity analysis** to assess extent to which a given parameter sensitivity depends on other parametric choices.

Data and Methods

Conceptual Considerations (preview only)

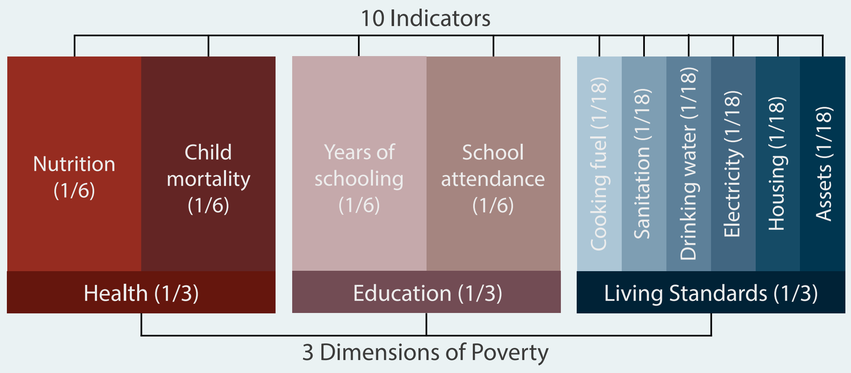
- task of specifying a poverty measure can be reframed as translating social value judgments into parametric choices.
- sensitivity analyses in poverty measurement are an integral component of the initial process fixing the parameters (and not compulsory ex-post exercise)
- in measurement exercises interpretation of sensitivity results is more complex: in general, robustness is desirable, non-robustness however does not automatically disqualify a measure. In fact, sensitivity is theoretically expected at some point.

Data

- we use data prepared for the GMPI 2019 release (Alkire et al., 2019).
- results for 101 countries and 1226 subnational regions from 98 countries
- micro data sets are mostly DHS, MICS, PAPFAM with survey years 2007–2018

The global MPI

- dual cutoff counting approach (Alkire and Foster, 2011) using 10 indicators, equal-nested weights, and poverty cutoff $k = \frac{1}{3}$ of weighted deprivation count
- focus on headcount ratio (H) and adjusted headcount ratio (MPI)



Alternative parameter choices

- poverty cutoff: 10 distinct values (including union and intersection); plausible range: $k \in [0.20, 0.50]$
- weights: 231 alternative weighting structures, i.e. for each dimension all weighting structures assigning values from 0–100% in increments of 5%-points; plausible range: weighting structures with weights of 25–50% for each dimension.
- indicator set: 6 alternative selections, dropping 1 living standard indicator at a time

Changes in subnational rankings

- Using statistical tests we can record for any pairwise comparison of two subnational units g and h and a poverty measure P specified using parameters θ

$$O_P^\theta(g,h) = \begin{cases} 1 & \text{if } P_g^\theta > P_h^\theta \\ 0 & \text{if } P_g^\theta = P_h^\theta \\ -1 & \text{if } P_g^\theta < P_h^\theta \end{cases} \tag{1}$$

Q: Moving from parametrization θ to θ', how do subnational rankings change?

- we define R_P as the **share of robust pairwise comparisons**

$$R_P = \frac{\sum_{1\le g<h\le 1}^{G} \mathbb{I}\left[O_P^\theta(g,h) = O_P^{\theta'}(g,h)\right]}{0.5G(G-1)} \tag{2}$$

- R_P ranges from 0–1, and yet interpretation is complex: (i) influence of single region varies with number of subnational regions in country, (ii) population shares affect several aspects, (iii) meaningful interpretation requires context
- note: this is a refined version of the approach adopted Alkire and Santos (2014)

Poverty sets

Q: Moving from parametrization θ to θ', how does the overlap in poverty sets change?

