

## **Income, Growth and Social Outcomes in India: Technical Note**

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This note elaborates on the technical aspects underlying the two pieces by Arvind Subramanian published in the *Business Standard* (July 25 and 26, 2012). It provides additional information (by way of regressions), details the computation of the variables that are illustrated in the graphs, explains some of the choices made, and identifies the data sources. The data used for this analysis are also posted as an Excel file.

### **Regressions**

The seven charts in the piece depicted the simple relationship between income and four different social indicators. In Tables 1-4 below are regressions that capture this relationship and test how robust it is. Columns 1-6 in each of the tables present the level relationship with columns 5 and 6 excluding outliers. The last column presents the association between changes in income (measured as the growth of state domestic product per capita) and changes in the social indicator (in log terms).

The second column in each of the tables corresponds to the charts from the first article (July 25, 2012) while column seven corresponds to the charts from the second article (July 26, 2012). Change regressions were not performed as consistent child malnutrition measures were not available across the two time periods. For the change-on-change graphs, the y-axis of the graph represents the percent change in the indicator (in log terms) between the two time periods after taking account of a possible convergence effect.

### **Data description and sources**

Income per capita: Income per capita was estimated by using the national state domestic product (NSDP) per capita from the Central Statistics Office (CSO). It is computed for two periods—early 1990s and mid-2000s—to correspond broadly to the data on the social indicators that are covered in the analysis. For the earlier period, the level of income per capita is the average of NSDP per capita for 1992 and 1993 (this choice

excludes the crisis year of 1991); for the later period, it is the average of NSDP per capita for 2004 and 2005. The averaging smooths some of the variability in the data which can affect the relative ranking of the states, especially when computing growth rates over this period. For poverty, income per capita for the later period is the average of the NSDP per capita for 2008 and 2009 to match the timing of the poverty data. NSDP data for the period before 2004 are from Kumar and Subramanian (2012)<sup>1</sup> based on the CSO's data release of March 2011. NSDP data for the period after 2004 are calculated by applying the growth rates released in March 2012<sup>2</sup> to the estimates for 2004, and relatively weighting these growth rates based on 2004 population estimates for states split in 2000.

Growth of income per capita: This variable was calculated as the difference in the logs of the two income levels between the two time periods.

Poverty: The headcount ratios for poverty are obtained from the all National Planning Commission (Annexure B of the 2009 Expert Group Report<sup>3</sup> and the table on p.45 of the Databook for Deputy Chairman (DCH), April 2012<sup>4</sup>). To facilitate comparison, estimates for both time periods were those based on the Tendulkar Methodology, described in greater detail in the Report of the Expert Group published by the Planning Commission in November 2009. However, the headcount ratios for both time periods correspond to the states after their split in 2000 in the data set. To maintain consistency across the analysis, the poverty data were adjusted to correspond to their pre-split identities. This required estimating population for 1993 and 2009 which was done by applying the average decadal growth rate for the 1990s and 2000s (from the Census of India 2001 and 2011, Chapter 3, Statement 4 in both)<sup>5,6</sup> to the appropriate base level of population.

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<sup>1</sup> Kumar, Utsav, and Arvind Subramanian. "[Growth in India's States in the First Decade of the 21st Century: Four Facts.](#)" *Economic and Political Weekly* 47.03 (2012).

<sup>2</sup> National Planning Commission. "[Per Capita Net State Domestic Product at Constant \(2004-05\) Prices.](#)" Ministry of Statistics and Program Implementation, 2012.

<sup>3</sup> National Planning Commission. "[Report of the Expert Group to Review the Methodology for Estimation of Poverty.](#)" Government of India, 2009.

<sup>4</sup> National Planning Commission. "[Data for Use of Deputy Chairman.](#)" Government of India, 2012.

<sup>5</sup> Government of India. "[Size, Growth Rate, and Distribution of Population.](#)" *Census of India*. 2001.

