Food Price Shocks and Poverty: The Left Hand Side

James E. Foster
The George Washington University and OPHI Oxford

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Motivation

- Why Policy Concern?
  - Indeed: prices change all the time
  - People substitute when they can, and experience changes in real income when they can't
  - Where is the policy issue?

Motivation

- Large Changes in Food Prices
  - Can have large absolute effect on real incomes and poverty
    - Poor and near poor are vulnerable since budget share on food is high
    - Compounding deprivation with more deprivation
    - Mitigating factors: Supplier of food or employed in sector
    - Traditional poverty measures

Motivation

- Large Changes in Food Prices
  - Can also have direct effects on food consumption and nutrition (and on capability of avoiding malnutrition)
    - Irreversible effects, especially on children
    - In extreme cases, irreversible effects on all
    - A multidimensional proposal

Motivation

- Large Changes in Food Prices
  - Can also affect other consumption/investment and key development indicators
    - Enrollment and education of children
    - Assets
    - Recovery possible but difficult
    - MPI?

Outline

- Income Poverty
- Food Poverty
- Multiple Dimensions
- Discussion

Price Shocks and Income Poverty

- Measuring the impacts
  - In terms of real incomes and poverty
    - Convert price change into income change via CV
    - Adjust nominal income
    - Determine poverty status
    - Aggregate via, say, FGT
  - Examples
    - Chico, Ivanic et al (2011)

Review: Income Poverty

Framework – Sen 1976 identification and aggregation

Goal – Poverty measure P(.)

Variable – income

Identification – poverty line

Aggregation – Foster-Greer-Thorbecke 1984

see also Foster, Greer, and Thorbecke 2010

Review: Income Poverty

Example Incomes $y = (7,3,4,8)$ Poverty line $z = 5$

Deprivation vector $g^0 = (0,1,1,0)$

Headcount ratio $P_0 = \mu \ (g^0) = 2/4$

prevalence

Normalized gap vector $g^1 = (0, 2/5, 1/5, 0)$

Poverty gap $= P_1 = \mu \ (g^1) = 3/20$ depth

Squared gap vector $g^2 = (0, 4/25, 1/25, 0)$

FGT Measure $= P_2 = \mu \ (g^2) = 5/100$ severity

Decomposable across population groups

Region

Ultrapoor

Price Shocks and Income Poverty

- Pros
  - Income poverty is salient concept
  - Powerful technology for prediction and evaluation
  - Micro theory based
  - Respects preferences

Price Shocks and Income Poverty

- Cons
  - Base price matters
  - Utility/price indices not data, yet crucial
    - especially when relative prices are very different
    - (not as important if relative prices only change a little)
  - Surely utility function varies across persons.
    - adjusted income distribution not known
    - uncertain poverty levels
  - Resource poverty – "what could be" not "what is"
    - decomposition by expenditure type

Price Shocks and Food Poverty

- Measuring the impacts
  - In terms of food consumption and food poverty
    - Quantity index, caloric content, or anthropomorphic measures
    - Aggregate via FGT
      - our original paper used calories not income to evaluate food poverty in Kenya
      - other unidimensional variables possible
  - Examples
    - Gundersen (2008)

Price Shocks and Food Poverty

- Pros
  - Focus on key policy variable
  - Particularly useful for surveillance
  - Measures “what is”

Price Shocks and Food Poverty

- Cons
  - Nutrition is multidimensional (Joachim von Braun)
    - Ex: Calories, protein, iron, vitamin A, etc
  - Incommensurate and limited substitutability
    - aggregating achievements may make no sense
    - however, monitoring *aggregate deprivations* could make sense

Question

- Can the FGT food poverty index be generalized to obtain a multidimensional index of food poverty?
  - Idea: Apply methods based on Alkire Foster *J Pub E* 2011 “Counting and Multidimensional Poverty Measurement”

Overview of this Approach

- Identification – Dual cutoffs
  - Deprivation cutoffs – each deprivation counts
  - Poverty cutoff – in terms of breadth of deprivation
- Aggregation – Adjusted FGT
  - Reduces to FGT in single variable case
- Background papers
  - Alkire and Foster "Counting and Multidimensional Poverty Measurement" forthcoming *Journal of Public Economics*
  - Alkire and Santos "Acute Multidimensional Poverty: A new Index for Developing Countries" OPHI WP 38, background for HDR 2010
  - Alkire and Foster "Understandings and Misunderstandings of Multidimensional Poverty Measurement" *Journal of Economic Inequality*

Multidimensional Data

Matrix of achievements for n persons in d domains

Multidimensional Data

Matrix of achievements for n persons in d domains

$$\begin{array}{ccc} & \text{Domains} & \\ \boldsymbol{y} = & \begin{bmatrix} \mathbf{13.1} & \mathbf{14} & \mathbf{4} & \mathbf{1} \\ \mathbf{15.2} & \mathbf{7} & \mathbf{5} & \mathbf{0} \\ \mathbf{12.5} & \mathbf{10} & \mathbf{1} & \mathbf{0} \\ \mathbf{20} & \mathbf{11} & \mathbf{3} & \mathbf{1} \end{bmatrix} & \text{Persons} \end{array}$$

