

OPHI

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UNIVERSITY OF
OXFORD

HDCA Summer School on Capability and Multidimensional Poverty

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Delft University of Technology, Netherlands

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Unidimensional Poverty Measurement

Axioms

(Classification of Foster, 2006)

- **Invariance** Axioms (replication, scale, focus, normalisation)
- **Dominance** Axioms (monotonicity, transfer)
- **Continuity**
- **Subgroup** Axioms (Consistency and Decomposability)

Classification of Measures

Basic Measures

Headcount Ratio

Income Gap Ratio

Poverty Gap Ratio

Advanced Measures

Squared Poverty Gap (Foster-Greer-Thorbecke)

Sen-Shorrocks-Thon Measure

Watts Measure

Clark-Hemming-Ulph-Chakravarty Class of Measures

Poverty Ordering

xPy if and only if
 $P(x;z) \leq P(y;z)$ for all z and
 $P(x;z) < P(y;z)$ for some z

xPy means that x has *unambiguously less poverty than* y with respect to poverty index P .

Multidimensional Poverty Measurement

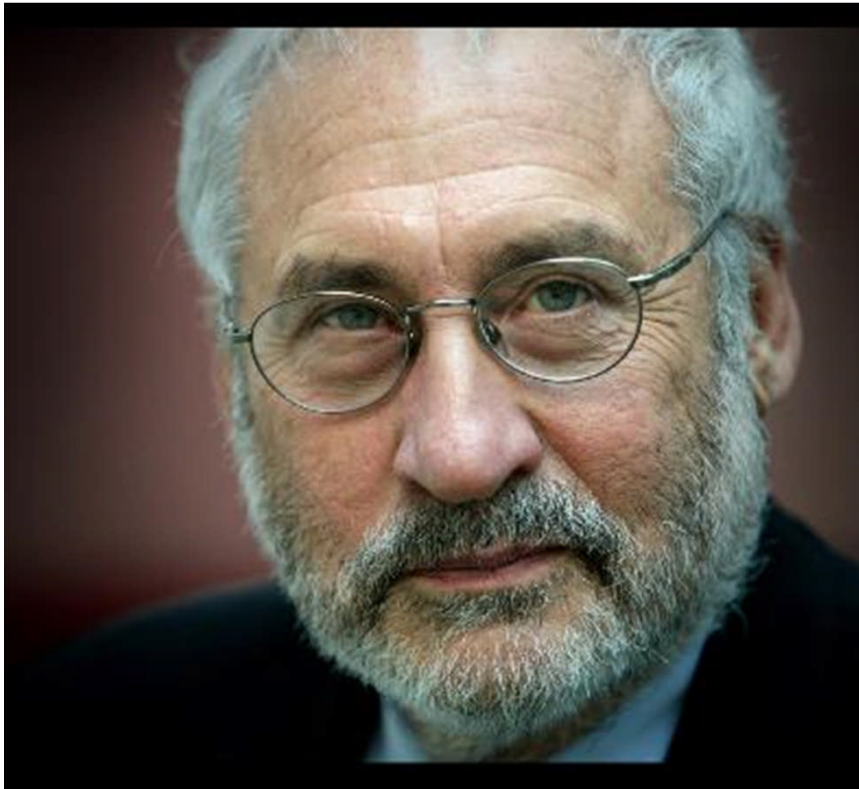
Axioms

- Most are **Natural Extensions** from unidimensional axioms (i.e. symmetry, replication invariance, scale invariance, poverty focus, deprivation focus, monotonicity, dimensional monotonicity, transfer)
- In multidimensional space, axioms are **joint restrictions** on identification and aggregation methodologies.
 - Recall: AF methodology is not fully factor decomposable; it can be decomposed by factor only post-identification (and censoring).

Why the new emphasis on measurement?

- 1) More and better data becoming available
- 2) More Measures being developed
- 3) 2010 HDR measures sparked interest and debate
- 4) Technical resources do not reflect Human Development measures
- 5) Political space is opening; demand increasing
- 6) Income poverty: important but incomplete.

