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Multidimensional Poverty Measurement and Analysis

Sabina Alkire, James Foster,
Suman Seth, Maria Emma Santos,
José Manuel Roche and Paola Ballon

22 June 2015
University of Oxford

Multidimensional Measurement Methods:

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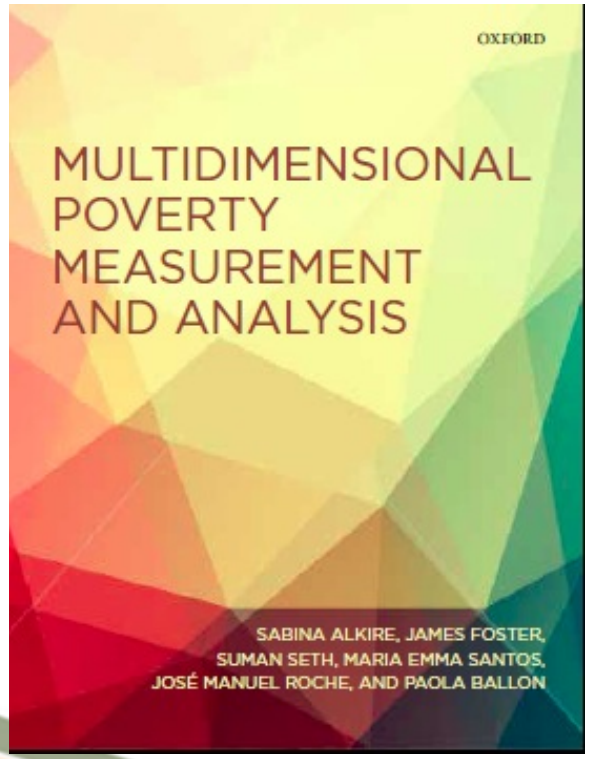

Multidimensional Poverty Measurement and Analysis

Sabina Alkire, James Foster, Suman Seth, Maria Emma Santos, Jose Manuel Roche, and Paola Ballon

- Comprehensive survey of methods used for measuring multidimensional poverty
- Illustrates state-of-the-art of quantitative techniques used in multidimensional poverty studies
- A unique guide to viewing poverty through a multi-dimensional lens

multidimensionalpoverty.org

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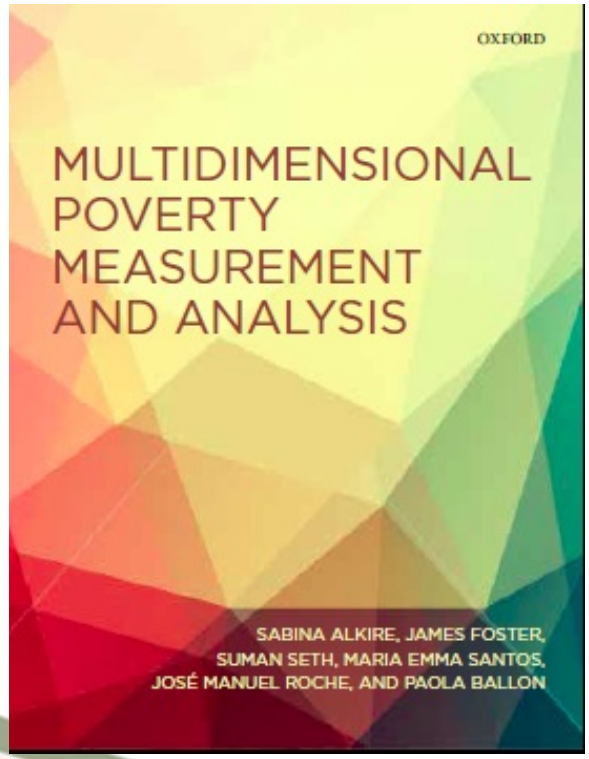

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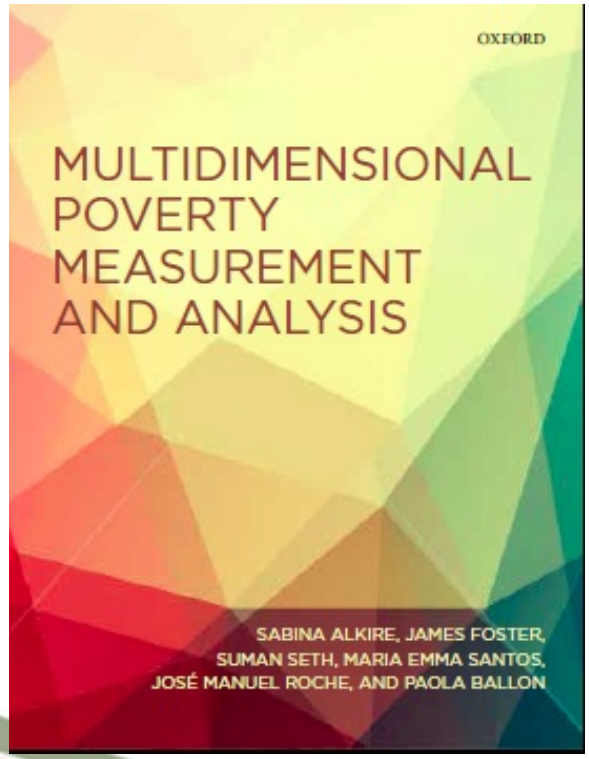