Multidimensional Data

Matrix of achievements for n persons in d domains

$$\begin{array}{cc} & \text{Domains} \\ y = \begin{bmatrix} 13.1 & 14 & 4 & 1 \\ 15.2 & 7 & 5 & 0 \\ 12.5 & 10 & 1 & 0 \\ 20 & 11 & 3 & 1 \end{bmatrix} & \text{Persons} \end{array}$$

$$z \qquad (13 \quad 12 \quad 3 \quad 1) \qquad \text{Cutoffs}$$

Multidimensional Data

Matrix of achievements for n persons in d domains

$$\begin{array}{lcl} & \text{Domains} & \\ y = & \begin{bmatrix} 13.1 & 14 & 4 & 1 \\ 15.2 & \underline{7} & 5 & \underline{0} \\ \underline{12.5} & \underline{10} & \underline{1} & \underline{0} \\ 20 & \underline{11} & 3 & 1 \end{bmatrix} & \text{Persons} \end{array}$$

$$z \qquad (\,13 \quad 12 \quad 3 \quad 1\,) \qquad \text{Cutoffs}$$

<u>These entries fall below cutoffs</u>

Deprivation Matrix

Replace entries: 1 if deprived, 0 if not deprived

$$
y = \begin{array}{cc}
\text{Domains} & \\
\begin{bmatrix}
13.1 & 14 & 4 & 1 \\
15.2 & \underline{7} & 5 & \underline{0} \\
\underline{12.5} & \underline{10} & \underline{1} & \underline{0} \\
20 & \underline{11} & 3 & 1
\end{bmatrix} & \text{Persons}
\end{array}
$$

Deprivation Matrix

Replace entries: 1 if deprived, 0 if not deprived

$$
\begin{array}{cc}
 & \text{Domains} \\
\boldsymbol{g}^{0} = & \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} \end{bmatrix} \quad \text{Persons}
\end{array}
$$

Normalized Gap Matrix

Matrix of achievements for *n* persons in *d* domains

$$\begin{array}{ccc} & \text{Domains} & \\ \boldsymbol{y} = & \begin{bmatrix} 13.1 & 14 & 4 & 1 \\ 15.2 & \underline{7} & 5 & \underline{0} \\ \underline{12.5} & \underline{10} & \underline{1} & \underline{0} \\ 20 & \underline{11} & 3 & 1 \end{bmatrix} & \text{Persons} \end{array}$$

$$\boldsymbol{z} \qquad (\,13 \quad 12 \quad 3 \quad 1\,) \qquad \text{Cutoffs}$$

<u>These entries fall below cutoffs</u>

Normalized Gap Matrix

Normalized gap = $(z_j - y_{ji})/z_j$ if deprived, 0 if not deprived

$$
\begin{array}{cc}
 & \text{Domains} \\
\boldsymbol{y} = & \begin{bmatrix} \mathbf{13.1} & \mathbf{14} & \mathbf{4} & \mathbf{1} \\ \mathbf{15.2} & \underline{\mathbf{7}} & \mathbf{5} & \underline{\mathbf{0}} \\ \underline{\mathbf{12.5}} & \underline{\mathbf{10}} & \underline{\mathbf{1}} & \underline{\mathbf{0}} \\ \mathbf{20} & \underline{\mathbf{11}} & \mathbf{3} & \mathbf{1} \end{bmatrix} \quad \text{Persons}
\end{array}
$$

$$\boldsymbol{z} \qquad (\,\mathbf{13} \quad \mathbf{12} \quad \mathbf{3} \quad \mathbf{1}) \qquad \text{Cutoffs}$$

<u>These entries fall below cutoffs</u>

Normalized Gap Matrix

Normalized gap = $(z_j - y_{ji})/z_j$ if deprived, 0 if not deprived

$$\boldsymbol{g}^1 = \begin{array}{cc} \text{Domains} & \\ \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0.42 & 0 & 1 \\ 0.04 & 0.17 & 0.67 & 1 \\ 0 & 0.08 & 0 & 0 \end{bmatrix} & \text{Persons} \end{array}$$

Squared Gap Matrix

Squared gap = $[(z_j - y_{ji})/z_j]^2$ if deprived, 0 if not deprived

$$\boldsymbol{g}^1 = \begin{array}{c} \text{Domains} \\ \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0.42} & \mathbf{0} & \mathbf{1} \\ \mathbf{0.04} & \mathbf{0.17} & \mathbf{0.67} & \mathbf{1} \\ \mathbf{0} & \mathbf{0.08} & \mathbf{0} & \mathbf{0} \end{bmatrix} \end{array} \ \text{Persons}$$

Squared Gap Matrix

Squared gap = $[(z_j - y_{ji})/z_j]^2$ if deprived, 0 if not deprived

$$\begin{array}{cc} & \text{Domains} \\ \mathbf{g}^2 = & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0.176 & 0 & 1 \\ 0.002 & 0.029 & 0.449 & 1 \\ 0 & 0.006 & 0 & 0 \end{bmatrix} \text{Persons} \end{array}$$

Identification

$$\begin{array}{cc} & \text{Domains} \\ \boldsymbol{g}^0 = \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} \end{bmatrix} & \text{Persons} \end{array}$$

Matrix of deprivations

Identification – Counting Deprivations

$$\begin{array}{cc} \text{Domains} & c \\ g^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} & \begin{matrix} 0 \\ 2 \\ 4 \\ 1 \end{matrix} \quad \text{Persons} \end{array}$$

Identification – Counting Deprivations

Q/ Who is poor?

$$\begin{array}{cccc} & \text{Domains} & & c \\ \boldsymbol{g}^0 = & \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} \end{bmatrix} & \begin{matrix} \mathbf{0} \\ \mathbf{2} \\ \mathbf{4} \\ \mathbf{1} \end{matrix} & \text{Persons} \end{array}$$

Identification – Union Approach

Q/ Who is poor?

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

$$
\begin{array}{cc}
\text{Domains} & c \\
\boldsymbol{g}^0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} & \begin{matrix} 0 \\ 2 \\ 4 \\ 1 \end{matrix} \quad \text{Persons}
\end{array}
$$

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\end{array}
$$

Identification – Intersection Approach

Q/ Who is poor?

