Multidimensional Poverty and Inclusive Growth in India: An Analysis Using Elasticities

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Motivation

• India maintained higher economic growth than neighbours (e.g. Bangladesh, Nepal)

• Yet, inclusiveness of growth not relatively high
  – In terms of income poverty reduction
  – In terms of key social indicators

• Ahluwalia (2011), Dreze and Sen (2013)
  – India’s growth needs to be more inclusive
## Inclusiveness of Economic Growth

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Year</th>
<th>India</th>
<th>Bangladesh</th>
<th>Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gross National Income per Capita</strong> (in International $)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>860</td>
<td>550</td>
<td>510</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>3620</td>
<td>1940</td>
<td>1260</td>
</tr>
<tr>
<td><em>Growth (p.a.)</em></td>
<td></td>
<td>6.8%</td>
<td>5.9%</td>
<td>4.2%</td>
</tr>
<tr>
<td><strong>Under-5 Mortality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>114.2</td>
<td>138.8</td>
<td>134.6</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>61.3</td>
<td>46.0</td>
<td>48.0</td>
</tr>
<tr>
<td><em>Change (p.a.)</em></td>
<td></td>
<td>-2.9%</td>
<td>-5.1%</td>
<td>-4.8%</td>
</tr>
<tr>
<td><strong>DPT Immunization Rate</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>1990</td>
<td>70</td>
<td>69</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>2010</td>
<td>72</td>
<td>95</td>
<td>82</td>
</tr>
<tr>
<td><em>Change (p.a.)</em></td>
<td></td>
<td>0.1%</td>
<td>1.6%</td>
<td>3.3%</td>
</tr>
<tr>
<td><strong>Adult Pop. with no Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>51.6</td>
<td>55.5</td>
<td>65.8</td>
</tr>
<tr>
<td></td>
<td>2010</td>
<td>32.7</td>
<td>31.9</td>
<td>37.2</td>
</tr>
<tr>
<td><em>Change (p.a.)</em></td>
<td></td>
<td>-2.3%</td>
<td>-2.7%</td>
<td>-2.8%</td>
</tr>
<tr>
<td><strong>Access to Improved Sanitation</strong> (rural pop)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>7</td>
<td>34</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>2010</td>
<td>23</td>
<td>55</td>
<td>27</td>
</tr>
<tr>
<td><em>Change (p.a.)</em></td>
<td></td>
<td>6.1%</td>
<td>2.4%</td>
<td>6.8%</td>
</tr>
</tbody>
</table>

*Source: Alkire and Seth (2013). The table is inspired by Drèze and Sen (2011), with minor additions.*
Multi-dimensional Poverty in India

• Studies on India’s multidimensional poverty
  – Jayaraj and Subramanian (2009)
  – Mishra and Ray (2013)
  – Alkire and Seth (2013)

• Counting approach to assess multidimensional poverty
  – Alkire and Foster (2011): MPI
  – Consideration of joint distribution in identification
  – Decomposability: Study horizontal inclusiveness
  – Dimensional breakdown: Study dimensional inclusiveness
Studying Inclusiveness Using Elasticity

- **Elasticity**: responsiveness of an “ends variable” with respect to a “means variable” between two periods
- **Vertical growth elasticity**: Responsiveness of national MD poverty to growth
- **Horizontal growth elasticity**: Responsiveness of sub-national MD poverty to growth
- **Dimensional growth elasticity**: Responsiveness of dimensional deprivations to growth
- Other partial elasticities

Foster (2014)
Growth Elasticity Literature

• Use of cross country regression analysis: income
  – Bourguignon (2003)

• Using of point elasticity (study distribution effect vs. growth effect): Income

• No well-known framework to study inclusiveness of growth to multidimensional poverty
  – Our approach in this paper
Notation: Counting Approach

- **Achievement matrix**: $X \in \mathbb{R}^{n \times d}_+$
- **An element of $X$**: $x_{ij}$ for $i = 1, \ldots, n; j = 1, \ldots, d$
- **Weights**: $w = (w_1, \ldots, w_d)$, $w_j > 0$, and $\Sigma_j w_j = 1$
- **Deprivation cutoff vector**: $z = (z_1, \ldots, z_d) \in \mathbb{R}_+^d$
- **Person $i$ is deprived in dimension $j$**: $x_{ij} < z_j$
- **Deprivation status value**: $g_{ij} = 1$ if $x_{ij} < z_j$, else $g_{ij} = 0$
- **Deprivation score**: $c_i = \Sigma_j w_j g_{ij}$, $c_i \in [0,1]$
- **Poverty cutoff**: $k \in (0,1]$; (Union vs. intersection vs. intermediate)
Notation: Counting Approach ($M_0$)

