Measuring Multi-dimensional Poverty in the U.S.

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What is Poverty?

– Poverty is hunger.
– Poverty is lack of shelter.
– Poverty is being sick and not being able to see a doctor.
– Poverty is not having access to school and not knowing how to read.
– Poverty is not having a job, is fear for the future, living one day at a time.
– Poverty is losing a child to illness brought about by unclean water.
– Poverty is powerlessness, lack of representation and freedom.

Voices of the Poor, World Bank, 2000
“Poverty” is an inherently vague concept, and developing a poverty measure requires a number of relatively arbitrary assumptions---Blank, 2008
U.S. Official Poverty Measure

- Subjective
- Objective
  - Multi dimensions
  - Single dimension
  - Relative
  - Absolute
    - Consumption
    - Income
U.S. Official Poverty Measure

• Developed in the mid-1960s, when President Lyndon Johnson launched the "War on Poverty".

• Poverty thresholds:
  – Proposed by M. Orshansky of the Social Security Administration
  – Calculated as the cost of subsistence food budget using the “Economy Food Plan” of the U.S. Department of Agriculture and multiplied by three.
  – Vary by family size and composition
  – Updated for inflation using the Consumer Price Index (CPI)

• Income Measure:
  – Total family gross annual cash income from all sources, such as earnings, pensions, interest, rent, assets and cash welfare.

• Data:
Official Poverty Measure: Drawbacks

• **Drawbacks:**

• **Poverty Thresholds:**
  – Constant over time and across regions
  – Do not change to reflect changes in standards of living.

• **Income Measure:**
  – Excludes non-cash income transfers such as food stamps, housing subsidies, and the Earned Income Tax Credit (EITC)
  – Does not exclude taxes, transportation costs for getting to work, cost of child care, so on.

• **Aggregation:**
  – Annual or monthly, quarterly or at different frequency
  – Family or individuals as units of observation
  – Relevant equivalent scales
Suggested Changes to Official Measure

• **Experimental poverty rates in the early 1980s**
  – Smeeding (1982)
  – Used the official threshold but alternative resource measures to include taxes, in-kind income and limited housing imputations.

• **National Research Council’s Panel on Poverty and Family Assistance**
  – Citro and Michael (1995)
  – alternate thresholds based on expenditures on necessities (food, housing, and clothing)
  – proposed a quasi-relative poverty threshold with partial costs changing with the standard of living.
  – the resource definition includes after-tax cash income, plus the imputed value of near-cash in-kind benefits, minus an adjustment for work expenses (transportation and child care expenses), minus an adjustment for out-of-pocket medical expenses.
Suggested Changes to Official Measure

• More than 20 different experimental poverty measures based on the NAS recommendations proposed between 2000-2005.

• A Supplemental Poverty Measure (SPM) was proposed in 2010 to complement the official poverty measure.
  – Differs from the official poverty measure by taking into account household expenses such as taxes, housing, utilities, health care and child support costs and including government income supplements, such as school lunch programs, housing subsidies, and food stamps.
Alternate Poverty Measures in U.S.

- **Subjective poverty measures**
  - Vos and Garner (1991)
  - Vaughn (1993)
- **Relative poverty**
  - Notten and de Neubourg (2007)
- **Consumption poverty**
  - Slesnick (1993),
  - Meyer and Sullivan (2012)
- **Earnings capacity**
  - Garfinkel and Haveman (1977),
  - Haveman and Bershadker (2001)
- **Wealth poverty**
  - Azpitarte (2011)
- **Asset poverty**
  - Oliver and Shapiro (1997),
  - Haveman and Wolff (2005)
Material Hardship Measures in U.S.

- Material hardship is defined as inadequate consumption of goods or services that the public deems minimally necessary for decent human functioning.
- Different U.S. agencies provide a range of material deprivation statistics
  - food security (U.S. Department of Agriculture)
  - housing quality (U.S. Department of Housing and Urban Development)
  - child well-being (HHS)
  - Health insurance coverage (HHS)
  - Educational achievement (U.S. Department of Education).
- Recent examples: Carl, Baumann and Short (2009), Nelson (2011)
Capability Approach

• Distinction between multidimensional poverty and material deprivation:
  
• *material deprivation index* restricts attention to functioning failures regarding material living conditions
  
• *multidimensional poverty measure* takes into consideration all dimensions of well-being that may be of relevance
  
  – including non-material attributes such as health status and political participation
Capability Approach

- Income is an inadequate proxy measure of an individual’s standard of living.
- Townsend (1979), Streeten (1981), and Sen (1992) highlighted that the well-being of an individual is dependent on many dimensions of human life such as housing, education, and life expectancy; income is but one of these dimensions.
- An individual’s well-being comes from a “capability” to function in society (Sen, 1993)
Capability Approach

• Poverty is the absence of one or more of the basic capabilities that are needed to achieve minimal functioning in the society in which one lives.