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

$$
\begin{array}{cc}
 & \text{Domains} \qquad\qquad\qquad c \\
\mathbf{g}^0 = & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \quad \begin{array}{c} 0 \\ 2 \\ 4 \\ 1 \end{array} \quad \text{Persons}
\end{array}
$$

Identification – Dual Cutoff Approach

Q/ Who is poor?

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

$$
\begin{array}{cccc}
 & \text{Domains} & c & \\
\boldsymbol{g}^0 = & \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} \end{bmatrix} & \begin{matrix} \mathbf{0} \\ \mathbf{2} \\ \mathbf{4} \\ \mathbf{1} \end{matrix} & \text{Persons}
\end{array}
$$

Identification – Dual Cutoff Approach

Q/ Who is poor?

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

$$\mathbf{g}^0 = \begin{array}{cc} \text{Domains} & c \\ \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} \end{bmatrix} & \begin{matrix} \mathbf{0} \\ \underline{\mathbf{2}} \\ \underline{\mathbf{4}} \\ \mathbf{1} \end{matrix} \end{array} \quad \text{Persons}$$

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Note

Includes both union and intersection

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Note

Includes both union and intersection

Especially useful when number of dimensions is large

Union becomes too large, intersection too small

Identification – Dual Cutoff Approach

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$$
\begin{array}{cc}
 & \text{Domains} \qquad\qquad\qquad c \\
\boldsymbol{g^0} = & \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \quad \begin{array}{c} 0 \\ \underline{2} \\ \underline{4} \\ 1 \end{array} \quad \text{Persons}
\end{array}
$$

Note

Includes both union and intersection

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Union becomes too large, intersection too small

Next step - *aggregate* into an overall measure of poverty

Aggregation

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

Aggregation

Censor data of nonpoor

$$\begin{array}{cccc} & \text{Domains} & c & \\ \boldsymbol{g}^{0} = & \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{0} \end{bmatrix} & \begin{matrix} \mathbf{0} \\ \underline{\mathbf{2}} \\ \underline{\mathbf{4}} \\ \mathbf{1} \end{matrix} & \text{Persons} \end{array}$$

Aggregation

Censor data of nonpoor

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

Aggregation

Censor data of nonpoor

$$\begin{array}{cccc}
 & \text{Domains} & c(k) & \\
\boldsymbol{g^0(k)} = & \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \end{bmatrix} & \begin{matrix} \mathbf{0} \\ \underline{\mathbf{2}} \\ \underline{\mathbf{4}} \\ \mathbf{0} \end{matrix} & \text{Persons}
\end{array}$$

Similarly for $g^1(k)$, etc

Aggregation – Headcount Ratio

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

Aggregation – Headcount Ratio

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

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

Critique

Suppose the number of deprivations rises for person 2

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

Two poor persons out of four: **H = ½** **‘incidence’**

Critique

Suppose the number of deprivations rises for person 2

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

Two poor persons out of four: **H = ½** **‘incidence’**

Critique

Suppose the number of deprivations rises for person 2

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

Two poor persons out of four: **H = ½** **‘incidence’**

No change!

Critique

Suppose the number of deprivations rises for person 2

$$\begin{array}{cccc} & \text{Domains} & c(k) & \\ \boldsymbol{g^0(k)} = & \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \underline{\mathbf{1}} & \mathbf{1} & \mathbf{0} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \end{bmatrix} & \begin{array}{c} \mathbf{0} \\ \underline{\mathbf{2}} \\ \underline{\mathbf{4}} \\ \mathbf{0} \end{array} & \text{Persons} \end{array}$$

Two poor persons out of four: **H = ½** **‘incidence’**

No change!

Violates ‘dimensional monotonicity’

Aggregation

Return to the original matrix

$$
\begin{array}{ccc}
 & \text{Domains} & c(k) & \\
g^0(k) = & \begin{bmatrix} 0 & 0 & 0 & 0 \\ \underline{1} & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{array}{c} 0 \\ \underline{2} \\ \underline{4} \\ 0 \end{array} & \text{Persons}
\end{array}
$$

Aggregation

Return to the original matrix

$$\begin{array}{cccc} & \text{Domains} & c(k) & \\ \boldsymbol{g}^{0}(\boldsymbol{k}) = & \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \end{bmatrix} & \begin{matrix} \mathbf{0} \\ \underline{\mathbf{2}} \\ \underline{\mathbf{4}} \\ \mathbf{0} \end{matrix} & \text{Persons} \end{array}$$

Aggregation

Need to augment information

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

Aggregation

Need to augment information "deprivation share"

Domains

$$g^0(k) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \qquad \begin{array}{cc} c(k) & c(k)/d \\ 0 & \\ \underline{2} & 2/4 \\ \underline{4} & 4/4 \\ 0 & \end{array}$$

Persons

Aggregation

Need to augment information ‘deprivation share’

‘intensity’

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

A = average intensity among poor = 3/4

Aggregation – Adjusted Headcount Ratio

Adjusted Headcount Ratio = M_0 = HA

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

A = average intensity among poor = 3/4

Aggregation – Adjusted Headcount Ratio

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

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

A = average intensity among poor = 3/4

Aggregation – Adjusted Headcount Ratio

Adjusted Headcount Ratio = M_0 = HA = $\boldsymbol{\mu}$ $(\mathbf{g^0(k)})$ **= 6/16 = .375**

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

A = average intensity among poor = 3/4

Aggregation – Adjusted Headcount Ratio

Adjusted Headcount Ratio = M_0 = HA = $\boldsymbol{\mu}$ $(\mathbf{g^0(k)})$ **= 6/16 = .375**

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

A = average intensity among poor = 3/4

Note: if person 2 has an additional deprivation, M_0 rises

Aggregation – Adjusted Headcount Ratio

Adjusted Headcount Ratio = M_0 = HA = $\boldsymbol{\mu}$ $(\mathbf{g^0(k)})$ **= 6/16 = .375**

$$
\begin{array}{ccc}
\text{Domains} & c(k) & c(k)/d \\
g^0(k) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \begin{matrix} 0 \\ \underline{2} \\ \underline{4} \\ 0 \end{matrix} & \begin{matrix} \\ 2/4 \\ 4/4 \\ \\ \end{matrix}
\end{array}
\quad \text{Persons}
$$

A = average intensity among poor = 3/4

Note: if person 2 has an additional deprivation, M_0 rises

Satisfies dimensional monotonicity

Adjusted Headcount Ratio

Note

- M_0 requires only ordinal information.

