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Within-Country Income Inequality and Human Development: An Ecological Analysis

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tetanus (DPT). A child is considered adequately immunized against measles after receiving one dose of vaccine and against DPT after receiving three doses. ● **Access to an improved water source** refers to the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring, or rainwater collection. Unimproved sources include vendors, tanker trucks, and unprotected wells and springs. Reasonable access is defined as the availability of at least 20 liters a person a day from a source within 1 kilometer of the dwelling.

4 Work and education indicators

Unemployment refers to the share of the labor force without work but available for and seeking employment. Definitions of labor force and unemployment differ by country

● **Primary education** provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music. ● **Secondary education** completes the provision of basic education that began at the primary level and aims at laying the foundations for lifelong learning and human development by offering more subject- or skill-oriented instruction using more specialized teachers.

5 Human development indicators (see Figure A1)

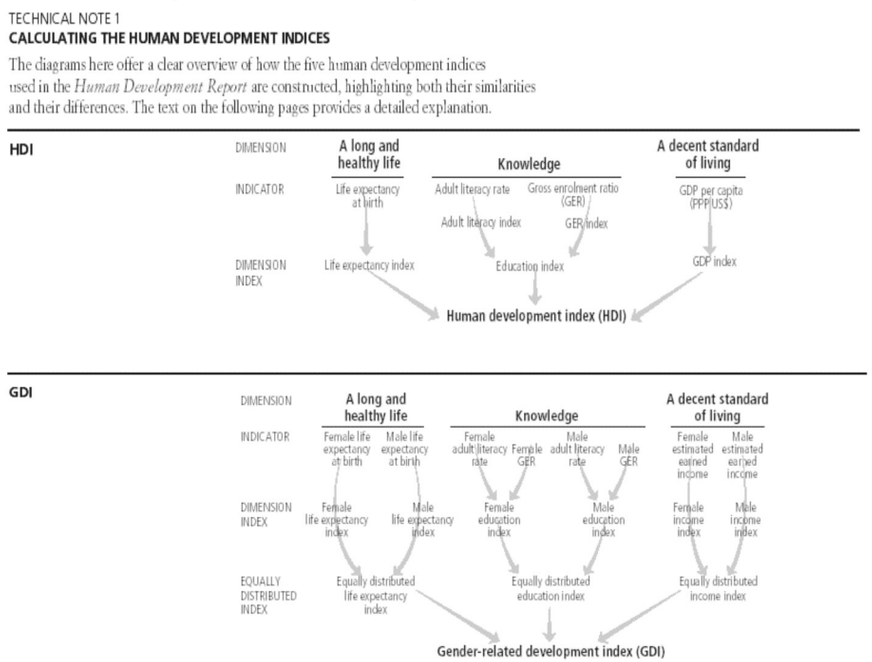

Figure A1. Components of the Human Development Index (HDI) and Gender-related Human Development Index (GDI). Source: 2004 World Development Report Technical Note 1[3]

Appendices:

Definitions*[1,2,3]*:

1 Economic indicators

● **Gross domestic product (GDP)** is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output. Growth is calculated from constant price GDP data in local currency. ● **GDP per capita** is gross domestic product divided by midyear population. ● **Gross national income (GNI)** is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. Data are in current U.S. dollars converted using the World Bank Atlas method. ● **GNI per capita** is gross national income divided by midyear population. GNI per capita in U.S. dollars is converted using the World Bank Atlas method. ● **PPP GNI** is gross national income converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GNI as a U.S. dollar has in the United States.

2 Mortality indicators

● **Crude death rate** is the number of deaths occurring during the year, per 1,000 population, estimated at midyear. ● **Maternal mortality ratio** is the number of women who die from pregnancy-related causes during pregnancy and childbirth, per 100,000 live births. ● **Infant mortality rate** is the number of infants dying before reaching one year of age, per 1,000 live births in a given year. ● **Under-five mortality rate** is the probability that a newborn baby will die before reaching age five, if subject to current age-specific mortality rates. The probability is expressed as a rate per 1,000. ● **Child mortality rate** is the probability of dying between the ages of one and five, if subject to current age-specific mortality rates. The probability is expressed as a rate per 1,000. ● **Adult mortality rate** is the probability of dying between the ages of 15 and 60-that is, the probability of a 15-year-old dying before reaching age 60-if subject to current age-specific mortality rates between those ages. ● **Life expectancy at birth** is the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.