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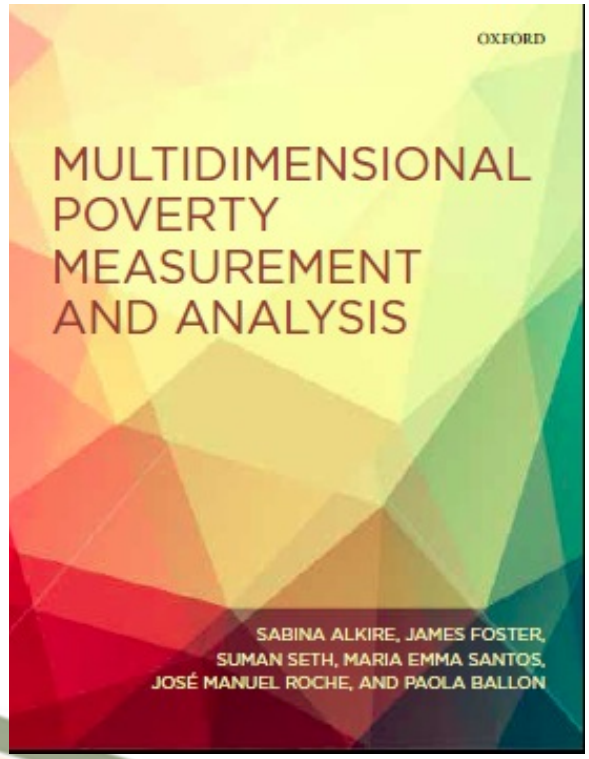

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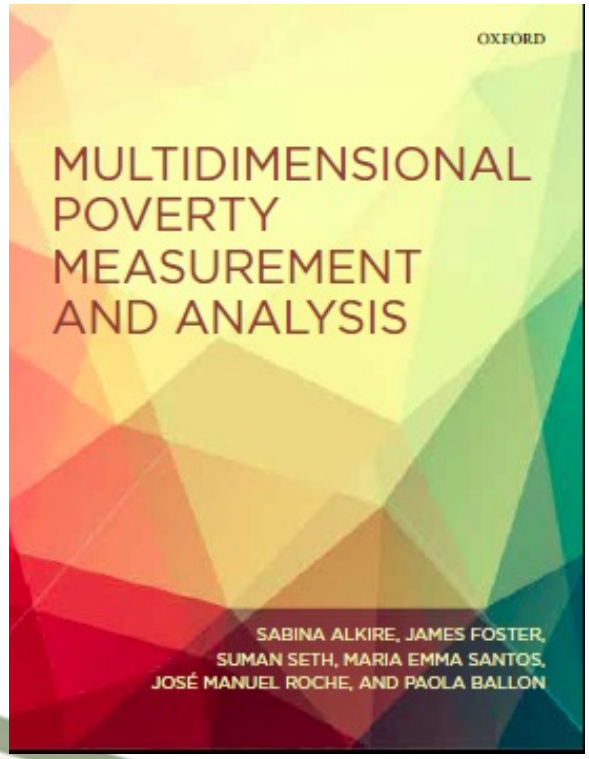

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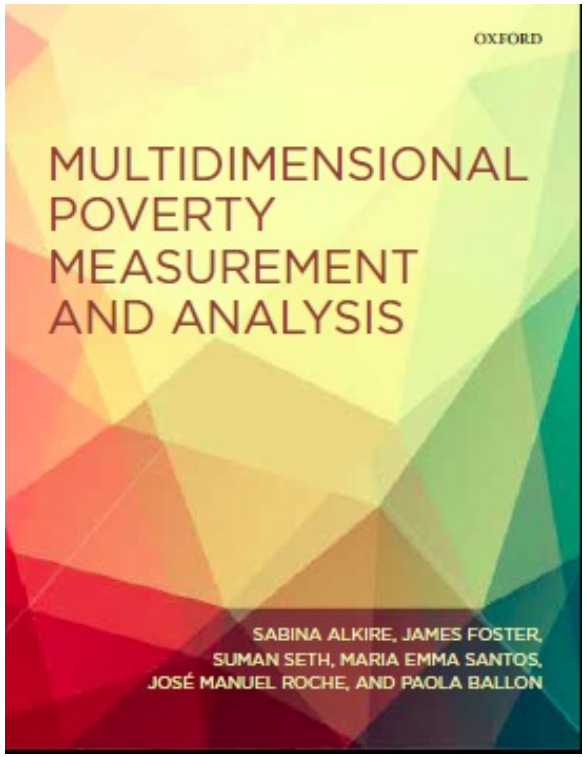

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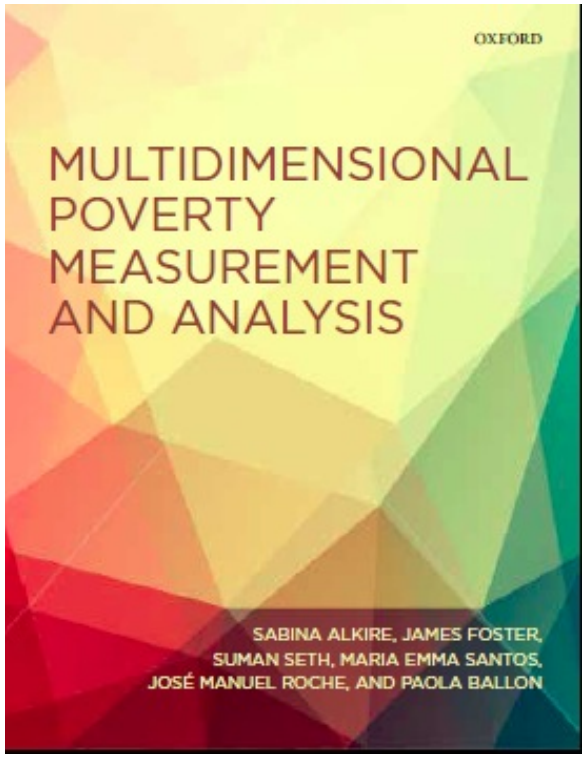