- Identification: Person $i$ is poor iff $c_i \geq k$
- Censoring: $c_i(k) = c_i$ if $c_i \geq k$ and $c_i(k) = 0$, otherwise

$$M_0 = \frac{1}{n} \sum_{i=1}^{n} c_i(k) = \frac{q}{n} \times \frac{1}{q} \sum_{i=1}^{n} c_i(k) = H \times A$$

- Adjusted headcount ratio ($M_0$)
  - $H$: Multidimensional Headcount Ratio (incidence)
  - $A$: Average deprivation score among the poor (intensity)
Properties of $M_0$

- Subgroup decomposition

\[ M_0 = \sum_{\ell=1}^{m} \frac{n^\ell}{n} M_0(X^\ell) \]

- There are $m$ population subgroups
- $X^\ell$ is the achievement matrix of subgroup $\ell$
- $n^\ell$ is the population of subgroup $\ell$
Properties of $M_0$

- Dimensional Breakdown

$$M_0 = \sum_{j=1}^{d} w_j h_j(k)$$

- $h_j(k)$: censored headcount ratio

$$h_j(k) = \frac{1}{n} \sum_{i=1}^{n} g_{ij} \mathbb{I}[c_i \geq k]$$
Elasticity

• What is elasticity?
  – The responsiveness of an “ends variable” $x$ with respect to a “means variable” $y$ between period $t_1$ and $t_2$
  – Referred as “$y$-elasticity of $x$”

• Definition: 
  
  $\frac{\delta x}{\delta y}$
  
  $\bar{\delta x} = \left[ \left( \frac{x_{t_2}}{x_{t_1}} \right)^{\frac{1}{t_2-t_1}} - 1 \right]$

• Percentage change in $x$ due to one percent change in $y$
Some Important Elasticity Formulae

- Growth Elasticities

\[ e(x; Y) = \frac{\delta x}{\delta Y} \]

- \( Y \) is the income variable
- \( x \) may be \( M_0, H, A, h_j(k) \) or subgroup estimates
- \( e(x; Y) \) is the “income-elasticity of \( x \)”
- For negative relationship, we add ‘−’ sign to make the elasticity positive
Other Elasticities

- $M_0$-elasticity of censored headcount ratio

\[
e(h_j (k); M_0) = \frac{\delta h_j (k)}{\delta M_0}
\]

- Uncensored-elasticity of censored headcount ratio

\[
e(h_j (k); h_j) = \frac{\delta h_j (k)}{\delta h_j}
\]

- $h_j$ is the uncensored headcount ratio of dimension $j$
Example ($k = 2/3$, equal weight)

<table>
<thead>
<tr>
<th>$X$</th>
<th>$X'$</th>
<th>$X''$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0</td>
<td>0 0 0</td>
<td>1 0 0</td>
</tr>
<tr>
<td>1 0 0</td>
<td>1 0 0</td>
<td>1 0 0</td>
</tr>
<tr>
<td>1 1 1</td>
<td>1 1 1</td>
<td>1 1 1</td>
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<td>1 1 0</td>
<td>1 0 1</td>
<td>1 0 0</td>
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<td>1 0 1</td>
<td>0 0 1</td>
<td>1 0 1</td>
</tr>
<tr>
<td>0 1 1</td>
<td>0 1 1</td>
<td>0 1 1</td>
</tr>
</tbody>
</table>

| CH  | 0.50 | 0.50 | 0.50 |
| RH  | 0.67 | 0.50 | 0.50 |
| MPI | 0.50 |      |      |

| CH  | 0.33 | 0.33 | 0.50 |
| RH  | 0.50 | 0.33 | 0.67 |
| MPI | 0.39 |      |      |

| CH  | 0.33 | 0.33 | 0.50 |
| RH  | 0.83 | 0.33 | 0.50 |
| MPI | 0.39 |      |      |

<table>
<thead>
<tr>
<th>Elasticity of CH Ratio</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>RH</td>
<td>1.3</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Elasticity of CH Ratio</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>RH</td>
<td>-1.3</td>
<td>1</td>
</tr>
</tbody>
</table>
Multiplicative Elasticity Decomposition

• $e(x; Y)$ can be decomposed as

$$e(x; Y) = e(x; y)e(y; Y) = \frac{\delta x}{\delta y} \times \frac{\delta y}{\delta Y}$$

• Example: Income-elasticity of subgroup $M_0$

$$e(M_0^\ell; Y) = e(M_0^\ell; Y^\ell)e(Y^\ell; Y) = -\frac{\delta M_0^\ell}{\delta Y} \frac{\delta Y^\ell}{\delta Y}$$

• Example: Income elasticity of CH ratio

$$e(h_j(k); Y) = e(h_j(k); h_j)e(h_j; Y) = -\frac{\delta h_j(k)}{\delta h_j} \frac{\delta h_j}{\delta Y}$$
Data

Multidimensional Poverty: Two rounds of National Family Health Surveys for trend analysis
NFHS-2 (1998/99) and NFHS-3 (2005/06)
Adjustment to preserve comparability (Alkire and Seth 2013)