3 Health indicators

● **Prevalence of undernourishment** is the percentage of the population that is undernourished. ● **Prevalence of child malnutrition** is the percentage of children under age five whose weight for age (underweight) or height for age (stunting) is more than two standard deviations below the median for the international reference population ages 0-59 months. For children up to two years old height is measured by recumbent length. For older children height is measured by stature while standing. The reference population, adopted by the WHO in 1983, is based on children from the United States, who are assumed to be well nourished. ● **Child immunization rate** is the percentage of children ages 12-23 months who received vaccinations before 12 months or at any time before the survey for four diseases-measles and diphtheria, pertussis (whooping cough), and

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Introduction

Why study inequality? Extreme inequalities in opportunity have a direct bearing on human capabilities and violates the principles of social justice and morality. Equality is central to the achievement of the Millennium Development Goals. As an acknowledgement of this precept, more recent reports of the major development agencies focused on equality and equity: the United Nation Development Programme's (UNDP) 2005 Human Development Report (HDR) explored the relationship between inequality and human development and the World Bank's (WB) 2006 World Development Report, Equity and Development, stressed the role of greater equity as complementary to the pursuit of poverty reduction and long-term prosperity. These reports showed data on the disparities in income and wealth across and within countries and how these disparities have affected health outcomes. [1,2,3] For instance, WDR showed that in Brazil the poorest 10 percent of the population account for 0.7 percent of national income, and the richest 10 percent for 47 percent. Inequalities within Sub-Saharan Africa are also very large. In Zambia, the ratio of the income of the richest to the poorest 10 percent is 42:1. In addition the report states that income distribution affects absolute poverty. For example, average income in Brazil is three times higher than average income in Viet Nam. But the poorest 20 percent of Brazilians have an income well below the average income in Viet Nam and comparable to the income of the poorest 20 percent of that country. Wealth-based differences fuels the intergenerational inequality cycle. Women in poor households are less likely to receive antenatal care and less likely to have safe deliveries, making their children less likely to survive or to complete school. Children who do not complete school are more likely to have lower incomes. Thus the cycle of deprivation is transmitted across generations.[3]

How has the level of within country inequality changed over time? Inequality trend studies have been inconsistent. Cornia (2003) reviewed the changes in within-country inequality over the last forty years, with particular attention to 1980-2000, against the inequality shifts intervened during the globalization of 1870-1914 and concluded that within country inequality appears to have risen to different extents in two thirds of the 73 countries analyzed, overturning in several cases prior trends towards lower inequality.[4] Firebaugh's (2003) review of studies that examined weighted averages showed no clear direction. His own analysis however presented rising within country inequality in all regions except Africa.[5]

How does income and income inequality relate to health? There are two prevailing hypotheses: absolute income (poverty) hypothesis and relative income hypothesis. The poverty hypothesis implies that, among the poorest countries, average income is what matters for population health, and income inequality is relatively less important. The reverse is true for rich countries average income is less important relative to income inequality, and the effect of the latter continues to grow as countries become richer. The relative income hypothesis implies that health depends on income relative to average incomes of one or more reference groups. This hypothesis argues that

If health is lower for those whose income is relatively low, then higher inequality makes the poor even poorer in relative terms and so worsens population health.[6]