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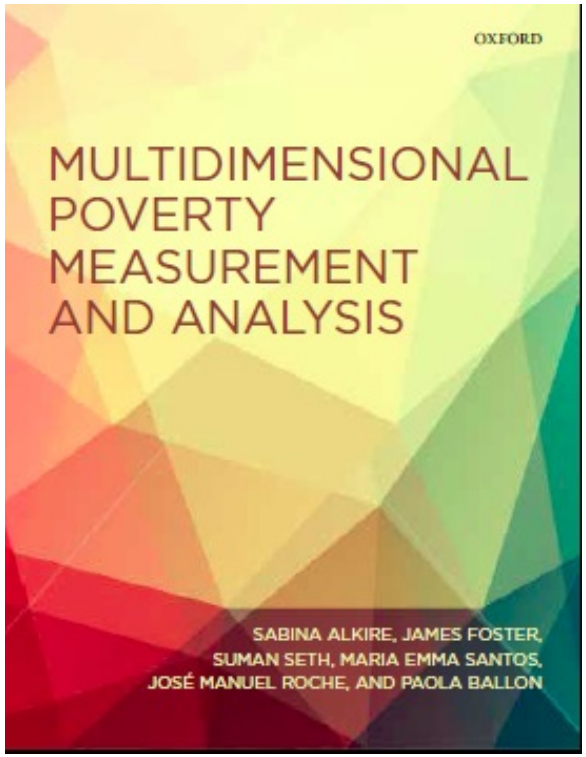

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Tabita, Kenya
Rabiya, India
Stéphanie, Madagascar
Agathe, Madagascar
Dalma, Kenya
Ann-Sophie, Kenya
Valérie, Madagasca

Background

Motivation:

- **Normative: Capability** Sen, A. K. (1992). *Inequality Re-examined.* Oxford: Oxford University Press.
- **Empirical: Mis-match**
- Stewart, F., Saith, R., and Harriss-White, B. (2007). *Defining Poverty in Developing Countries*. Basingstoke: Palgrave Macmillan.
- Bourguignon, F., Bénassy-Quéré, A., Dercon, S., Estache, A., Gunning, J.W., Kanbur, R., Klasen, S., Maxwell, S., Platteau, J-P., and A. Spadaro (2010) 'Millennium Development Goals: An Assessment', in R. Kanbur and M. Spencer (eds.), *Equity and Growth in a Globalizing World*. World Bank, ch. 2.
- **Policy:** Atkinson, A. B. (2003). 'Multidimensional Deprivation: Contrasting Social Welfare and Counting Approaches', *Journal of Economic Inequality*, 1(1):51-65.

Methods:

- **Dashboard:** Ravallion, M. (2011b). 'On Multidimensional Indices of Poverty', *Journal of Economic Inequality*, 9(2): 235–48.
- **Composite:** Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffman, A., and Giovannini, E. (2008). *Handbook on Constructing Composite Indicators: Methodology and User Guide*. Ispra, Italy: OECD.

Methods:

- **Dominance:** Duclos, J. Y., Sahn, D. E., and Younger, S. D. (2006a). 'Robust Multidimensional Poverty Comparisons', *The Economic Journal*, 116(514): 943–68.
- **Statistical:** Asselin, L. M. (2009). *Analysis of Multidimensional Poverty: Theory and Case Studies*. Dordrecht: Springer.
- **Fuzzy:** Lemmi, A. and Betti, G. (2006). *Fuzzy Set Approach to Multidimensional Poverty Measurement*. New York: Springer.
- **Axiomatic:** Bourguignon, F. and Chakravarty, S. R. (2003). 'The Measurement of Multidimensional Poverty', *Journal of Economic Inequality*, 1(1): 25–49.
- **Counting:** Nolan, B. and Whelan, C. (2011). *Poverty and Deprivation in Europe*. Oxford: Oxford University Press.

Moving Forward: Axiomatic & Counting

- **Identification:** Sen, A. K. (1976). 'Poverty: An Ordinal Approach to Measurement', *Econometrica*, 44(2): 219–31.
- **Decomposability:** Foster, J. E., Greer, J., and Thorbecke, E. (1984). 'A Class of Decomposable Poverty Measures', *Econometrica*, 52(3): 761–6.
- **Functionings & Counting:** Brandolini, A., D'Alessio, G., 1998. Measuring Well-being in the Functioning Space. Mimeo. Rome. Banco d'Italia Research Department.

The Alkire-Foster Methodology

Multidimensional Data

Matrix of well-being scores for n persons in d dimensions

Dimensions

$$X = \begin{bmatrix} 13.1 & 14 & 4 & 1 \\ 15.2 & 7 & 5 & 0 \\ 12.5 & 10 & 1 & 0 \\ 20 & 11 & 3 & 1 \end{bmatrix}$$

Persons

$$z = (13 \quad 12 \quad 3 \quad 1)$$

Cutoffs

Multidimensional Data

Replace entries: 1 if deprived, 0 if not deprived

Dimensions

$$X = \begin{bmatrix} 13.1 & 14 & 4 & 1 \\ 15.2 & \underline{7} & 5 & \underline{0} \\ \underline{12.5} & \underline{10} & \underline{1} & \underline{0} \\ 20 & \underline{11} & 3 & 1 \end{bmatrix}$$