Q/

- What if data are cardinal?
- How to incorporate information on *depth* of deprivation?

Aggregation: Adjusted Poverty Gap

Augment information of M_0 using normalized gaps

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

Aggregation: Adjusted Poverty Gap

Augment information of M_0 using normalized gaps

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

Average **gap** across all deprived dimensions of the poor:

G = (0.04+0.42+0.17+0.67+1+1)/6

Aggregation: Adjusted Poverty Gap

Adjusted Poverty Gap = M_1 = M_0G = HAG

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

Average **gap** across all deprived dimensions of the poor:

G = (0.04 + 0.42 + 0.17 + 0.67 + 1 + 1) / 6

Aggregation: Adjusted Poverty Gap

Adjusted Poverty Gap = $M_1 = M_0G$ = HAG = $\boldsymbol{\mu\ (g^1(k))}$

$$
\begin{array}{cc}
 & \text{Domains} \\
\boldsymbol{g^1(k)} = & \begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0.42} & \mathbf{0} & \mathbf{1} \\ \mathbf{0.04} & \mathbf{0.17} & \mathbf{0.67} & \mathbf{1} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \end{bmatrix} \quad \text{Persons}
\end{array}
$$

Average **gap** across all deprived dimensions of the poor:

$G = (0.04 + 0.42 + 0.17 + 0.67 + 1 + 1) / 6$

Aggregation: Adjusted Poverty Gap

Adjusted Poverty Gap = $M_1 = M_0G$ = HAG = μ $(g^1(k))$

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

Obviously, if in a deprived dimension, a poor person becomes even more deprived, then M_1 will rise.

Aggregation: Adjusted Poverty Gap

Adjusted Poverty Gap = $M_1 = M_0 G$ = HAG = μ **($g^1(k)$)**

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

Obviously, if in a deprived dimension, a poor person becomes even more deprived, then M_1 will rise.

Satisfies monotonicity – reflects incidence, intensity, depth

Aggregation: Adjusted FGT

Consider the matrix of squared gaps

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

Aggregation: Adjusted FGT

Consider the matrix of squared gaps

$$g^2(k) = \begin{array}{cl} \text{Domains} & \\ \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0.42^2 & 0 & 1^2 \\ 0.04^2 & 0.17^2 & 0.67^2 & 1^2 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \text{Persons} \end{array}$$

Aggregation: Adjusted FGT

Adjusted FGT is $M_2 = \mu\ (g^2\ (k))$

$$g^2(k) = \begin{array}{cc} \text{Domains} & \\ \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0.42^2 & 0 & 1^2 \\ 0.04^2 & 0.17^2 & 0.67^2 & 1^2 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \text{Persons} \end{array}$$

Aggregation: Adjusted FGT

Adjusted FGT is $M_2 = \mu(g^2(k))$

$$
\begin{array}{cc}
 & \text{Domains} \\
g^2(k) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0.42^2 & 0 & 1^2 \\ 0.04^2 & 0.17^2 & 0.67^2 & 1^2 \\ 0 & 0 & 0 & 0 \end{bmatrix} & \text{Persons}
\end{array}
$$