Does within country income inequality affect health and well-being? The interest in the health effects of income inequality has been induced by the observation that income inequality was strongly associated with life expectancy among nine Organization for Economic Cooperation and Development (OECD) nations. These data from the late 1970s and early 1980s showed that more economically unequal countries like USA and UK had lower life expectancy than more egalitarian Nordic countries. Preston (1975 in Deaton 2003) looked at international patterns of GDP and life expectancy and showed negative association. However, contrary findings have also been shown by more recent studies.[7,8] For example, Ross (2000) argued that there is no necessary association between income inequality and population health as it may depend on the distribution of other health-relevant resources and exposures that exist within a country. In this study examining Canada and US, the authors concluded that higher income inequality within the US is associated with mortality only because it is also strongly associated with more unequal distribution of many powerful determinants of health.[9] Deaton (2003) reviewed literature on the association between health and income inequality and concluded that "the stories about income inequality affecting health are stronger than evidence". Most studies of individual mortality and income show no link: infant and child mortality studies in developing countries are primarily a consequence of poverty. There is nothing that implicates income (inequality) as the main correlate of the degree to which people experience disease-inducing insults. He further writes that there is no evidence that making the rich richer is hazardous to the health of the poor or their children given that they maintain their income. Income inequality is not important per se, other than its effects through poverty.[6]

To sum, there is strong emphasis on alleviating inequality not just for the interest of social justice but also to enhance human development. Studies have been conducted to look at income inequality and its association with health but most of these focused on mortality measures. With possibly increasing within-country income inequality, it is important to continue examining its effect on human development. Against this background, this study aims to contribute to this knowledge base by examining the: (1) change in the level of within country income inequality between the 2000 & 2006 WDR; and (2) association between within country income inequality and selected human development indicators.

Methods

Data source and measurements

This study used data reported by the World Bank's (WB) 2000 and 2006 World Development Indicators and the United Nations Development Programme's (UNDP) 2003 Human Development Indicators (HDI). The World Development Indicators is an annex of the annual World Development Report (WDR), the World Bank's major analytical publication that has the largest circulation of any international economic report in the world. It is a compilation of data on economic and social development in more that 120 countries. The WDR's objective is to both consolidate existing knowledge on a particular aspect of development as well as stimulate policy debate on new directions for development policy[1,2]