Persons

$$z = (13 \quad 12 \quad 3 \quad 1)$$

Cutoffs

These entries fall below cutoffs

Deprivation Matrix

Replace entries: 1 if deprived, 0 if not deprived

Dimensions

$$g^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

Persons

Identification – Weights

Deprivation Matrix

Dimensions

$$g^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

$$w = \begin{bmatrix} w_1 & w_2 & w_3 & w_4 \end{bmatrix}$$

Weighted Deprivation Matrix

Dimensions

$$\bar{g}^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & w_2 & 0 & w_4 \\ w_1 & w_2 & w_3 & w_4 \\ 0 & w_2 & 0 & 0 \end{bmatrix}$$

Identification – Counting Deprivations

Assuming **equal weights** and $\sum_{j=1}^{d} w_j = d$

$$\bar{g}^0 = \begin{matrix} \text{Dimensions} \\ \end{matrix} \quad \begin{matrix} c \\ \end{matrix}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \quad \begin{matrix} 0 \\ 2 \\ 4 \\ 1 \end{matrix}$$

Persons

Identification

Q/ Who is poor?

$$\bar{g}^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \quad \begin{matrix} c \\ 0 \\ 2 \\ 4 \\ 1 \end{matrix}$$

Dimensions

Persons

Identification – Union Approach

Q/ Who is poor?

A1/ Poor if deprived in any dimension $c_i \geq 1$

Dimensions c

$$\bar{g}^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \begin{matrix} 0 \\ 2 \\ 4 \\ 1 \end{matrix}$$

Persons

Identification – Union Approach

Q/ Who is poor?

A1/ Poor if deprived in any dimension $c_i \geq 1$

Dimensions $\quad c$

$$\bar{g}^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \begin{matrix} 0 \\ \underline{2} \\ \underline{4} \\ \underline{1} \end{matrix}$$

Persons

Observations

Union approach often predicts very high numbers.

Charavarty et al '98, Tsui '02, Bourguignon & Chakravarty 2003 etc use the union approach

Identification – Intersection Approach

Q/ Who is poor?

A2/ Poor if deprived in all dimensions $c_i = d$

$$\bar{g}^0 = \begin{matrix} \\ \\ \\ \\ \text{Persons} \end{matrix} \begin{matrix} \overset{\text{Dimensions}}{\overbrace{}} \\ \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \end{matrix} \begin{matrix} c \\ \\ 0 \\ 2 \\ 4 \\ 1 \end{matrix}$$

Identification – Intersection Approach

Q/ Who is poor?

A2/ Poor if deprived in all dimensions $c_i = d$

$$\bar{g}^0 = \begin{matrix} \\ \\ \\ \\ \text{Persons} \end{matrix} \begin{matrix} \overset{\text{Dimensions}}{\overbrace{\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix}}} & \overset{c}{\begin{matrix} 0 \\ 2 \\ \underline{4} \\ 1 \end{matrix}} \end{matrix}$$

Observations

- Demanding requirement (especially if d large)
- Often identifies a very narrow slice of population

Atkinson 2003 first to apply these terms.

Identification – Dual Cutoff Approach

Q/ Who is poor?

A/ Fix cutoff k, identify as poor if $c_i \geq k$

Dimensions $\quad c$

$$\bar{g}^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \begin{matrix} 0 \\ 2 \\ 4 \\ 1 \end{matrix}$$

Persons

Identification – Dual Cutoff Approach

Q/ Who is poor?

A/ Fix cutoff k, identify as poor if $c_i \geq k$ **(Ex: $k = 2$)**

Dimensions $\quad c$

$$\bar{g}^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \begin{matrix} 0 \\ \underline{2} \\ \underline{4} \\ 1 \end{matrix}$$

Persons

Identification – Empirical Example

k =	H
Union 1	91.2%
2	75.5%
3	54.4%
4	33.3%
5	16.5%
6	6.3%
7	1.5%
8	0.2%
9	0.0%
Inters. 10	0.0%

Poverty in India for 10 dimensions

91% of population would be targeted using union

0% using intersection

We need something in the middle

(Alkire and Seth 2009)

Aggregation

k = 2

Censor data of non-poor

$$\bar{g}^0 = \begin{matrix} \\ \\ \\ \\ \text{Persons} \end{matrix} \begin{matrix} \text{Dimensions} \\ \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \end{matrix} \begin{matrix} c \\ 0 \\ \underline{2} \\ \underline{4} \\ 1 \end{matrix}$$

Aggregation

k = 2

Censored weighted deprivation matrix and censored deprivation score

$$\bar{g}^0(k) = \begin{matrix} \\ \\ \\ \\ \end{matrix} \begin{matrix} \text{Dimensions} \\ \end{matrix} \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{matrix} c(k) \\ 0 \\ \underline{2} \\ \underline{4} \\ 0 \end{matrix} \quad \text{Persons}$$

Aggregation – Headcount Ratio

k = 2

Censored weighted deprivation matrix

$$\bar{g}^0(2) = \begin{matrix} \\ \\ \\ \\ \end{matrix} \begin{matrix} \text{Dimensions} \\ \end{matrix} \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{matrix} c(2) \\ \end{matrix} \begin{matrix} 0 \\ \underline{2} \\ \underline{4} \\ 0 \end{matrix} \begin{matrix} \\ \\ \text{Persons} \\ \\ \end{matrix}$$

Two poor persons out of four: **H = 1/2**

Critique

Suppose the number of deprivations rises for person 2

$$\bar{g}^0(2) = \begin{matrix} \\ \\ \\ \\ \end{matrix} \begin{matrix} \text{Dimensions} \\ \end{matrix} \begin{matrix} c(2) \\ \end{matrix}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ \underline{1} & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{matrix} 0 \\ \underline{3} \\ \underline{4} \\ 0 \end{matrix}$$

Critique

Suppose the number of deprivations rises for person 2

$$\bar{g}^0(2) = \begin{matrix} \text{Dimensions} \\ \end{matrix} \quad c(2)$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ \underline{1} & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \quad \begin{matrix} 0 \\ \underline{3} \\ \underline{4} \\ 0 \end{matrix}$$

Two poor persons out of four: **H = ½**

No change!