<sup>6</sup> Government of India. "[Size, Growth Rate, and Distribution of Population.](#)" *Census of India*. 2011

Life Expectancy: Data for life expectancy for 1990 and 2004 actually refers to data from the SRS Abridged Tables, for the period of 1988-1992 and 2002-2006, respectively, where 1990 and 2004 indicate the midpoint of the period for which the data was collected. The first set of data was found in an Indian Institute of Population Studies' Report, Chapter 5, Table 1 (2005)<sup>7</sup> and the second in the UNDP's Inequality Adjusted Human Development Indices for India's States Report (2011)<sup>8</sup>. For 2004, the numbers for the divided states correspond to those for the parent states as data were not available for Jharkand, Chattisgarh, and Uttarakhand.

Child Malnutrition: Data for 2005 was available based on the new state lines. To be consistent across time and across indicators, these data were adjusted to correspond to the states before they were split. This required estimating the population for 2005 which was done according to the procedure described for adjusting poverty data above. Note that child malnutrition data for 1992<sup>9</sup> and those for 2005<sup>10</sup> are not strictly comparable because the definition of "child" is different: 4 years in 1993 and 5 years in 2005. Hence, for this indicator, the change on change charts and regressions are not presented.

Inequality: The data for inequality is an average of the urban and rural consumption-based Gini calculated from the NSS Survey data and was obtained from Bhandari and Debroy (Table 2, 2007)<sup>11</sup>.

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<sup>7</sup> International Institute of Population Studies, 2005. "[Estimation of Life Expectancy at Birth](#)," pp. 51-59.

<sup>8</sup> Suryanarayana M.H., Ankush Agrawal, and K. S. Prabhu. "[Inequality Adjusted Human Development Index for India's States](#)." UNDP India, 2011.

<sup>9</sup> International Institute for Population Studies, 1995. "[Infant Feeding and Child Nutrition](#)." National Family Health Survey 1992-93, p. 286.

<sup>10</sup> Ministry of Health and Family Welfare, Government of India. "[Nutrition and Anaemia](#)." National Family Health Survey 2005-06, p. 273.

<sup>11</sup> Bhandari, Laveesh, and Bibek Debroy. "[Exclusive Growth - Inclusive Inequality](#)." *FISME Policy Paper*. Federation of Indian Micro and Small & Medium Enterprises (FISME), Sept. 2007.

**Table 1: Poverty**

| Dependent variable              | (1)<br>Headcount<br>Ratio, 1993 | (2)<br>Headcount<br>Ratio, 2009 | (3)<br>Log of<br>Headcount<br>Ratio, 1993 | (4)<br>Log of<br>Headcount<br>Ratio, 2009 | (5)<br>Headcount<br>Ratio w/o<br>outliers,<br>1993 | (6)<br>Headcount<br>Ratio w/o<br>outliers,<br>2009 | (7)<br>Change log of<br>headcount ratio,<br>1993-2009 |
|---------------------------------|---------------------------------|---------------------------------|---|---|--|--|---|
| Log of income per capita        | -24.9***<br>(4.1)               | -17.5***<br>(4.1)               | -0.7***<br>(0.2)                          | -0.6***<br>(0.2)                          | -20.3**<br>(8.9)                                   | -20.2***<br>(4.0)                                  |   |
| Initial log of headcount ratio  |                                 |                                 |   |   |  |  | -0.02<br>(0.34)                                       |
| Change log of income per capita |                                 |                                 |   |   |  |  | -0.69<br>(0.46)                                       |
| Observations                    | 18                              | 18                              | 18  | 18  | 15   | 15   | 18  |
| R-squared                       | 0.6                             | 0.5                             | 0.6                                       | 0.4                                       | 0.4  | 0.7  | 0.16  |

Robust standard errors in parentheses. \*\*\*, \*\*, and \* represent, respectively, statistical significance at the 1, 5, and 10 percent confidence intervals. Outlier states were Bihar, Delhi, and Jammu & Kashmir.