Satisfies transfer axiom

– reflects incidence, intensity, depth, severity

– focuses on most deprived

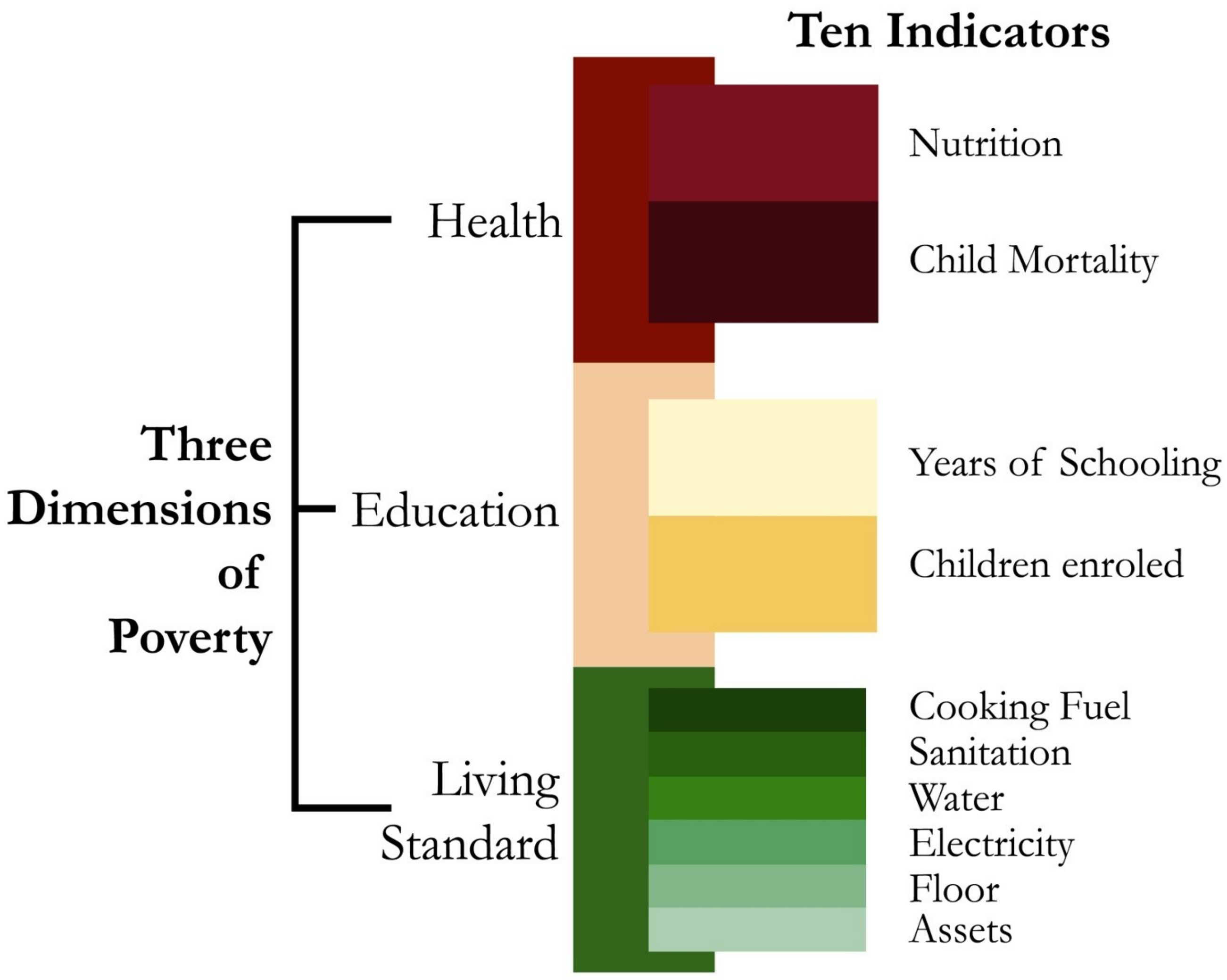
Overview

- Concept - Poverty as multiple deprivation
  - Mirrors identification used by NGOs – BRAC
  - Depends on joint distribution
- Transparent
- Can be implemented at any level
  - Cross country – MPI in the 2010 HDR
    - Includes: Nutrition, enrollment, assets
  - Within country – Mexico*, Colombia, Bhutan, etc.
  - Local village level – Participatory methods India, Bhutan, etc
  - Evaluation – Impacts on poverty

Proposal

- Multidimensional measure of food poverty
  - Dimensions and indicators
  - Deprivation cutoffs
  - Weights
  - Poverty cutoff
- Pros
  - All pieces on the table
  - Robust to cutoffs
  - Readily linked to existing poverty methods
  - Limited substitution natural in this context
- Cons

Food Price Shocks and the MPI?



Other Issues

- Chronic and Transient Effects
- Substitution
  - Quantity, quality, time
- Ultrapoor
- Intra-Household Impacts
- Just in Time Data and Forecasting
- Endogenous Policies
  - Parameter Insurance?

Thank you

Illustration: USA

Data Source: National Health Interview Survey, 2004, *United States Department of Health and Human Services. National Center for Health Statistics* - ICPSR 4349.

Tables Generated By: Suman Seth.

Unit of Analysis: Individual.

Number of Observations: 46009.

Variables:

(1) *income* measured in poverty line increments and grouped into 15 categories

(2) self-reported *health*

(3) health *insurance*

(4) years of *schooling*.

Illustration: USA

Profile of US Poverty by Ethnic/Racial Group

Illustration: USA

Profile of US Poverty by Ethnic/Racial Group

1	2	3
Group	**Population**	**Percentage Contrib.**
Hispanic	9100	19.8%
White	29184	63.6%
African American	5742	12.5%
Others	1858	4.1%
Total	**45884**	**100.0%**

Illustration: USA

Profile of US Poverty by Ethnic/Racial Group

1	2	3	4	5
Group	**Population**	**Percentage Contrib.**	**Income Poverty Headcount**	**Percentage Contrib.**
Hispanic	9100	19.8%	0.23	37.5%
White	29184	63.6%	0.07	39.1%
African American	5742	12.5%	0.19	20.0%
Others	1858	4.1%	0.10	3.5%
Total	**45884**	**100.0%**	**0.12**	**100.0%**

Illustration: USA

Profile of US Poverty by Ethnic/Racial Group

1 Group	4 Income Poverty Headcount	5 Percentage Contrib.
Hispanic	0.23	37.5%
White	0.07	39.1%
African American	0.19	20.0%
Others	0.10	3.5%
Total	**0.12**	**100.0%**

Illustration: USA

Profile of US Poverty by Ethnic/Racial Group

1 Group	4 Income Poverty Headcount	5 Percentage Contrib.	6 *H*	7 Percentage Contrib.
Hispanic	0.23	37.5%	0.39	46.6%
White	0.07	39.1%	0.09	34.4%
African American	0.19	20.0%	0.21	16.0%
Others	0.10	3.5%	0.12	3.0%
Total	**0.12**	**100.0%**	**0.16**	**100.0%**