Violates 'dimensional monotonicity'

Aggregation

Return to the original censored weighted deprivation matrix

$$\bar{g}^0(2) = \begin{matrix} \\ \\ \\ \\ \text{Persons} \end{matrix} \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{matrix} c(2) \\ 0 \\ \underline{2} \\ \underline{4} \\ 0 \end{matrix}$$

Dimensions

Aggregation - Intensity

Need to augment information

Deprivation shares among poor

Dimensions $c(k)$ $c(k)/d$

$$\bar{g}^0(2) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{matrix} 0 \\ \underline{2} \\ \underline{4} \\ 0 \end{matrix} \begin{matrix} \\ 2/4 \\ 4/4 \\ \end{matrix}$$

Aggregation - Intensity

Need to augment information

Deprivation shares among poor

	Dimensions				$c(k)$	$c(k)/d$
$\bar{g}^0(2) =$	0	0	0	0	0	
	0	1	0	1	2	2/4
	1	1	1	1	4	4/4
	0	0	0	0	0	

A = average deprivation share among poor = 3/4

Aggregation: Adjusted Headcount Ratio

Adjusted Headcount Ratio = M_0 = HA

$$\bar{g}^0(2) = \begin{array}{c} \\ \text{Persons} \end{array} \begin{array}{c} \begin{array}{cccc} \text{Dimensions} & & & \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \end{array} \begin{array}{c} c(k) \\ 0 \\ \underline{2} \\ \underline{4} \\ 0 \end{array} \begin{array}{c} c(k)/d \\ \\ 2/4 \\ 4/4 \\ \\ \end{array}$$

M_0 = HA = (1/2)*(3/4) = 0.375

Aggregation: Adjusted Headcount Ratio

Adjusted Headcount Ratio = M_0 = HA = $\mu(\overline{g}^0(k))$

Dimensions $c(k)$ $c(k)/d$

Persons $\overline{g}^0(2) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ $\begin{matrix} 0 \\ \underline{2} \\ \underline{4} \\ 0 \end{matrix}$ $\begin{matrix} \\ 2/4 \\ 4/4 \\ \end{matrix}$

M_0 = HA = (1/2)*(3/4) = 0.375

$M_0 = \mu(\overline{g}^0(k)) = 6/16 = 0.375$

Aggregation: Adjusted Headcount Ratio

Suppose the number of deprivations rises for person 2

$$\bar{g}^0(2) = \begin{matrix} \\ \\ \\ \\ \end{matrix} \begin{matrix} \text{Dimensions} \\ \end{matrix} \begin{bmatrix} 0 & 0 & 0 & 0 \\ \underline{1} & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{matrix} c(k) \\ \\ 0 \\ \underline{3} \\ \underline{4} \\ 0 \end{matrix} \begin{matrix} c(k)/d \\ \\ \\ 3/4 \\ 4/4 \\ \\ \end{matrix} \begin{matrix} \\ \\ \\ \\ \\ \text{Persons} \end{matrix}$$

Aggregation: Adjusted Headcount Ratio

Suppose the number of deprivations rises for person 2

$$\bar{g}^0(2) = \begin{array}{c} \text{Dimensions} \\ \\ \\ \\ \\ \end{array} \begin{array}{c} \\ \\ \\ \\ \\ \end{array} \begin{array}{c} c(k) \\ \\ \\ \\ \\ \end{array} \begin{array}{c} c(k)/d \\ \\ \\ \\ \\ \end{array} \begin{bmatrix} 0 & 0 & 0 & 0 \\ \underline{1} & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{array}{c} 0 \\ \underline{3} \\ \underline{4} \\ 0 \\ \\ \end{array} \begin{array}{c} \\ 3/4 \\ 4/4 \\ \\ \\ \end{array} \begin{array}{c} \\ \\ \\ \\ \text{Persons} \end{array}$$

A = average deprivation share among poor = 7/8

M_0 changes! $M_0 = 7/16 = 0.4375$

Satisfies dimensional monotonicity

Methodology: Adjusted Headcount Ratio

Interpretation: conveys information on deprivations

Applicability: valid for ordinal data

Simplicity: easy to compute

Useful properties

- Subgroup decomposition
- Dimensional breakdown

Expandable: If variables are all **cardinal** can go further

Multidimensional Measurement Methods:

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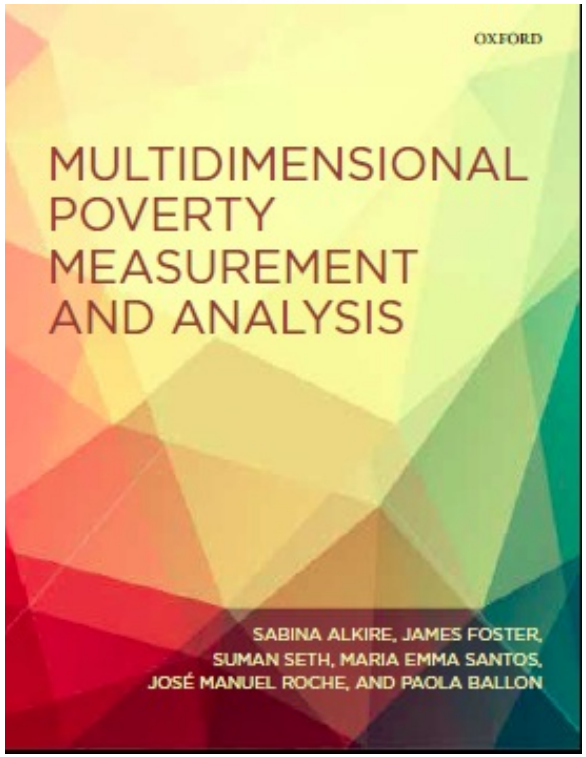

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Countries

This methodology can be used to design robust official statistics

- Official multidimensional poverty statistics are used in Mexico, Colombia, Bhutan, Chile and others.