Stiglitz Sen Fitoussi: Commission on the Measurement of Economic Performance and Social Progress: www.stiglitz-sen-fitoussi.fr



“For many purposes, we need better metrics.”

Two major challenges to multidimensional poverty measures

1. Money-metric poverty (e.g. \$1.25/ day) is multidimensional and based on consumer theory. Why replace it?
2. Let's use a dashboard!

Multidimensional Poverty- our challenge:

- A government would like to create an official multidimensional poverty indicator
- Desiderata
 - It must understandable and easy to describe
 - It must conform to “common sense” notions of poverty
 - It must be able to target the poor, track changes, and guide policy.
 - It must be technically solid
 - It must be operationally viable
 - It must be easily replicable
- **What would you advise?**

Multidimensional Poverty Comparisons

- **There are many steps to creating index:**
 - Choice of purpose for the index (monitor, target, etc)
 - Choice of Unit of Analysis (indy, hh, cty)
 - Choice of Dimensions
 - Choice of Variables/Indicator(s) for dimensions
 - Choice of Poverty Lines for each indicator/dimension
 - Choice of Weights for indicators within dimensions
 - If more than one indicator per dimension, aggregation
 - Choice of Weights across dimensions
 - **Identification method**
 - **Aggregation method – within /across dimensions.**

Achievement Matrix

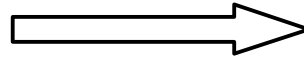
$$Y = \begin{matrix} & \text{Dimensions} & & \\ \begin{matrix} \text{Persons} \\ \text{Cutoffs} \end{matrix} & \begin{bmatrix} 13.1 & 14 & 4 & 1 \\ 15.2 & \underline{7} & 5 & \underline{0} \\ \underline{12.5} & \underline{10} & \underline{1} & \underline{0} \\ 20 & \underline{11} & 3 & 1 \end{bmatrix} & \end{matrix}$$

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

Deprivation and Censored Matrix

Deprivation Matrix

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



Censored Deprivation Matrix, k=2

$$g^0(k) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 2 \\ 4 \\ 0 \end{bmatrix}$$

Aggregation: Adjusted FGT Family

Adjusted FGT is $M_\alpha = \mu(g^\alpha(\tau))$ for $\alpha \geq 0$

Domains

$$g^\alpha(k) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0.42^\alpha & 0 & 1^\alpha \\ 0.04^\alpha & 0.17^\alpha & 0.67^\alpha & 1^\alpha \\ 0 & 0 & 0 & 0 \end{bmatrix} \text{Persons}$$

Theorem 1 For any given weighting vector and cutoffs, the methodology $M_{ka} = (\rho_k, M_\alpha)$ satisfies: decomposability, replication invariance, symmetry, poverty and deprivation focus, weak and dimensional monotonicity, nontriviality, normalisation, and weak rearrangement for $\alpha \geq 0$; monotonicity for $\alpha > 0$; and weak transfer for $\alpha \geq 1$.

NONTRIVIALITY:

M achieves at least two distinct values.

Informal Glossary of Terms

Deprivation: if $y_{id} < z$ person i is **deprived** in y_d

Poverty: if $c_i \leq k$ person i is poor.