• The poor are those
  – who lack income to ensure being adequately fed, clothed, or sheltered or being unhealthy,
  – as well as being denied access to education, political participation, or a full role in society.

• The capability approach to individual well-being is much appealing but it is difficult to bring in practice.
Multidimensional Measures: Achievement

I. The Physical Quality of Life Index (PQLI)
• developed for the Overseas Development Council in the mid-1970s by Morris David Morris
• an attempt to measure the well-being of a country
• the average of three statistics: basic literacy rate, infant mortality, and life expectancy at age one, all equally weighted

II. Human Development Index (HDI)
• The UNDP has published the HDI since 1990 in its annual Human Development Report (HDR)
• a weighted average of indicators of life expectancy, educational attainment and income
• sets a minimum and a maximum for each dimension, called goalposts, and then shows where each country stands in relation to these goalposts
• HDI was revised in 2010 - calculates a geometric mean instead of an arithmetic mean
Multidimensional Measures: Deprivation

III. The Human Poverty Index (HPI)
- published annually in the HDR during 1997 and 2009.
- aggregates deprivations in health, education, and standards of living
- HPI is derived separately for developing countries (HPI-1) and a group of select high-income OECD countries (HPI-2).

IV. Global Multi-dimensional Poverty Index (MPI)
- In 2010, the HPI was replaced by MPI.
- HPI used country averages to reflect aggregate deprivations; the MPI is based on individual records collected from survey data.
- MPI identifies deprivations across the same three dimensions (health, education, and standards of living)
- Identifies the number of people who are multi-dimensionally poor as those suffering deprivations in 33% of weighted indicators
Purpose of the Study

• The 2011 HDR published global MPI for about 100 developing countries.
• Deprivation dimensions and the indicators included in the global MPI are chosen to measure well-being in developing countries.
• The choice is often constrained by a lack of comparable data across countries.
• Less is known about multidimensional poverty in developed nations such as the U.S.
• Measure multi-dimensional poverty index for the U.S. which reflects the standard of living in the U.S.
Methodology

• Follow the same methodology as the global MPI
• The MPI was developed by the Oxford Poverty and Human Development Initiative (OPHI)
• It is a special case of the more broadly defined multidimensional deprivation indices proposed by Alkire and Foster (2011)
• Generalization of the Foster-Greer-Thorbecke (1984) poverty measures
Methodological Choices

- Multi-dimen.
  - Dimensions
  - Weights
  - Indicators
    - Agg. Dimen. for each indi.
    - Agg. Indi. for each dimen.
      - Agg.Indi.
      - Agg.Dimen.
        - MPI
        - HPI
  - Poverty Thresholds

Constructing MPI

➢ **Notation**
  - $i = 1, 2, \ldots, n$: individuals
  - $j = 1, 2, \ldots, d, d \geq 2$: indicators
  - $w_1, w_2, \ldots, w_d$: weights of indicators

➢ **Example**
  - $n = 5$
  - $d = 4$
  - $w_1 = w_2 = \ldots = w_d = \frac{1}{4}$
Constructing MPI

**Notation**

- $y_{nxd}$: achievement matrix
- $y_{ij}$: achievement of individual $i$ in indicator $j$
- $z_{1xd}$: threshold vector
- $z_j$: poverty threshold for indicator $j$

**Example**

$$y_{5x4} = \begin{bmatrix} y_{11} & \cdots & y_{14} \\ \vdots & \ddots & \vdots \\ y_{51} & \cdots & y_{54} \end{bmatrix}$$

$$z_{1x4} = \begin{bmatrix} Z_1 & Z_2 & Z_3 & Z_4 \end{bmatrix}$$
Dual Identification of Poor

Step 1

- Use the poverty thresholds to identify deprivation in a particular dimension

Step 2

- Define deprivation in a minimum number of indicators ($1 \leq k \leq d$) to be identified as multi-dimensionally poor
Step 1 Identification of Poor

- **Use the poverty thresholds**

- $g_{nxd}^0$: deprivation matrix

- If $(y_{ij} < z_j)$ then $g_{ij}^0 = 1$

- If $(y_{ij} \geq z_j)$ then $g_{ij}^0 = 0$

- $c_{n\times1}^0$: column vector

- $c_i^0 = \sum_{j=1}^{d} g_{ij}^0$: individual’s deprivation score

| $g_{5\times4}^0$ | 1 1 0 0  \\
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 0 1 0</td>
</tr>
<tr>
<td></td>
<td>1 1 1 1</td>
</tr>
<tr>
<td></td>
<td>0 1 0 0</td>
</tr>
<tr>
<td></td>
<td>0 1 1 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$c_{5\times1}^0$</th>
<th>2 2 4 1 3</th>
</tr>
</thead>
</table>
Step 2 Identification of Poor