Figure 4. 2004 prevalence of undernourishment by 2006 gini coefficient

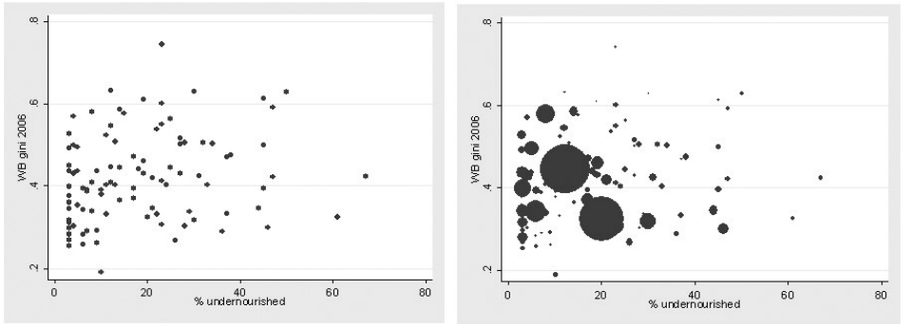
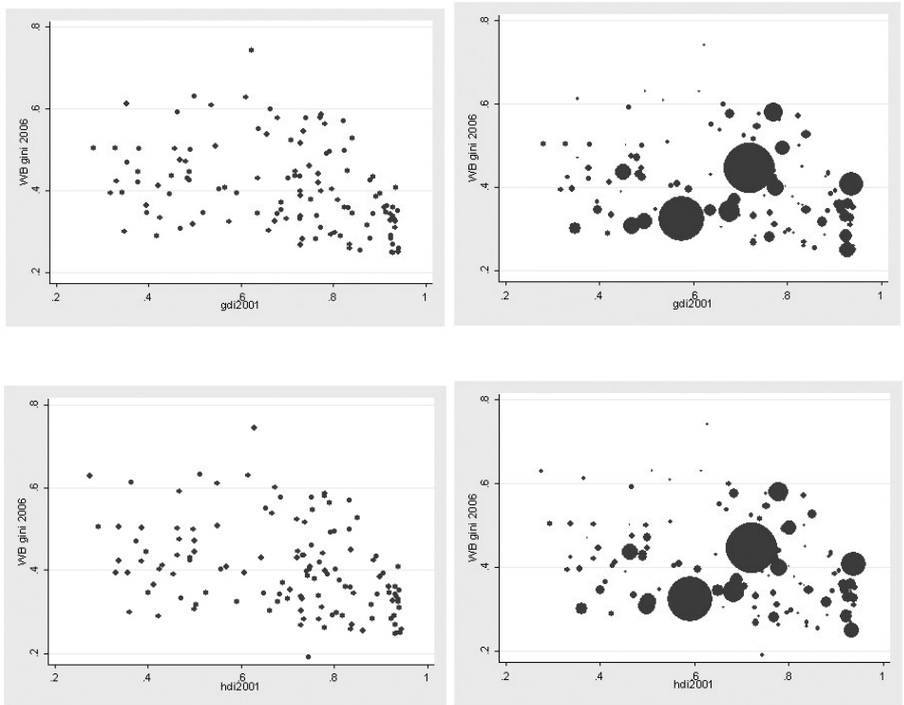
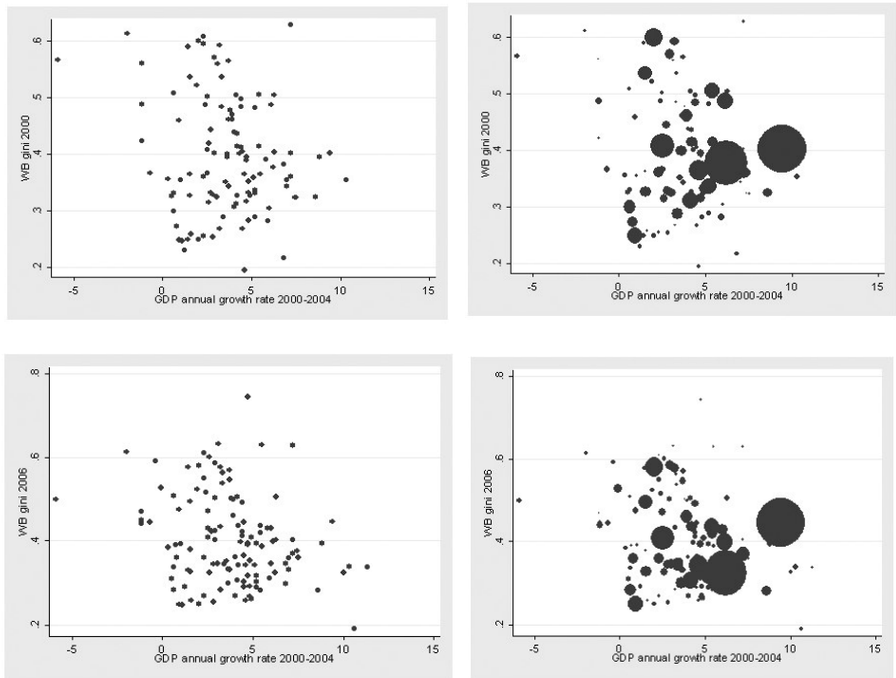