Illustration: USA

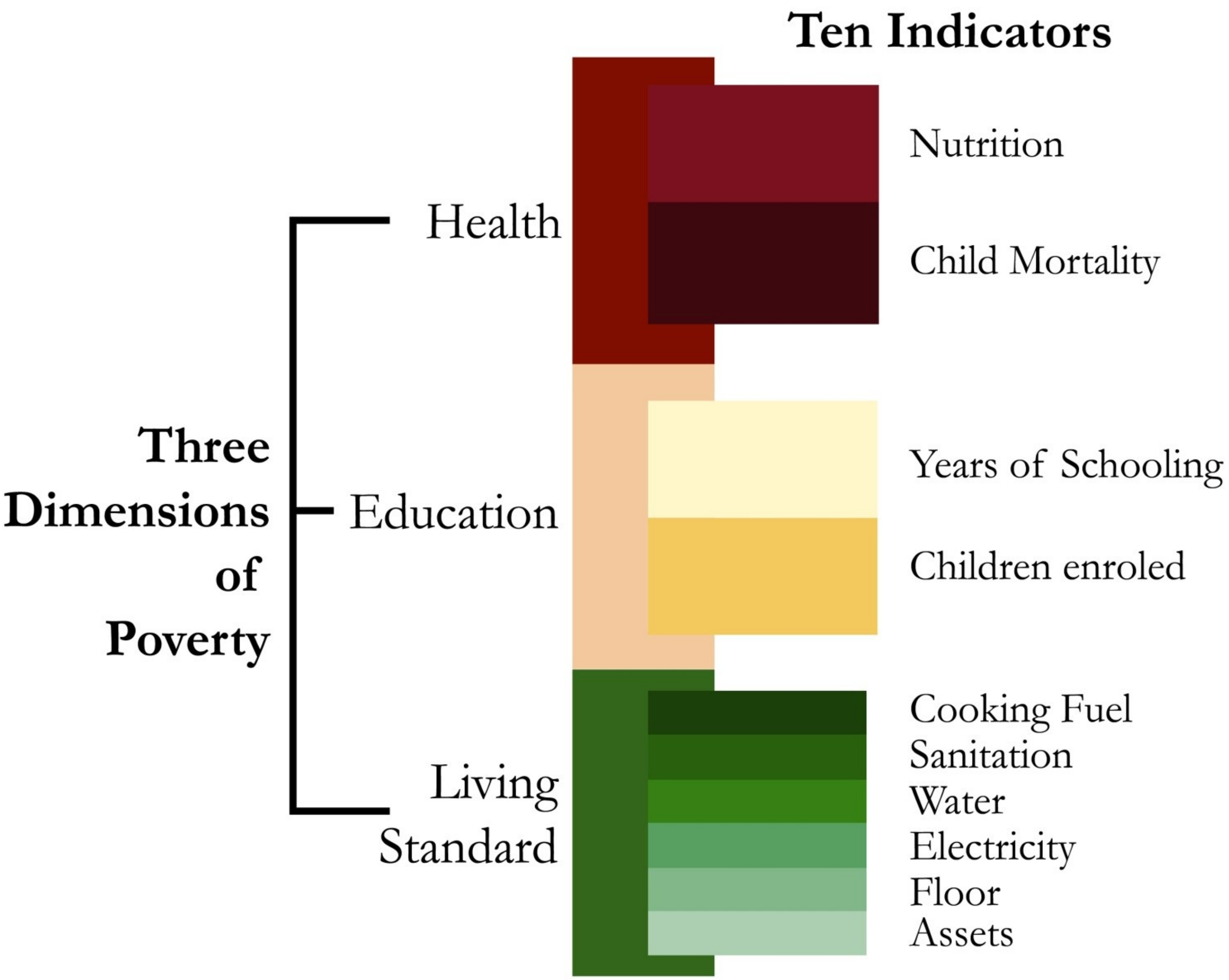
Profile of US Poverty by Ethnic/Racial Group

1 Group	4 Income Poverty Headcount	5 Percentage Contrib.	8 M_0	9 Percentage Contrib.
Hispanic	0.23	37.5%	0.229	47.8%
White	0.07	39.1%	0.050	33.3%
African American	0.19	20.0%	0.122	16.1%
Others	0.10	3.5%	0.067	2.8%
Total	**0.12**	**100.0%**	**0.09**	**100.0%**