This book can be useful for technical advisors in countries that are exploring or actively designing multidimensional poverty measures

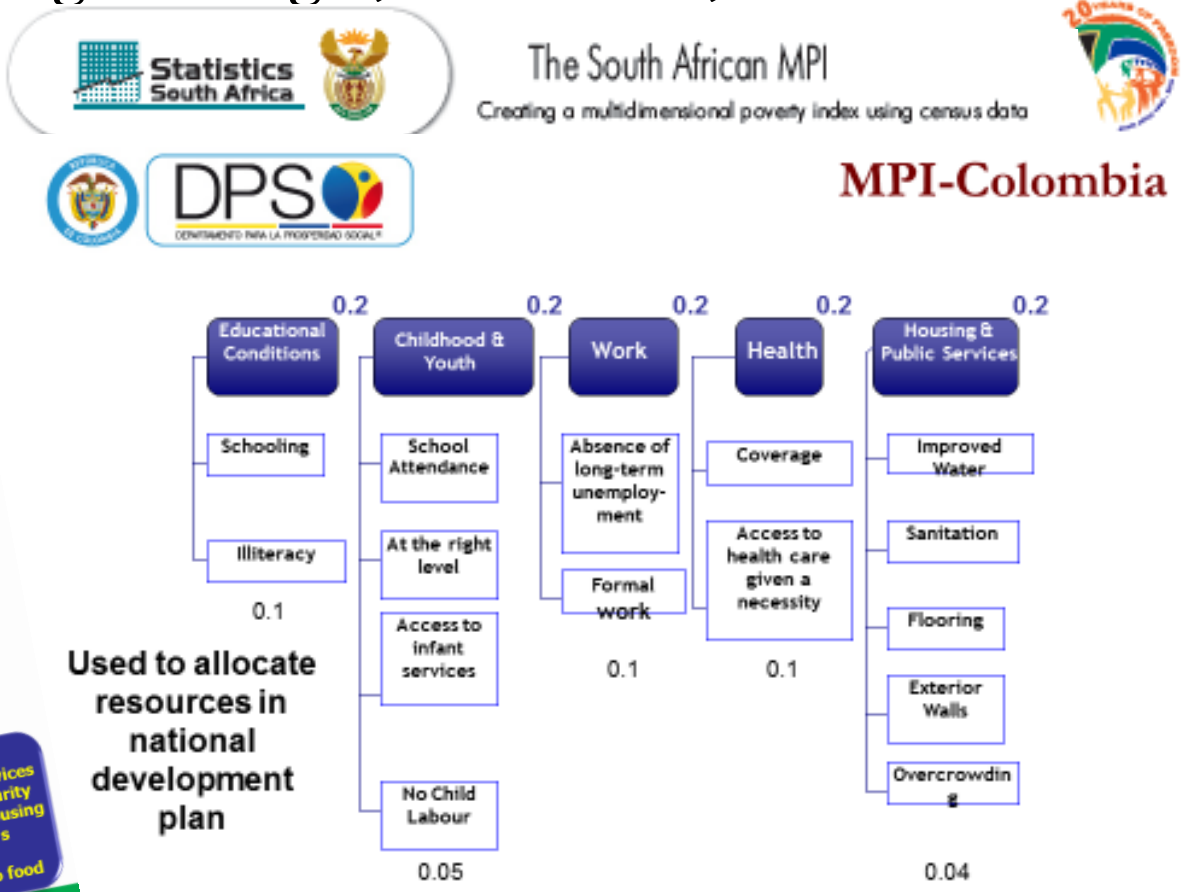
- The MPPN (Multidimensional Poverty Peer Network) is a network of some 40 countries with such an interest.