State Domestic Product and Net National Product
2011-12 Handbook of Statistics on the India Economy
Adjustment due to different base years prices
Net vs. Gross: Sub-national analysis
Results: National

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2006</th>
<th>Growth</th>
<th>NNP-Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI</td>
<td>0.300</td>
<td>0.251</td>
<td>-2.6%</td>
<td>0.55</td>
</tr>
<tr>
<td>H</td>
<td>56.8%</td>
<td>48.5%</td>
<td>-2.2%</td>
<td>0.49</td>
</tr>
<tr>
<td>A</td>
<td>52.9%</td>
<td>51.7%</td>
<td>-0.3%</td>
<td>0.07</td>
</tr>
<tr>
<td>PC-NNP</td>
<td></td>
<td></td>
<td>4.6%</td>
<td></td>
</tr>
</tbody>
</table>

PC-NNP: Per Capita Net Domestic Product

Vertical inclusiveness of growth

For a comparison of vertical inclusiveness across countries, see Alkire, Roche, and Vaz (2014)
MPI Growth Vs. Income Growth across States

- Arunachal Pradesh
- Assam
- Bihar
- Goa
- Gujarat
- Haryana
- Himachal Pradesh
- India
- Jammu & Kashmir
- Karnataka
- Kerala
- Madhya Pradesh
- Maharashtra
- Meghalaya
- Manipur
- Mizoram
- Nagaland
- Orissa
- Punjab
- Rajasthan
- Sikkim
- Tamil Nadu
- Tripura
- Uttar Pradesh
- West Bengal

Graph equation: $y = -0.699x - 0.017$

Growth in Per-Capita Net State Domestic Product

Growth in MPI

1.0% 2.0% 3.0% 4.0% 5.0% 6.0% 7.0% 8.0%
Horizontal Inclusiveness of National Growth

National Growth Elasticity of MPI
Decomposition of Horizontal Inclusiveness

![Graph showing the decomposition of horizontal inclusiveness with data points for different states and the national and state growth elasticities of MPI.]

- National Growth Elasticity of MPI
- State Growth Elasticity of MPI
- National Growth Elasticity of State Growth
Incidence vs. Intensity

![Incidence vs. Intensity Chart]

- Tripura
- Bihar
- Haryana
- Meghalaya
- West Bengal
- Uttar Pradesh
- Orissa
- Rajasthan
- Sikkim
- Nagaland
- Madhya Pradesh
- Assam
- Andhra Pradesh
- Gujarat
- Himachal Pradesh
- Maharashtra
- Karnataka
- Tamil Nadu
- Manipur
- Punjab
- Jammu & Kashmir
- Kerala
- Goa
- Mizoram

Growth Elasticity of MPI
H Elasticity of MPI
Dimensional Inclusiveness of National Growth

![Dimensional Inclusiveness of National Growth](chart)

- **Schooling**
- **Attendance**
- **Mortality**
- **Nutrition**
- **Electricity**
- **Sanitation**
- **Water**
- **Housing**
- **Cooking Fuel**
- **Assets**

**Growth Elasticity of Censored Headcount Ratio**
Uncensored-Censored Elasticity Decomposition

Growth Elasticity of Censored Headcount Ratio
Uncensored Elasticity of Censored Headcount Ratio
Growth Elasticity of Uncensored Headcount Ratio
MPI vs. Uncensored Elasticity of CH Ratio

![Graph showing MPI vs. Uncensored Elasticity of CH Ratio across various categories such as Schooling, Attendance, Mortality, Nutrition, Electricity, Sanitation, Water, Housing, Cooking Fuel, and Assets. The graph illustrates the elasticity of censored headcount ratio and uncensored elasticity of censored headcount ratio.]
Example: West Bengal

![Bar chart showing MPI Elasticity of Censored Headcount Ratio and Uncensored Elasticity of Censored Headcount Ratio for various indicators such as Schooling, Attendance, Mortality, Nutrition, Electricity, Sanitation, Water, Housing, Cooking Fuel, and Assets.]
Example: Urban Areas

- **MPI Elasticity of Censored Headcount Ratio**
- **Uncensored Elasticity of Censored Headcount Ratio**
Concluding Remarks

Although India has higher economic growth than neighbors, growth in MPI is has been much slower

We explore three types of inclusiveness
  – Vertical inclusiveness
  – Horizontal inclusiveness
  – Dimensional inclusiveness

We use elasticities to study responsiveness
Concluding Remarks

Elasticity decomposition

- National Growth, state growth, MPI
- State growth, incidence, MPI
- National growth, uncensored headcount, censored headcount

Nationally, growth-elasticity of MPI is 0.55

- Large heterogeneity across states
- Look at translation of national growth to states and the MPI
- Analyze dimensional inclusiveness nationally and across states