Deprivation cutoffs: the z cutoffs for each dimension

Poverty cutoff: the overall cutoff k

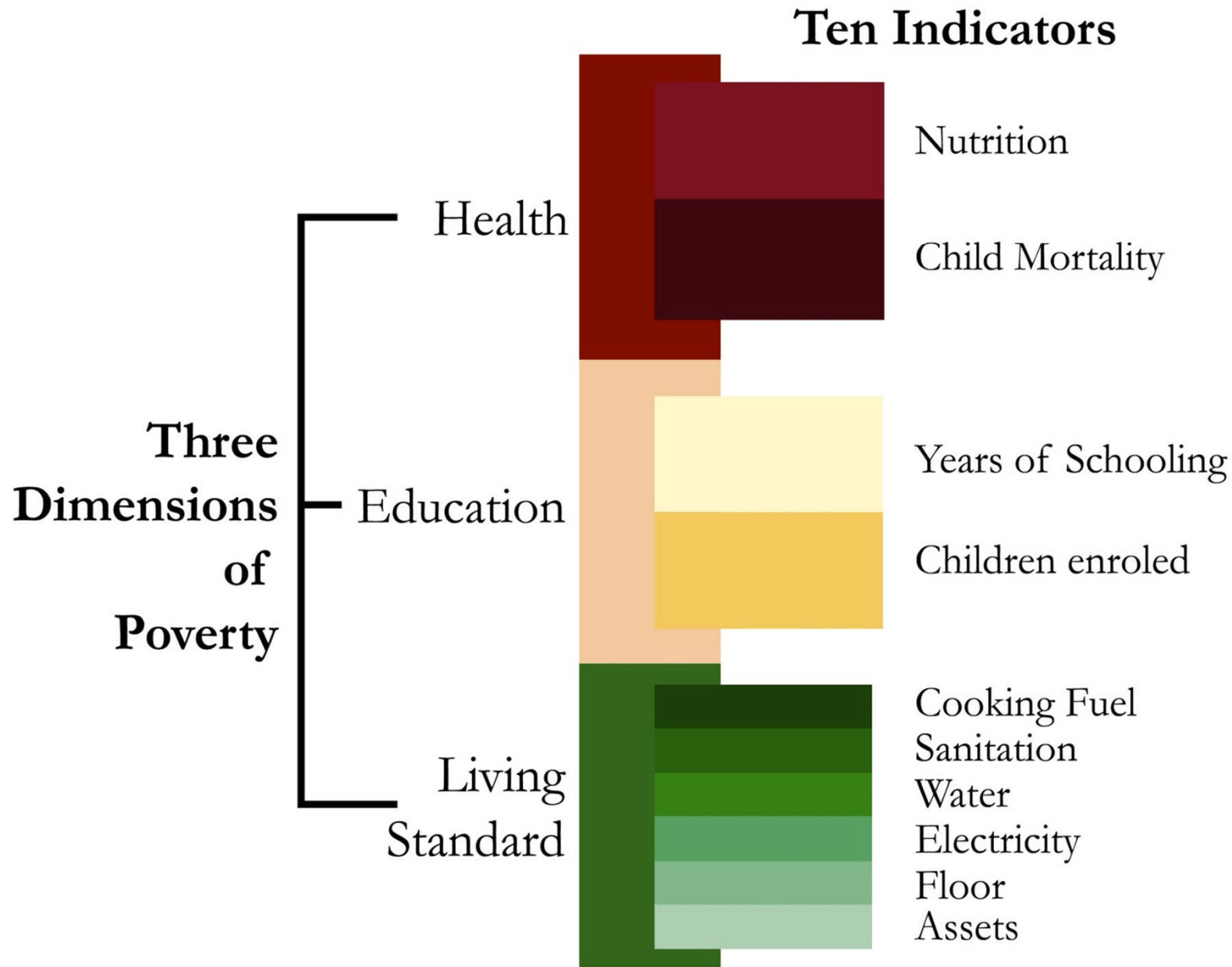
Dimension: for AF – a column in the matrix having its own deprivation cutoff (sometimes called an ‘indicator’)

Joint distribution: showing the simultaneous or coupled deprivations a person/hh has

Background: the MPI

- An international measure of **acute** poverty for 104 developing countries.
- Launched by UNDP's HDRO and OPHI on 14 July 2010, and in the HDR launched 4 November 2010
- An experimental series that supplants HPI-I
- Updated annually for countries having new data
- MPI-2 may be developed for less poor countries
- Aims to encourage the development of better national measures of multidimensional poverty

MPI: Dimensions, Indicators, & Weights



MPI 2010: data constraints

The MPI is deeply affected by the lack of **comparable** data.

- key **indicators** are not collected (stock, quality)
- data for some dimensions are **missing**
- **missing values** lead to sample size reduction/biases
- **respondent(s)** vary; individual level data is sparse
- surveys **updated** every 3-5 years, and in different **years**
- data exclude certain populations (elders, institutionalized)
- **income/consumption** surveys lack MPI health indicators.