**Table 2: Life expectancy at birth**

| Dependent variable              | (1)<br>Life<br>expectancy<br>1990 | (2)<br>Life<br>expectancy,<br>2004 | (3)<br>Log of life<br>expectancy,<br>1990 | (4)<br>Log of life<br>expectancy,<br>2004 | (5)<br>Life<br>expectancy<br>w/o outliers,<br>1990 | (6)<br>Life<br>expectancy<br>w/o outliers,<br>2004 | (7)<br>Change log<br>of life<br>expectancy,<br>1990-2004 |
|---------------------------------|-----------------------------------|------------------------------------|---|---|--|--|--|
| Log of income per capita        | 10.2***<br>(2.6)                  | 7.9***<br>(2.1)                    | 0.2***<br>(0.0)                           | 0.1***<br>(0.0)                           | 9.2***<br>(2.4)                                    | 6.8***<br>(1.7)                                    |  |
| Initial log of life expectancy  |                                   |                                    |   |   |  |  | -0.20***<br>(0.03)                                       |
| Change log of income per capita |                                   |                                    |   |   |  |  | 0.02<br>(0.01)   |
| Observations                    | 16                                | 16                                 | 16  | 16  | 15   | 15   | 16   |
| R-squared                       | 0.4                               | 0.6                                | 0.5                                       | 0.6                                       | 0.6  | 0.7  | 0.80   |

Robust standard errors in parentheses. \*\*\*, \*\*, and \* represent, respectively, statistical significance at the 1, 5, and 10 percent confidence intervals. Outlier state was Kerala. 1990 and 2004 are the midpoints of the ranges over which the data were collected, 1988-1992 and 2002-2006.

**Table 3: Child Malnutrition**

| Dependent variable       | (1)<br>Proportion<br>undernourished,<br>1992 | (2)<br>Proportion<br>undernourished,<br>2005 | (3)<br>Log of proportion<br>undernourished,<br>1992 | (4)<br>Log of<br>undernourished,<br>2005 | (5)<br>Proportion<br>undernourished<br>w/o outliers,<br>1992 | (6)<br>Proportion<br>undernourished<br>w/o outliers,<br>2005 |
|--------------------------|--|--|---|--|--|--|
| Log of income per capita | -12.9***<br>(3.4)                            | -13.8***<br>(3.3)                            | -0.3***<br>(0.1)                                    | -0.4***<br>(0.1)                         | -11.7***<br>(3.1)  | -12.0***<br>(3.2)  |
| Observations             | 17   | 17   | 17  | 17                                       | 14   | 14   |
| R-squared                | 0.3  | 0.5  | 0.3   | 0.5                                      | 0.5  | 0.6  |

Robust standard errors in parentheses. \*\*\*, \*\*, and \* represent, respectively, statistical significance at the 1, 5, and 10 percent confidence intervals. The outlier states were Kerala, Madhya Pradesh, and Gujarat.

**Table 4: Inequality**

| Dependent variable              | (1)<br>Gini<br>coefficient,<br>1993 | (2)<br>Gini<br>coefficient,<br>2004 | (3)<br>Log of Gini<br>coefficient,<br>1993 | (4)<br>Log of Gini<br>coefficient,<br>2004 | (5)<br>Gini<br>coefficient w/o<br>outliers, 1993 | (6)<br>Gini<br>coefficient<br>w/o outliers,<br>2004 | (7)<br>Change log of Gini<br>coefficient, 1993-<br>2004 |
|---------------------------------|-------------------------------------|-------------------------------------|--|--|--|---|---|
| Log of income per capita        | 7.5***<br>(2.0)                     | 5.2**<br>(2.1)                      | 0.2***<br>(0.1)                            | 0.2**<br>(0.1)                             | 5.3*<br>(2.6)                                    | 5.8***<br>(1.9)                                     |   |
| Initial log of Gini coefficient |                                     |                                     |  |  |  |   | -0.37<br>(0.24)   |
| Change log of income per capita |                                     |                                     |  |  |  |   | 0.21<br>(0.15)  |
| Observations                    | 17                                  | 17                                  | 17   | 17   | 15   | 15  | 17  |
| R-squared                       | 0.4                                 | 0.3                                 | 0.4  | 0.4  | 0.3  | 0.5   | 0.27  |

Robust standard errors in parentheses. \*\*\*, \*\*, and \* represent, respectively, statistical significance at the 1, 5, and 10 percent confidence intervals. Outlier states were Delhi and Assam.