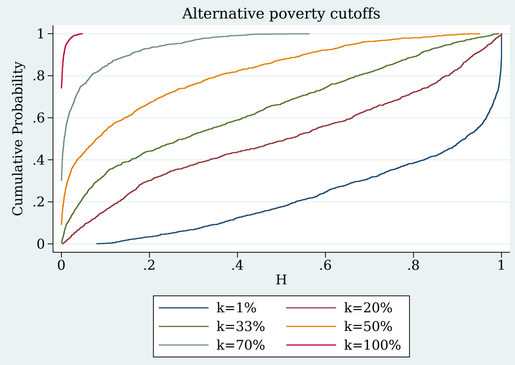
- The **Jaccard-coefficient**, is one among other measures (Alkire et al., 2015).

$$J = \frac{|\mathbb{P}(\theta) \cap \mathbb{P}(\theta')|}{|\mathbb{P}(\theta) \cup \mathbb{P}(\theta')|} \tag{3}$$

- $J = 1$ iff both sets coincide, but J will **decrease** if the headcount ratio for an alternative parametrization would change, the actual overlap decreases, or both.

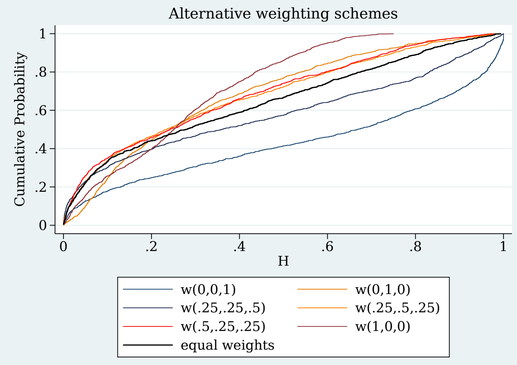
Selected Results

CDF of H for alternative poverty cutoffs



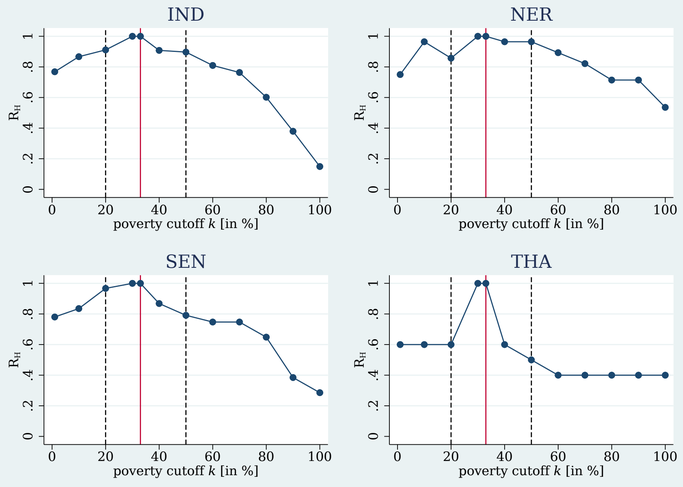
Notes: subnational estimates; only equal-nested weighting scheme.

CDF of H for alternative weights



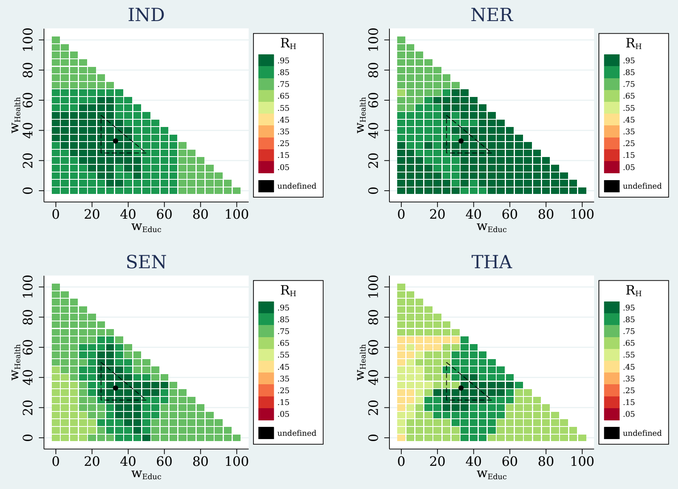
Notes: subnational estimates; underyling poverty cutoff: $k = \frac{1}{3}$.