These can be addressed at a national level for national measures.

“Improving data gathering and its quality in all countries should be a central focus ...”

Bourguignon *et al.* 2008 page 6

Methodology: MPI $g_0(k)$ matrix

Adjusted Headcount Ratio = M_0 = HA = **.442**

k=3.3333

(have MPI for all k values)

Indicators

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

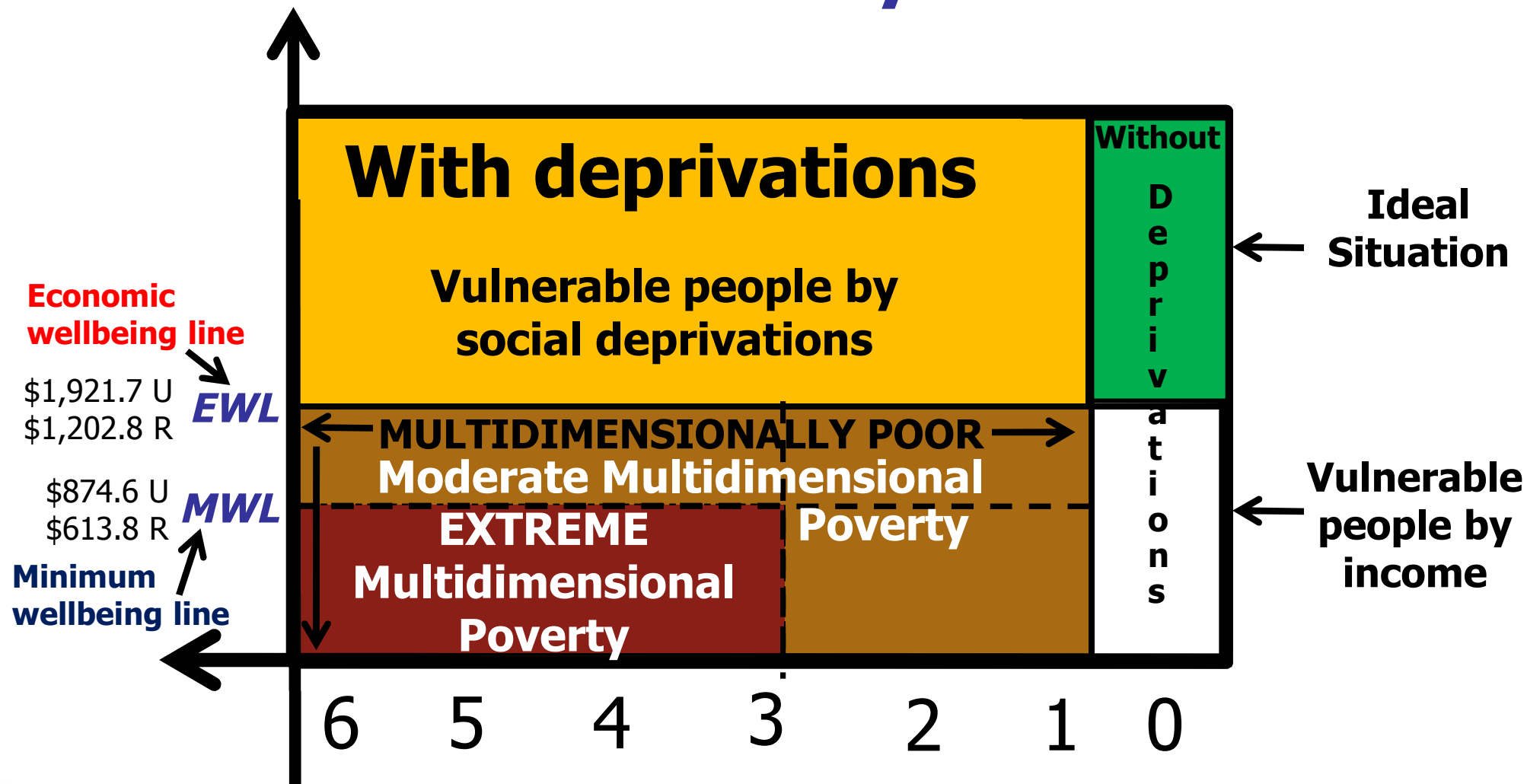
$$g^0(k) = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1.67 & 1.67 & 1.67 & 1.67 & .55 & 0 & 0 & 0 & 0 & .55 \\ 0 & 1.67 & 0 & 1.67 & .55 & 0 & .55 & .55 & .55 & 0 \\ 0 & 0 & 0 & 1.67 & .55 & .55 & .55 & 0 & .55 & .55 \end{bmatrix} \begin{matrix} 0 & 0 \\ 7.76 & .776 \\ 5.53 & .553 \\ 4.42 & .442 \end{matrix}$$