Figure 5. 2001 GDI and HDI by 2006 gini coefficient



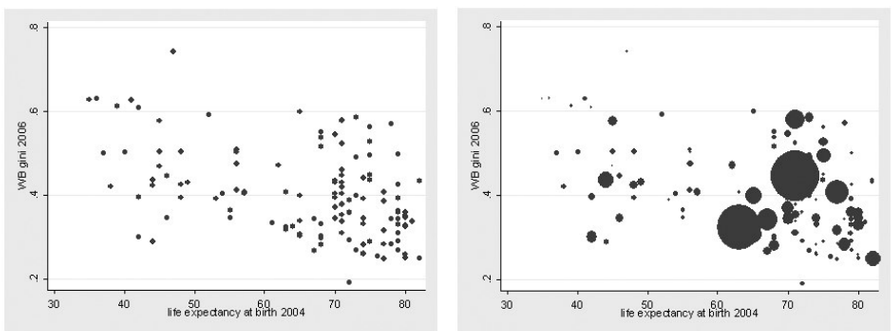
Unweighted Weighted

Figure 2. Annual GDP growth rate 2000-2004 by 2006 Gini coefficient



Unweighted Weighted

Figure 3. 2004 Life expectancy at birth by 2006 gini coefficient



Unweighted Weighted

The UNDP Human Development Indicators, an annex of the Human Development Report (HDR), provides objective information trends on human development and inputs for the analysis of critical policy issues. The Report's primary purpose is to assess the state of human development across the globe, and focuses on human well-being rather than on economic trends. It is a secondary user of data, with original sources ranging from national censuses and surveys to international data series collected and harmonized by international organizations the World Bank is one of its major sources. To allow comparisons across countries and over time, statistics are based on internationally standardized data, collected and processed by sister agencies in the international system or, in a few cases, by other bodies. These organizations, whether collecting data from national sources or through their own surveys, harmonize definitions and collection methods to make their data as internationally comparable as possible.[3]

The development measures selected for this analysis are grouped into economic, mortality, health, work and employment and over-all development indicators; all taken from the WDI except for the summary development indices which were taken from the HDI. Success in these indicators (among others) is crucial in the achievement of the Millennium Development Goals of 2015.

Income inequality. The Gini coefficient (index) is used as a summary measure of income inequality which ranges from 0 to 1 higher values represent higher inequality. It measures the extent to which the distribution of income (or consumption) among individuals or households within a country deviates from a perfectly equal distribution. It measures the area between the Lorenz curve (plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household) and a hypothetical line of absolute equality, expressed as the proportion of the maximum area under the line. Data for the estimation of gini index come from nationally representative household surveys; where the original data from the household survey were available, they have been used to directly calculate the income or consumption shares by quintile. Otherwise, shares have been estimated from the best available grouped data.[1]

Economic indicators. Economic indicators include annual Gross Domestic Product (GDP) growth rate from 2000 to 2004, Gross National Income (GNI) per capita PPP$ adjusted, and direct foreign investments (net inputs) as percent of GDP. GNI per capita, GDP growth, and GDP per capita growth are estimated by World Bank staff based on national accounts data collected by World Bank staff during economic missions or reported by national statistical offices to other international organizations such as the OECD. Purchasing power parity conversion factors are estimated by World Bank staff based on data collected by the International Comparison Program.[1]

Mortality indicators. I selected summary as well as life-stage specific measures of mortality crude death rate, maternal mortality ratio, infant mortality rate, under-5 mortality rate, adult mortality rate (males and females) and life expectancy at birth, mostly for the year 2004. The death rates are based on data derived from death registration systems, censuses, and sample surveys conducted by national statistical offices and other organizations, or on demographic analysis. The estimates for 2004 for many countries are national projections based on extrapolations of levels and trends measured in earlier years. Data on infant and under-five mortality are mostly from the harmonized estimates of the World Health Organization, UNICEF, and the World Bank, based mainly on household surveys, censuses, and vital registrations, supplemented by the World Bank's estimates based on household surveys and vital registrations.[1]

Health indicators. Health measures of interest include measurements for children and for the whole population, including disease prevention prevalence of childhood malnutrition (underweight and stunting), prevalence of undernourishment in the whole population, vaccination (measles and DPT) rates for children ages 12-23 months, and access to improved water source. Prevalence of underweight is the most common indicator of malnutrition; stunting is used to indicate longer-term malnutrition or deprivation. Immunization rates and access to improved water source are important measures included in the WHO's efforts to monitor and evaluate progress in implementing national health strategies. Estimates of child malnutrition are from national survey data. Data on undernourishment are produced by the Food and Agriculture Organization (FAO) of the United Nations based on the calories available from local food production, trade, and stocks; the number of calories needed by different age and gender groups; the proportion of the population represented by each age group; and a coefficient of distribution to take account of inequality in access to food. Data on water and sanitation are from the WHO and UNICEF's Meeting the MDG Drinking Water and Sanitation Target (www.unicef.org/wes/mdgreport). Data on immunization are from WHO and UNICEF estimates of national immunization coverage.[1]