It can also be used for designing other policy-relevant indices

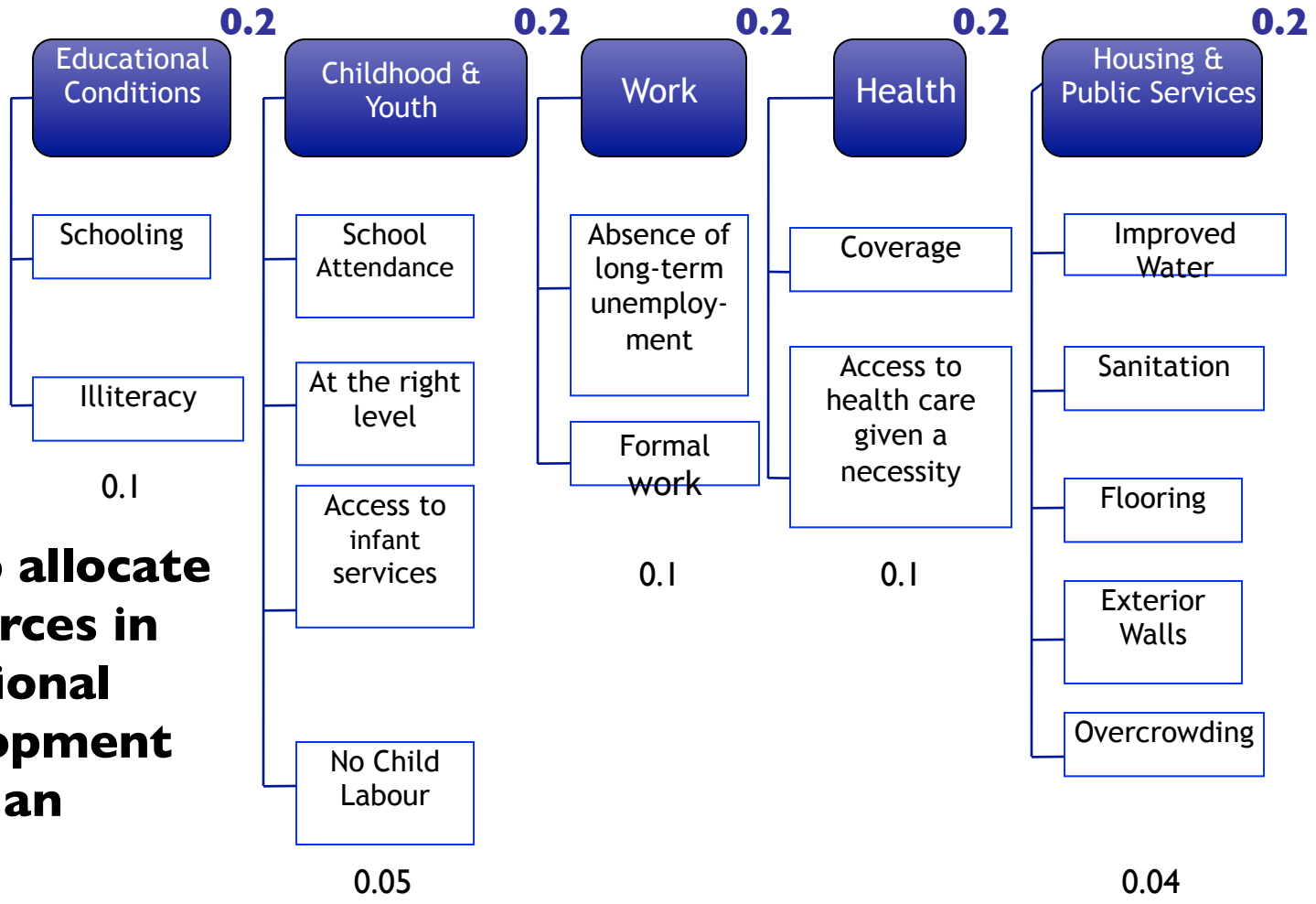
- Examples: Well-being, Child Poverty, Empowerment (WEAI)

National MPIs

- Reflect National Priorities
- Vital for policy
- Measure to Manage ~ Target, Coordinate, M&E



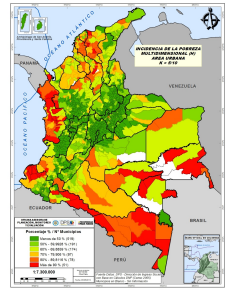
MPI-Colombia

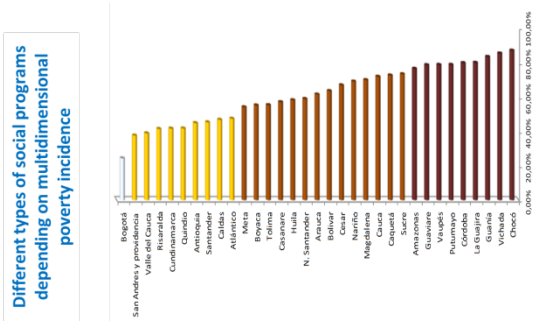


Used to allocate resources in national development plan

MPI 4 key aspects:

1. Reflects the objectives of social policy
2. Coordinates public policy sectors
3. Monitors public policy
4. Informs Decision-making:
    1. Geographic targeting
    2. Programme composition
    3. Graduation from CCTs





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MPI

International Agencies & Civil Society

Use for Programme Quality

(inward looking)

- Diagnostic and prioritization
- Baseline and M&E tool
- Applied to distinct domains
  (poverty, empowerment, child rights, etc)
- Understanding underlying multidimensional processes

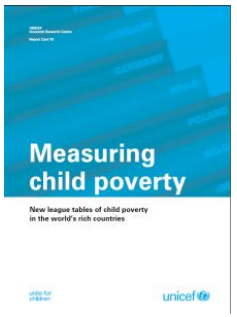
Multidimensional measures force institutions to break silos, and to discuss interaction between dimensions!

International Agencies & Civil Society

Use for Policy & Research or Advocacy

(outward looking)

- Accountability tool to hold governments to account
- Monitoring multidimensional outcomes
  (Global MPI, UNICEF MODA, MPI & Post2015)
- Policy analysis for evidence based advocacy



Teaching

Masters/PhD level courses

- ✓ Module on poverty measurement
- ✓ Comprehensive overview for teachers
- ✓ Unified notation and framework

From book website: http://multidimensionalpoverty.org/

- ✓ Online chapters
- ✓ Video presentations
- ✓ PowerPoints
- ✓ Paper exercises
- ✓ Stata do files for statistical exercises

How Can the Book be Used for Teaching?

How Can the Book be Used for Teaching?