Pairwise-comparison of H for alternative poverty cutoffs



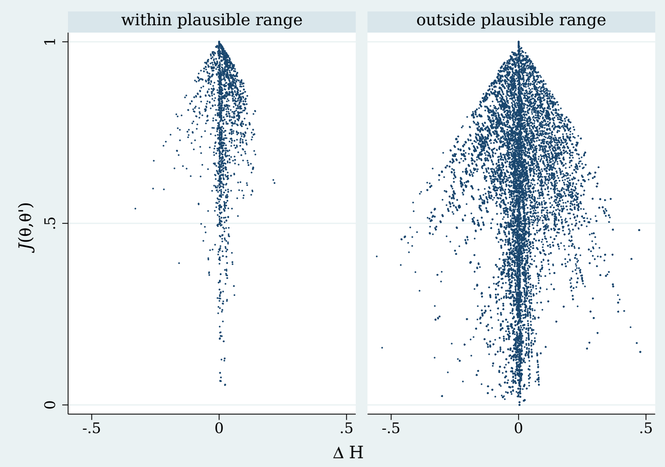
Notes: Pairwise comparisons are performed for subnational regions in terms of the headcount ratio; only equal-nested weights.

Pairwise-comparison of H for alternative weights



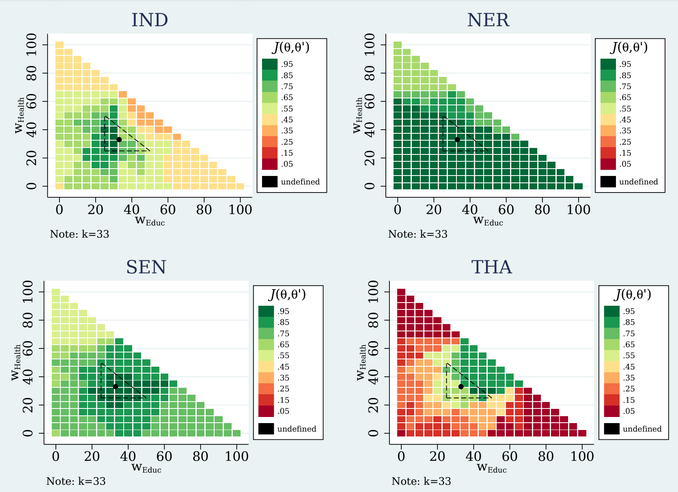
Notes: Pairwise comparisons performed for subnational regions in terms of headcount ratio. Dot in centre indicates equal weights, small black triangle indicates plausible weights; $k = 33\%$.

Poverty sets and H for alternative weights



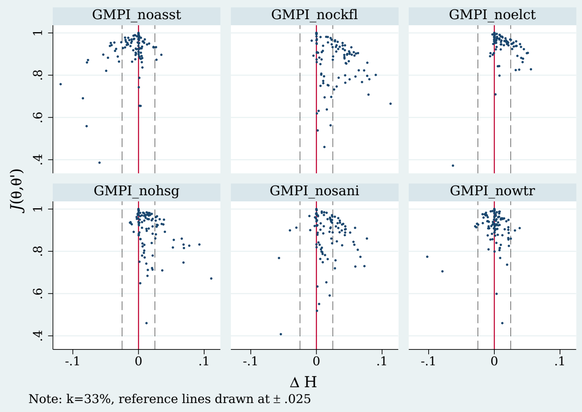
Notes: Analysis of national level data for alternative weights; plausible weights assign a value between 25–50% to every dimension; left panel contains 101 × 21 dots, whereas right panel contains 101 × 210 dots.

Poverty sets and weights.