H = headcount = $\frac{3}{4}$ = **75%**

A = average deprivation share among poor = **.59 = 59%**

HA = MPI = **0.442**

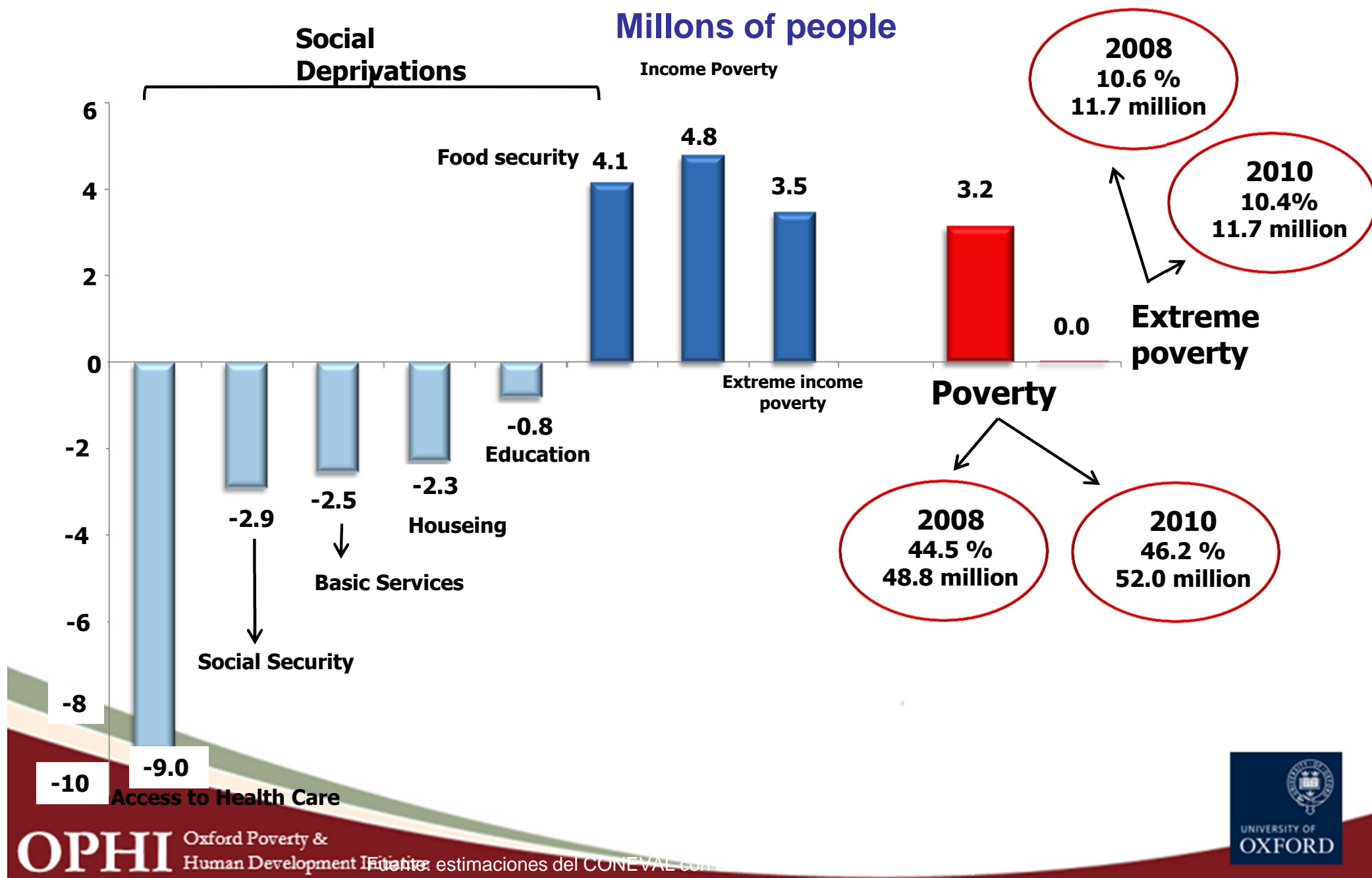
Mexico's MD Poverty Measure 2008



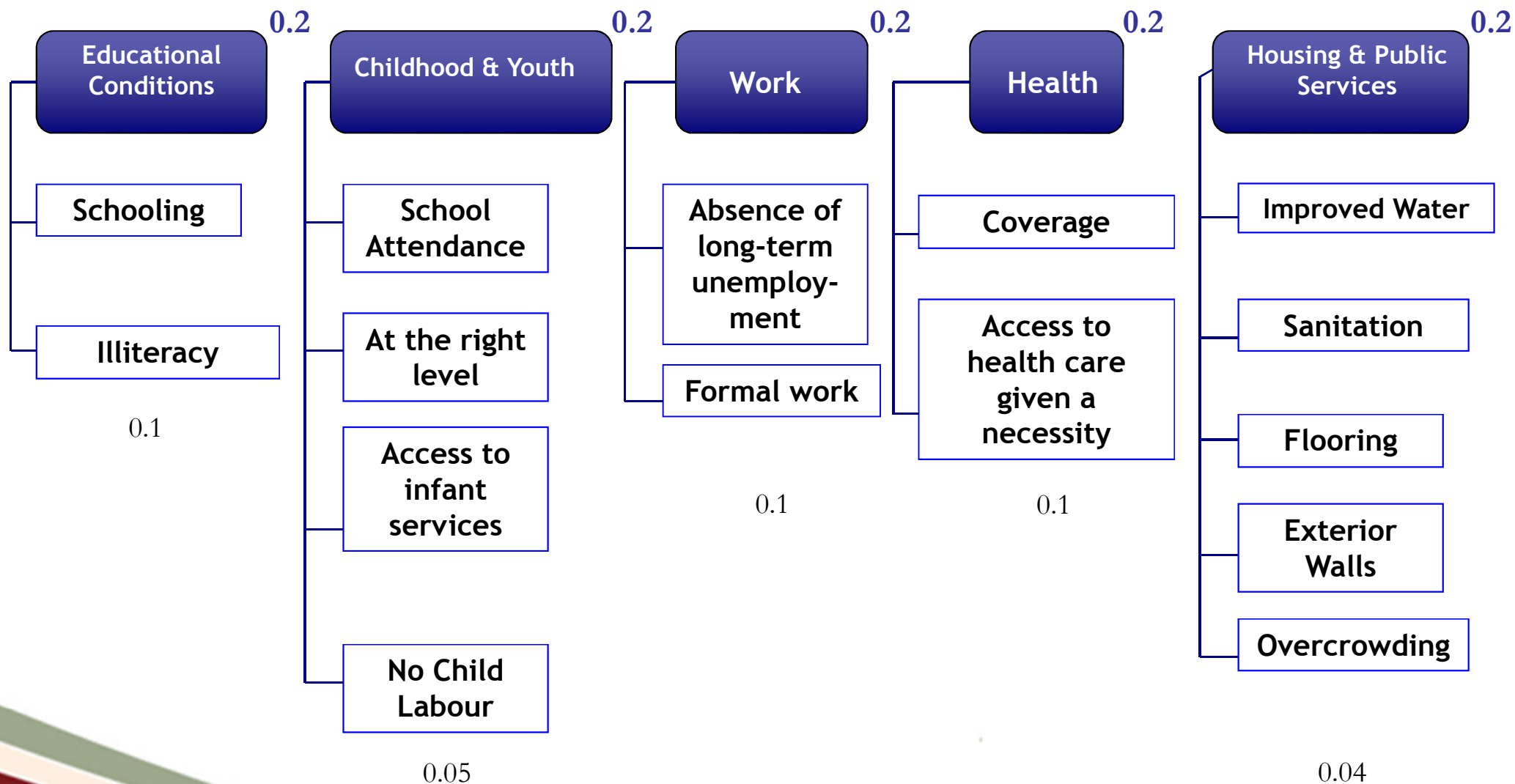
**Deprivations
Social Rights**

Source:
CONEVAL

Change in the number of poor people in Mexico, 2008-2010



Dimensions, Variables and Weights - MPI Colombia



Key question: In which space will you measure?

Resources	Capability	Functionings	Utility
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Bike	Able to ride around	Ride around	😊
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Food	Able to be nourished	Nourished	😊
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In which space will you measure?

- **Sen:** “The Capability approach is concerned primarily with identification of value-objects, and sees the evaluative space in terms of functionings and capabilities to function.” 1992:43
- Not all multidimensional measures are in capability/functionings space. Needs to suit purpose.
- Key points for your paper/report:
 - Are the indicators drawn from the same space?
 - If you mix space, what assumptions are you making
 - E.g. conversion rates between resources/functionings
 - E.g. conversion rates between functionings/subjectivity.

Six Essential Choices for AF measure:

1. **Unit of Analysis** (person or household)
2. **Dimensions** (not strictly essential)
3. **Indicators**