Multidimensional Poverty Measurement & Analysis

OPHI
Oxford Poverty & Human Development Initiative

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Chapter 3 – Overview of Methods for Multidimensional Poverty Assessment

Overview:

This chapter presents a constructive survey of the major existing methods for measuring multidimensional poverty. Many measures were motivated by the basic needs approach, the capability approach, and the social inclusion approach among others. This chapter reviews Dashboards, the composite indices approach, Venn diagrams, the dominance approach, statistical approaches, fuzzy sets, and the axiomatic approach. The first two methods (dashboard and composite indices) methods that are implemented using aggregate data from different sources ignoring the joint distribution of deprivations. The other methods reflect the joint distribution and are implemented using data in which information on each dimension is available for each unit of analysis. After outlininge each method, we provide a critical evaluation by discussing its advantages and disadvantages.

Read Full Chapter

View chapter as PDF

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Resources

Check this page regularly for new study and teaching resources, which will be made available ahead of the book's hardcopy publication in June 2015.

View videos relating to individual book chapters below. All recordings are from OPHI's 2014 summer school in Oxford.

Chapter 1

'Why Multidimensional Poverty Measures?' (Sabina Alkire)

Resources

OPHI Online Training Portal

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Resources

- **Working Papers**
- **Research in Progress**
- **Research & Policy Briefs**
- **Journal Special Issues**
- **Online Training Portal**
- **Videos**
- Multidimensional Poverty Peer Network Launch
- Dynamic Comparison Between Multidimensional Poverty and Monetary Poverty

Online Training Portal

The following resources provide a thorough conceptual and technical introduction to current literature on the **capability approach** and on **techniques of measuring multidimensional poverty**. There is a strong emphasis on the Alkire-Foster method developed by OPHI and used to construct the global Multidimensional Poverty Index (MPI) and national multidimensional poverty measures in Mexico and Colombia.

- **Background to the course**
- **Who is it for?**

Videos are available for most of the sessions, which can be watched online or downloaded. Lighter, **audio-only**, files are also available, along with **lecture slides** and supporting resources such as **exercises** and **reading lists**.

Session title	Resources available			
	Video and audio	Slides	Exercises	Reading List
Background: axioms in poverty measures				
Unidimensional Poverty Measurement: Axioms, Measures, and Dominance	✓	✓	✓	✓
Why Multidimensional Poverty Measures?	✓	✓		✓

Featured

Multidimensional Poverty Measurement & Analysis is a book from OPHI (forthcoming June 2015) providing an in-depth account of multidimensional poverty comparison methodologies, with a particular focus on the Alkire-Foster Method. **E-chapters available now.**

An Introduction to the Human Development and Capability Approach ~ Freedom and Agency
OPHI supported the development of this new textbook aimed at students in the social sciences and development practitioners. It provides an introduction to Amartya Sen's human development and capability approach. **Download as a free e-textbook from IDRC.**

Researchers

Empirical research questions

Descriptive

Measures: Comparable M0 for OECD countries.

Applied measures: Health poverty, Child/elder poverty

Inferential

Assess the transmission mechanisms between polices and multidimensional poverty

- 'Micro' and 'macro' regressions;
- Impact evaluation analyses

Researchers

Methodological research questions

Measurement

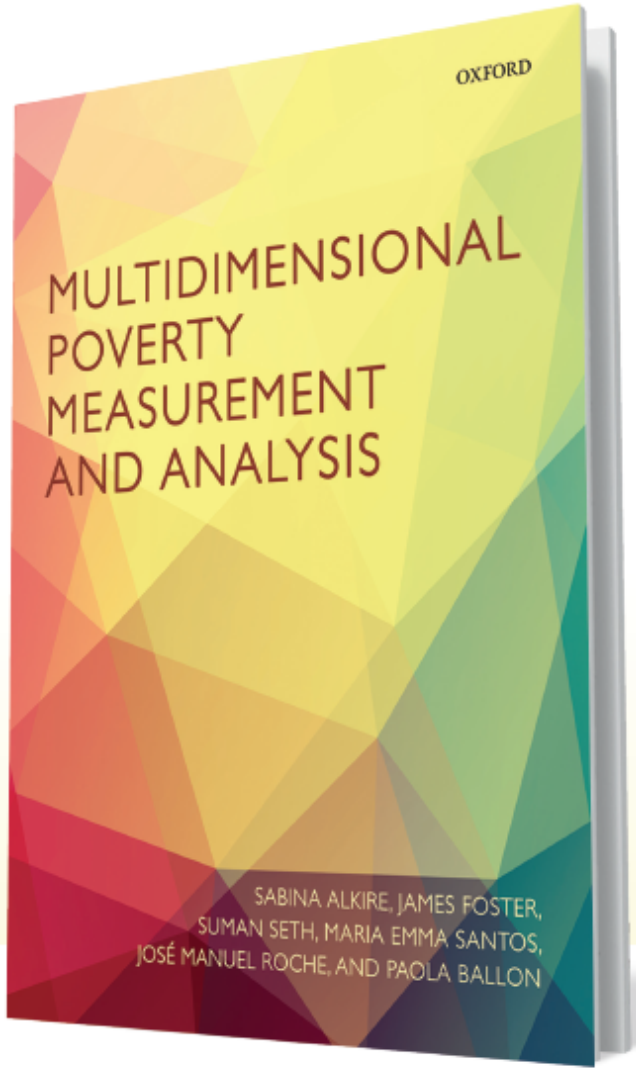
Axioms - distributional analysis

Standards for robustness analyses

Data analysis

Treatment of missing values

Treatment of panel data and demographics (dynamic analysis of poverty)



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MULTIDIMENSIONAL POVERTY MEASUREMENT AND ANALYSIS

SABINA ALKIRE, JAMES FOSTER,
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