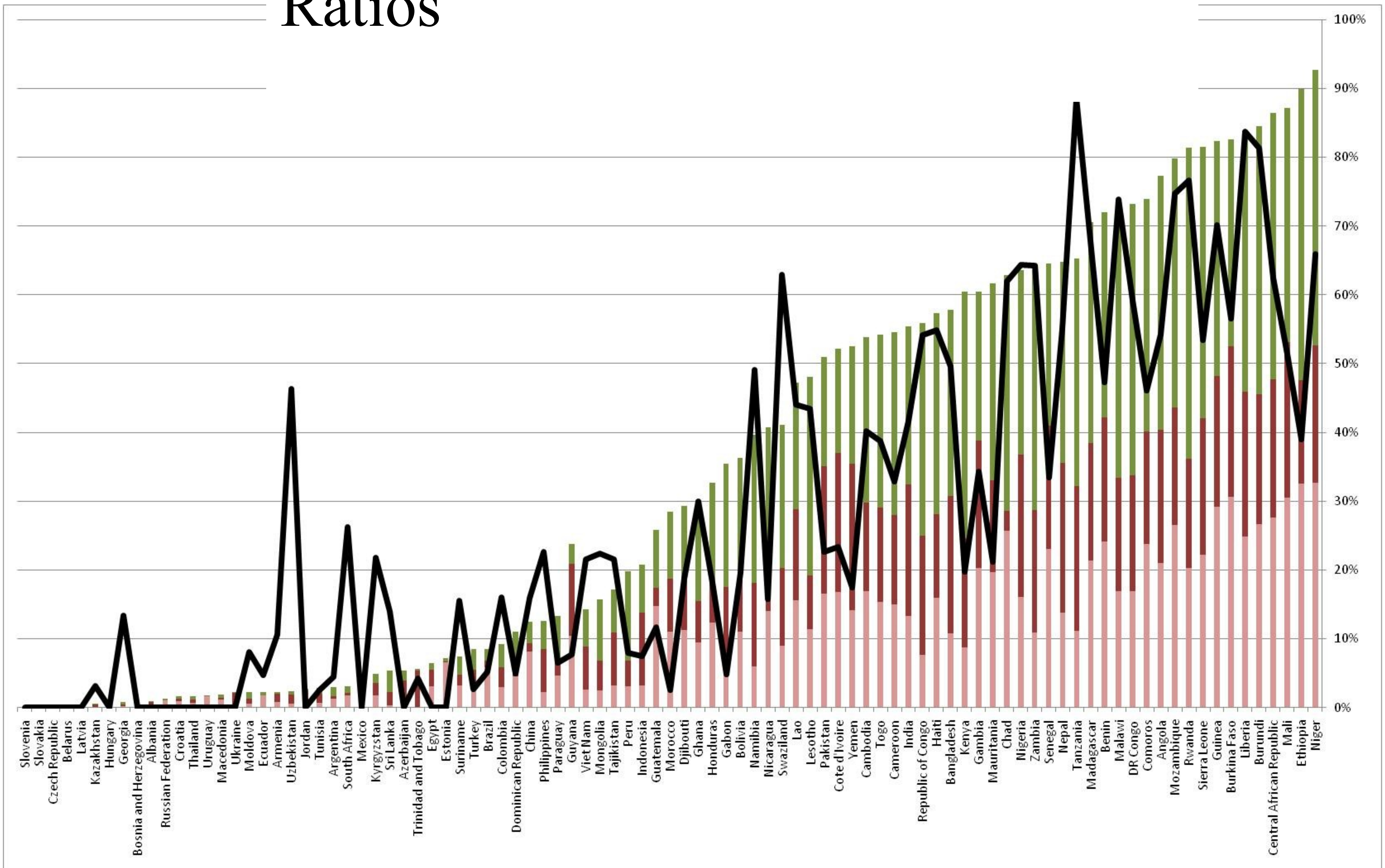
Illustration: USA

1	2	3	4	5	6
Ethnicity	***H_1 Income***	***H_2 Health***	***H_3 H. Insurance***	***H_4 Schooling***	***M_0***
Hispanic	0.200	0.116	0.274	0.324	0.229
Percentage Contribution	21.8%	12.7%	30.0%	35.5%	100%
White	0.045	0.053	0.043	0.057	0.050
Percentage Contribution	22.9%	26.9%	21.5%	28.7%	100%
Black	0.142	0.112	0.095	0.138	0.122
Percentage Contribution	29.1%	23.0%	19.5%	28.4%	100%
Others	0.065	0.053	0.071	0.078	0.067
Percentage Contribution	24.2%	20.0%	26.5%	29.3%	100%

Illustration: MPI



MPI and Traditional Headcount Ratios



Weights

- Weighted identification
  - Weight on first dimension (say income): 2
  - Weight on other three dimensions: 2/3
    - Cutoff k = 2
      - Poor if income poor, or suffer three or more deprivations
    - Cutoff k = 2.5 (or make inequality strict)
      - Poor if income poor and suffer one or more other deprivations
        - Nolan, Brian and Christopher T. Whelan, Resources, Deprivation and Poverty, 1996
- Weighted aggregation
  - Weighted intensity – otherwise same

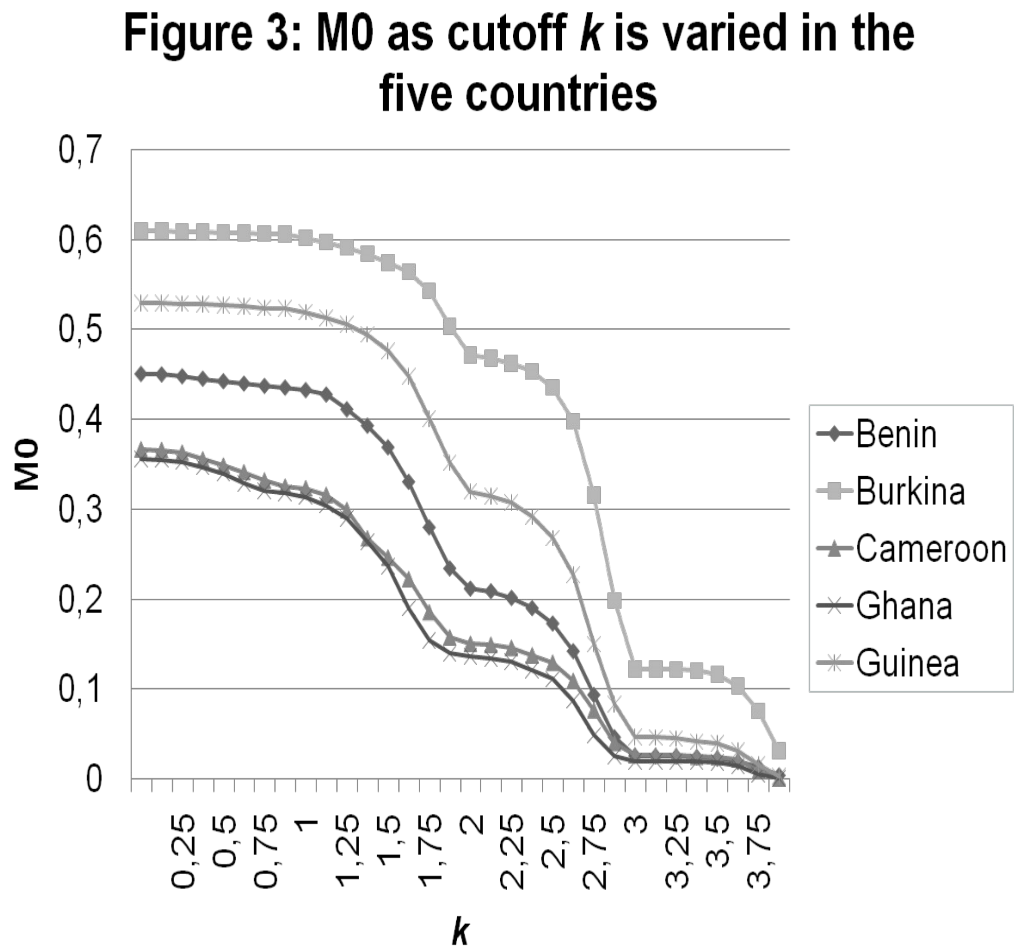
Caveats and Observations

- Identification
  - No tradeoffs across dimensions
    - Can’t eat a house
    - Measuring “what is” rather than “what could be”
  - Fundamentally multidimensional each deprivation matters
    - Need to set deprivation cutoffs
    - Need to set weights select dimensions
    - Need to set poverty cutoff across dimension
    - Lots of parts: Robustness?