4. **Deprivation Cutoffs** for each Indicator
5. **Weights** for each Indicator (Dimension)
6. **Poverty cutoff** (to identify the poor)
(Whether to use M_0 , M_1 , or M_2)

Calibration: Who Chooses MD Parameters

Considerations:

1. Purpose of Evaluative Exercise
 - Targeting
 - Evaluation
 - National Poverty Measure
2. Formal Constraints (constitution)
3. Space (capability; resources)
4. Choice Mechanisms (participatory)
5. Robustness tests (for pluralism, diversity)

In practice...your paper or report should:

1. Write out the purpose of the measure – what evaluative exercise(s) it will serve
2. Identify the ‘criteria’ used to select indicators/ deprivation cutoffs / weights / poverty cutoff
3. Justify each calibration choice using normative and empirical grounds & the literature
4. Identify plausible alternatives (e.g. a range of possible weights; alternative indicators), which you will then use to test robustness
5. Identify relevant processes (consultation, participation)
6. Caveat: identify systematically the limitations and weaknesses; tests

Quality difference between two papers/ reports with the same final measure & analysis but systematic vs lazy articulation of the calibration choices is very large. Why?

Dimensions often a subset of these:

Stiglitz-Sen-Fitoussi

Health
Education
Economic security
Personal Security
Balance of Time
Political Voice &
Governance
Social Connections
Environmental
Conditions
Subjective measures
of quality of life