• Choose the number of indicators

• **Union Approach** \((k = 1)\)
  – Dimensions are perfect complements
  – A person who is deprived in ANY dimension is poor
  – Overestimate poverty rates

• **Intersection Approach** \((k = d)\)
  – Dimensions are perfect substitutes
  – A person who is deprived in ALL dimensions is poor
  – Underestimate poverty rates

• **Counting Approach** \((1 \leq k \leq d)\)
  – Defines a minimum number of poverty dimensions, in which an individual has to be deprived to be poor.
  – Assumes implicitly that up to some critical point the dimensions are substitutes while they are complements beyond this critical point
Step 2 Identification of Poor

- Minimum number of indicators
- $1 \leq k \leq d$
- $c^0(k)$: column vector
- Individual’s truncated deprivation score
- $c^0_i(k)$ if $c^0_i \geq k$
- $c^0_i(k) = 0$ otherwise

\[
\begin{bmatrix}
1 & 1 & 0 & 0 \\
1 & 0 & 1 & 0 \\
1 & 1 & 1 & 1 \\
0 & 1 & 0 & 0 \\
0 & 1 & 1 & 1 \\
\end{bmatrix}
\]

\[
\begin{bmatrix}
2 \\
2 \\
4 \\
1 \\
3 \\
\end{bmatrix}
= c^0(k=2) =
\begin{bmatrix}
2 \\
2 \\
4 \\
0 \\
3 \\
\end{bmatrix}
\]
Constructing MPI

Notation

• Adjusted headcount ratio

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

Example

• \( c^0(k=2) = \begin{bmatrix} 2 \\ 2 \\ 4 \\ 0 \\ 3 \end{bmatrix} \)

• \( M_0 = \frac{1}{5 \times 4} \times 11 \)

• \( M_0 = 0.55 \)
Components

- \( M_0 = H \cdot A \)
- \( H = \left( \frac{q}{n} \right) \): headcount ratio
- \( A = \frac{1}{qd} \sum_{i=1}^{n} c_i(k) \): average deprivation score among poor
- \( c^0(k=2) = \begin{bmatrix} 2 \\ 2 \\ 4 \\ 0 \\ 3 \end{bmatrix} \)
- \( H = \frac{4}{5} \)
- \( A = \frac{1}{4x4} \times 11 \)
- \( M_0 = 0.55 \)
Properties

• Clarity and simplicity
• The adjusted headcount ratio can be measured using cardinal as well as ordinal data
• The adjusted headcount ratio measures:
  – Incidence (H)
  – Intensity (A)

of multidimensional poverty
Properties

• **Subgroup decomposability**
  – overall poverty is a population share weighted average of subgroup poverty levels

• **Subgroup consistency**
  – overall poverty to fall if poverty decreases in one subgroup and is unchanged in the other subgroups, given fixed subgroup populations

• **Dimension decomposition**
  – a weighted average of deprivation in different dimensions and in different population subgroups

• **Dimensional monotonicity**
  – If a poor individual becomes deprived in an additional dimension, then poverty index will increase
Drawbacks of the Methodology

• Violates transfer principle within the poor
• Ignores substitutability and complementarity between indicators
  – For any individual deemed poor in one or more dimensions, it is important to know how she fares in terms of the dimensions in which she is not deprived
Global MPI

• The global MPI is a special case of the adjusted headcount ratio.
• It is based on 3 dimensions and 10 indicators; all are equally weighted.
# Global MPI

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators (thresholds)</th>
</tr>
</thead>
</table>
| 1. Health        | - Child Mortality (any child has died in the family)  
                       - Nutrition (any adult or child for who is malnourished)  |
| 2. Education     | - Years of school (if no household member has completed five years of schooling)  
                       - Children enrolled (any school-aged child is not attending school up to class 8) |
| 3. Standard of Living | -- Cooking fuel (cooks with dung, wood or charcoal)  
                       - Sanitation (sanitation facility is not improved according to MDG guidelines)  
                       - Water (no access to safe drinking water or safe drinking water is more than a 30-minute walk from home round trip)  
                       - Electricity (no electricity)  
                       - Floor (has a dirt, sand or dung floor)  
                       - Assets (does not own more than one radio, TV, telephone, bike, motorbike or refrigerator and does not own a car or truck) |
U.S. MPI

• The American Community Survey (ACS) data
• Most recent 1 year-round 2011
• Information on demographic, social, economic, and housing characteristics of a sample of the population.
• All ACS data are survey estimates collected from areas with population of 65,000 or more.
ACS Data