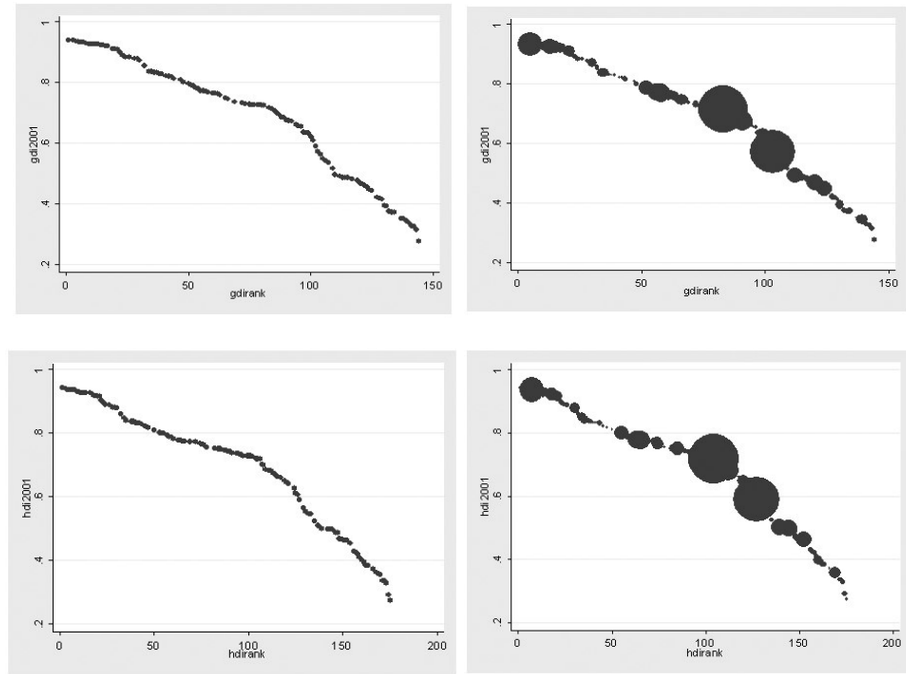
Work and education indicators. This group of indicators includes unemployment rate (a broad indicator of economic activity) and rates of enrolment in primary and secondary schools. Data on unemployment are drawn from labor force sample surveys and general household sample surveys, censuses, and other administrative records such as social insurance statistics, employment office statistics, and official estimates, which are usually based on information drawn from one or more of the above sources. Data on school enrollment are from the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics, as reported to them by national education authorities and statistical offices.[1]

Over-all development indicators. For over-all development, summary measures related to human development created by the United Nations will be used the human development index (HDI) and the gender-related human development index (GDI). Both indicators are composite indices measuring average achievement in three basic dimensions of human development a long and healthy life, knowledge, and decent standard of living. The latter measure is adjusted to account for inequalities between men and women. A diagram illustrating the components of these indices are shown in Appendix Figure 1A.[3]