Sub-Sahara Africa: Robustness Across k

Burkina is ***always*** poorer than Guinea, regardless of whether we count as poor persons who are deprived in only *one* kind of assets (0.25) or *every* dimension (assets, health, education, and empowerment, in this example). (DHS Data used)

Batana, 2008- OPHI WP 13



Caveats and Observations

- Aggregation
  - Neutral
    - Ignores coupling of disadvantages
    - Not substitutes, not complements
  - Discontinuities
    - More frequent, less abrupt

Advantages

- Intuitive
- Transparent
- Flexible
  - MPI – Acute poverty
  - Country Specific Measures
    - Policy impact and good governance
    - Targeting
  - Accounting structure for evaluating policies
  - Participatory tool

Understandings and Misunderstandings

- Data Requirements: Single survey sourcing
  - Depends on joint distribution, need information on joint dist.
  - Q: What if "best available data" are in different datasets?
  - A: Not best available data
  - Ex: Elasticity exercise with best available price data from one source and best available quantity data from another
  - Ex: Unlinked expenditure surveys

Understandings and Misunderstandings

Adjusted Headcount Ratio vs. MPI vs. HDI

Adjusted headcount ratio M_0 – general methodology

MPI – a specific implementation for cross-country comparisons

HDI – not a poverty measure

Understandings and Misunderstandings

Underpinnings: Poverty and Welfare

- Firmly rooted in axiomatic poverty analysis
  - Evaluate methods via axioms satisfied and violated
  - MPI – a specific implementation
- Adjusted headcount ratio
  - crude (like unidimensional headcount ratio)
  - not directly linked to welfare (ditto)
  - conveys tangible information
  - transparent parameters

Understandings and Misunderstandings

Calibration: Who chooses the parameters?

See country studies

Context dependent

Revisit Objectives

- Desiderata
  - It must **understandable** and easy to describe
  - It must conform to a **common sense** notion of poverty
  - It must fit the **purpose** for which it is being developed
  - It must be **technically** solid
  - It must be **operationally** viable
  - It must be easily **replicable**
- What do you think?

Thank you

Poverty Measurement

Framework – Sen 1976 identification and aggregation

Goals – Who is poor? targeting

– How much poverty? in any population

Poverty Measurement

Suppose

Single variable – calories, income or aggregate expend.

Unidimensional methods

Identification – poverty line

Aggregation – Foster-Greer-Thorbecke 1984, 2010

Note

Decomposability

Robustness

Poverty Measurement

Suppose

Many variables How to measure poverty?

Answer

If variables can be meaningfully aggregated into some overall resource or achievement variable *can use unidimensional methods*

Poverty Measurement

Examples

- Welfare aggregation
  - Construct each person's welfare function
  - Set cutoff and apply unidimensional poverty index
- Many assumptions needed
  - Alkire and Foster (2010) "Designing the Inequality-Adjusted Human Development Index"
- Ordinal variables problematic

Poverty Measurement

- Examples
  - Price aggregation
    - Construct each person’s expenditure level
    - Set cutoff and apply unidimensional poverty index
  - Many assumptions needed
  - Ordinal and nonmarket variables problematic
  - Link to welfare tenuous (local and unidirectional)

Poverty Measurement

- Suppose
  - Many variables that *cannot* be meaningfully aggregated into some overall resource or achievement variable. How to measure poverty?
- Answers?
  - Blinders Limit consideration to a subset that *can* be aggregated, and use unidimensional methods.
    - Key dimensions ignored
  - Marginal methods Apply unidimensional methods separately to one or more variables in turn.
    - Inadequate identification. Ignores joint distribution.

Hypothetical Challenge

- A government would like to create an official multidimensional poverty indicator
- Desiderata
  - It must **understandable** and easy to describe
  - It must conform to a **common sense** notion of poverty
  - It must fit the **purpose** for which it is being developed
  - It must be **technically** solid
  - It must be **operationally** viable
  - It must be easily **replicable**
- What would you advise?

Not So Hypothetical

- 2006 Mexico
  - Law: must alter official poverty methods
  - Include six other dimensions
    - education, dwelling space, dwelling services, access to food, access to health services, access to social security
- 2007 Oxford
  - Alkire and Foster “Counting and Multidimensional Poverty Measurement”
- 2009 Mexico
  - Announces official methodology; Ricardo Aparicio will discuss

Continued Interest

- 2008 Bhutan
  - Gross National Happiness Index
- 2010 Chile
  - Conference (May)
- 2010 London
  - Release of MPI by UNDP and OPHI (July)
- 2010-11 Colombia
  - Conference; Roberto Angulo will discuss
- 2008- OPHI and GW
  - Workshops: Missing dimensions; Weights; Country applications; Other measures; Targeting; Robustness; Rights/poverty; Ultrapoverty
  - Training: 40 officials from 28 countries
- 2009-11 Washington DC
  - World Bank (several), IDB (several), USAID, CGD, OECD

Price Shocks and Income Poverty

- Pros
  - Income poverty is salient concept
  - Powerful technology for prediction and evaluation
  - Micro theory based
  - Respects preferences