Bhutan's GNH

Health
Education
Material Std
of living
Time Use
Governance
Community
Environment
Culture &
spirituality
Emotional
Well-being

Voices of the Poor

Bodily Wellbeing
Material Wellbeing
Social Wellbeing
Security
Psychological
Wellbeing

Finnis

Health & Security
Knowledge
Work & Play
Agency &
empowerment
Relationships
Harmony - Art,
Religion, Nature
Inner peace

On weights:

No ... magic formula does, of course, exist, since the issue of weighting is one of valuation and judgment, and not one of some impersonal technology. (Sen 1999:79)

Key: make weights explicit and open to scrutiny.

- **Stochastic dominance conditions:**

ascertain whether an ordinal comparison is robust to changes in the parameters or members of a family of evaluation functions.

- **When dominance conditions are not fulfilled** then the comparison depends on the choice of parameters
- One could **restrict the dominance analysis** to smaller sets of parameters (or families of indices), but requires care, lest significant parts of the domain of interest are left out.
- Dominance conditions at best provide **ordinal comparisons across countries** – not cardinal. Sensitivity analysis is required.
- Dominance conditions can be provided for continuous variables, **ordinal variables** (Yalonetzky, 2011), or combinations

Some Robustness tests for weights:

- Correlation coefficients for pairs of rankings, e.g. the Gamma by Goodman and Kruskal, and Spearman's Rho.