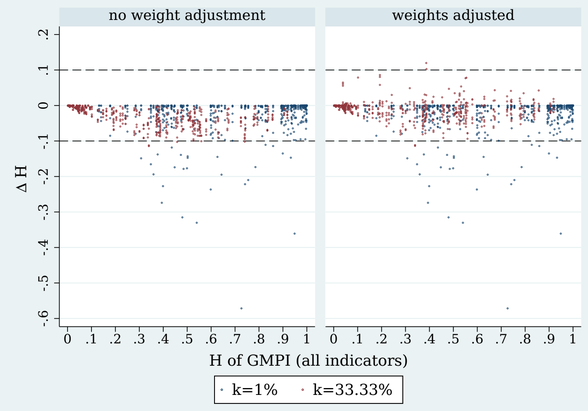
Notes: The point in centre of the graph indicates the equal weights, the dashed contracted simplex covers all 'plausible' dimensional weights.

Poverty sets and indicator selections



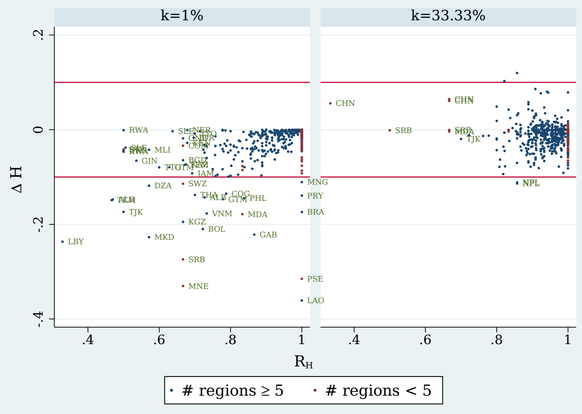
Notes: Jaccard coefficient calculated for national level for 101 countries; each sub-graph contains one dot per country; remaining living standard indicators are re-weighted to sum-up to one third; underlying $k = 33\%$ and equal-nested weights.

Second-order sensitivity analyses: ΔH



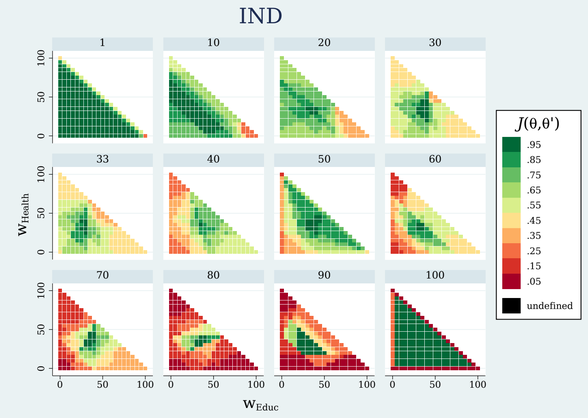
Notes: Each dot represents one country-indicator set combination; six alternative indicator selections are covered for 101 countries. H on x-axis refers to specification without indicator drop under respective k; weight adjustment refers to remaining indicator of dimension living standards.

Second-order sensitivity analyses: H and R_H



Notes: Analysis for 98 countries; each panel contains 98 × 6 dots, where each dot represents a particular country-indicator set combination, ΔH refers to national difference in the headcount ratio between with and without drop of single living standard indicator under respective k.

Second-order sensitivity analyses: Poverty sets



Notes: Denoted poverty cutoff applies to both reference and alternative specification. Each square represents a particular weighting structure. J is undefined if **both** poverty sets are empty.

Concluding Remarks

1. Empirically, the global MPI is found to be rather insensitive to local parameter variations.
2. Indicator selection has similar implications in terms of poverty sets and subnational rankings as poverty cutoffs and weights, but so far received significantly less academic attention.
3. Poverty sets are an important outcome for sensitivity analyses. Our evidence suggest that poverty sets often change without being associated with a change in the headcount ratio.
4. Second-order sensitivity analysis finds union identification to be more sensitive to indicator selection, in terms of both headcount ratios and subnational rankings.

Selected References

Alkire, S. and Foster, J. (2011). Counting and multidimensional poverty measurement. *Journal of Public Economics*, 95(7-8):476–487.

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Alkire, S. and Santos, M. E. (2014). Measuring acute poverty in the developing world: Robustness and scope of the multidimensional poverty index. *World Development*, 59:251–274.

Comments, questions, and suggestions are welcome under nsuppa@ced.uab.es!