• The ACS Public Use Microdata Sample (PUMS) files
  – a set of untabulated records about individual people or housing units.
  – data users can create custom tables that are not available through summary ACS data products.
• Person records of people aged 16 and above are included
• Persons living in group quarters (e.g., jails, college dormitories, and nursing homes) are excluded
• Sample of 1,278,613 individuals
# U.S. MPI: Illustrative Example

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Indicators (thresholds)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Health</strong></td>
<td>--Health insurance (deprived if no public or private insurance)</td>
</tr>
<tr>
<td></td>
<td>--Disability (deprived if disabled)</td>
</tr>
<tr>
<td><strong>2. Education</strong></td>
<td>--Ability to speak English (deprived if not well or not at all)</td>
</tr>
<tr>
<td></td>
<td>--Educational attainment (deprived if no high school diploma)</td>
</tr>
<tr>
<td><strong>3. Standard of Living</strong></td>
<td>--Income (deprived if income less than poverty threshold)</td>
</tr>
<tr>
<td></td>
<td>--Employment Status (deprived if in labor force and unemployed)</td>
</tr>
</tbody>
</table>
Deprivation in Individual Dimensions

- Income
- Employment
- Health insurance
- Disability
- English
- Schooling
## Multidimensional Poverty Index

<table>
<thead>
<tr>
<th>Identification Approach</th>
<th>Percent Deprivation (min. indicators)</th>
<th>Adj. HCR ($M_0$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Union</td>
<td>17 (1)</td>
<td>12.45</td>
</tr>
<tr>
<td>MPI</td>
<td>33 (2)</td>
<td>7.90</td>
</tr>
<tr>
<td></td>
<td>50 (3)</td>
<td>3.50</td>
</tr>
<tr>
<td></td>
<td>67 (4)</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>83 (5)</td>
<td>0.12</td>
</tr>
<tr>
<td>Intersection</td>
<td>100 (6)</td>
<td>0.005</td>
</tr>
</tbody>
</table>
# Multidimensional Poverty Index

<table>
<thead>
<tr>
<th>Iden. Approach</th>
<th>Dep. in at least</th>
<th>No. Poor Persons</th>
<th>HCR</th>
<th>Total Dep. Score</th>
<th>Av. Dep. Score</th>
<th>Adjusted HCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Union</td>
<td>1</td>
<td>601,333</td>
<td>47.0</td>
<td>955,253</td>
<td>0.26</td>
<td>12.5</td>
</tr>
<tr>
<td>MPI</td>
<td>2</td>
<td>251,561</td>
<td>19.7</td>
<td>605,481</td>
<td>0.40</td>
<td>7.90</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>82,976</td>
<td>6.5</td>
<td>268,311</td>
<td>0.54</td>
<td>3.50</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>17,460</td>
<td>1.4</td>
<td>71,763</td>
<td>0.68</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1,856</td>
<td>0.15</td>
<td>9,347</td>
<td>0.84</td>
<td>0.12</td>
</tr>
<tr>
<td>Intersection</td>
<td>6</td>
<td>67</td>
<td>0.005</td>
<td>402</td>
<td>1.00</td>
<td>0.005</td>
</tr>
</tbody>
</table>
Dimensional Contribution

- Schooling, 23.7
- Income, 20.8
- HI Cov, 19.5
- English, 13.6
- Disability, 13.3
- Employ, 9.1

Shown for MPI (k=3)
## Comparison of Poverty Estimates

<table>
<thead>
<tr>
<th>Poverty Measures</th>
<th>Data</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official HCR</td>
<td>CPS</td>
<td>13.7</td>
</tr>
<tr>
<td>SPM HCR</td>
<td>CPS</td>
<td>15.5</td>
</tr>
<tr>
<td>MSI-GA-CPI</td>
<td>CPS</td>
<td>13.6</td>
</tr>
<tr>
<td>MIT-GA-CE</td>
<td>CPS</td>
<td>16.9</td>
</tr>
<tr>
<td>Multi. HCR</td>
<td>ACS</td>
<td>19.7</td>
</tr>
</tbody>
</table>

MSI means "Medical out-of-pocket expenses (MOOP) subtracted from income."
MIT means "MOOP in the thresholds."
GA means "Geographic Adjustment (of poverty thresholds)."
NGA means "No Geographic Adjustment (of poverty thresholds)."
CPI means "Thresholds were adjusted since 1999 using the Consumer Price Index for All Urban Consumers."
CE means "Thresholds were recomputed since 1999 using data from the Consumer Expenditure Survey."
Summarize

• No multidimensional estimates of poverty in the US available
• Purpose is to provide reliable multidimensional poverty measures for the US
• Compatible with the global MPI estimates
• Many arbitrary choices involved
  – Dimensions
  – Indicators
  – Weights
  – Thresholds
• Thanks for your time and your suggestions!