Assumption: rankings matter to analysis

- The multiple rank concordance indices, e.g. Kendall-Friedman, Kendall, Joe.
- Percentages of reversed comparisons.
- Large changes in the positions.

Standard Errors at a Glance

Standard errors of **averages** in simple surveys

Asymptotic standard errors for **ratios**

Asymptotic standard errors for **percentage changes**

Percentage changes in **cross sections**

Percentage changes in **panel data**

Computation of standard errors with more **complex surveys**

Bootstrap / jackknife – also v useful as a fallback.

Standard Errors at a Glance

May need to consider:

- Strata
- Clusters
- Sampling weights
- svyset: namecluster [pweight=nameweight],
strata(namestrata) householdid
- svy: mean poor

Decomposition

By population subgroup

By dimensional subgroup (**post-identification**)

Subgroup Decomposition:

$g^0(k) =$

Income	Years of Education	Housing Index	Mal-nourished	
0	0	0	0	Person 1
1	0	0	1	Person 2
1	1	1	1	Person 3
0	0	0	0	Person 4

M_0 for pink group: $H_1 \times A_1 = 2/8 = 1/4$

M_0 for green group: $H_2 \times A_2 = 4/8 = 1/2$

Overall $M_0 = (1/2) \times (1/2) + (1/2) \times (1/4) = 3/8 = 6/16$

Dimensional Breakdown:

The **censored headcount** ratio of indicator d is

censored H

$$g^0(k) = \begin{array}{c|cccc|l} & \text{Income} & \text{Years of Education} & \text{Housing Index} & \text{Mal-nourished} & \\ \hline & 0 & 0 & 0 & 0 & \text{Person 1} \\ & \mathbf{1} & 0 & 0 & \mathbf{1} & \text{Person 2} \\ & \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} & \text{Person 3} \\ & 0 & 0 & 0 & 0 & \text{Person 4} \\ \hline \frac{1}{2} & \frac{1}{4} & \frac{1}{4} & \frac{1}{2} & \end{array}$$

Contribution of dimension d to M_0 poverty is

$$(w_d/D) \times [\underline{H}_d/M_0(x)]$$

Statistical Data Reduction

Methods

Factor Analysis – Exploratory, Confirmatory

Principal Components

Polychoric correlations

[Multiple Correspondence Analysis]

Possible uses:

identify redundancy/ reduce indicators

design synthetic indicators and scales

set weights among a set of indicators

Strengths

- ✓ Aggregation solution with high power of data reduction
- ✓ Deals well with measurement errors
- ✓ Explores or Confirms identification of underlying dimensions
- ✓ Reduces the chance of double-counting
- ✓ The factor loadings or component score can be used in further analysis for inferences and model-testing (alternatively, incorporated directly into the model as in structural equation modelling)

Weaknesses

- ✓ Aggregation and weights would vary by dataset, compromising comparisons (e.g. comparisons between years or countries)
- ✓ Not a *single* aggregation solution (depends on the extraction and rotation method)
- ✓ In confirmatory analysis, the construct validity of the final factors depends on the theoretical relevance of initial indicators
- ✓ Ordinal scale variables often interpreted cardinally (alternatives: multiple correspondence analysis, or structural equation modelling)
- ✓ Factors scores: difficult to interpret

QUALITY OF WORK

Informal employment, security and safety at work



PSYCHOLOGICAL WELLBEING

Happiness, satisfaction and a meaningful life



EMPOWERMENT

Agency and the power people have to shape their lives



Missing Dimensions of Poverty Data

WITHOUT SHAME

Freedom from shame, humiliation and isolation



PHYSICAL SAFETY

Freedom from violence against people and property



Political Considerations:

Why measure?

Policy

Incentives

How develop?

Politically

Technically

How Update?

Institutions

Authority

Manipulation