Analysis sample and statistical approach

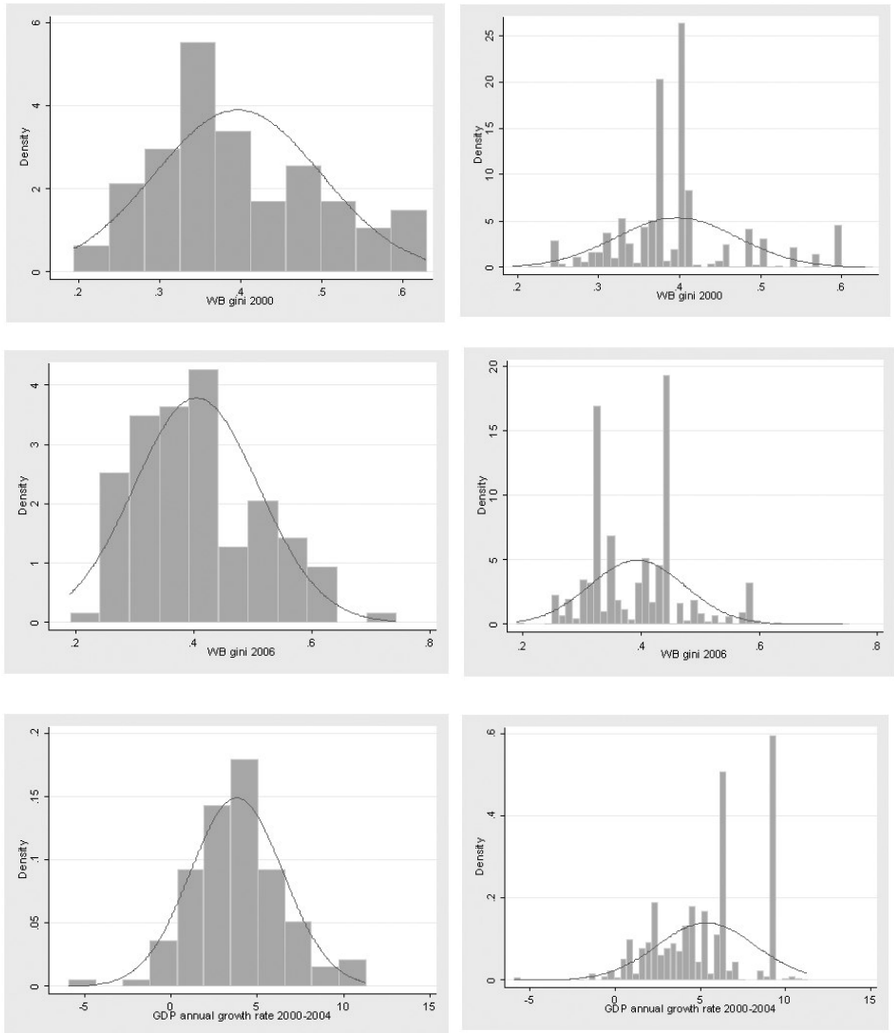
Although the WDR presented statistics on more than 150 countries in 2006, this study is limited only to countries with data on income inequality (gini index). This leaves the analysis sample to 126 countries, covering more than 93 percent of the world population. In looking at change in the level of inequality, only countries with gini index data on both the 2000 and 2006 WDI reports with at least 3 years survey interval are included. Survey interval is calculated as the difference between the survey years of income or consumption data in which the gini indices were based. This excluded 39 countries, leaving 87 countries for the gini change analysis. The 87 countries still cover about 84 percent of the world population.

Figure 1. Distribution of selected indicators continued



Unweighted Weighted

Figure 1. Distribution of selected indicators



Unweighted Weighted

Countries are grouped into 4 income categories according to the WDR cut-off points based on per capita GNI: low income (= $ 825), low middle income (> $825 but <$3255), high middle income (= $3255 but < $10066), and high income (= $10066). Descriptive statistics (means, proportions), Pearson correlation coefficients, and regression coefficients were calculated to examine the association between income inequality and the selected development indicators. For descriptive and correlation analysis, unweighted and weighted by population size estimates are presented; for regression analysis, only weighted estimates are presented

Results

Profile of countries by development indicators

Of the 126 sample countries, majority (63%) have gini coefficients between 0.300 to 0.500, representing about 85 percent of the population; only about 16 percent of the countries have less income inequality where 7 percent of the population reside. Figure 1 shows the distribution of gini coefficients reported in 2000 and 2006, unweighted and weighted by population size. For the selected income development indicators, Table 1 shows that more than half of the countries have lower than mean PPP $ adjusted GNI per capita and lower than mean direct foreign investment inflows while almost half have annual GDP growth rates lower than 3.81 percent. Mortality indicators show that majority of the sample countries have rates below average and most countries have life expectancies higher than 65.7 years (unweighted average). More than half of the countries have lower than average undernutrition and unemployment rates; while less than half of the countries have values lower than mean vaccination rates, access to safe water, enrolment rates, and over-all development indices.

Substantial differences in the unweighted and weighted mean estimates are observed for some, but not all indicators. For example, weighted 2004 GNI per capita is about PPP$ 925 less than the unweighted mean but estimates for over-all development indices GDI and HDI are very similar. Since population size is used as weights, estimates are pulled closer to those of large population countries. Mean estimates of annual GDP growth rate from 2000-2004 are substantially different (unweighted: 3.81 versus weighted 5.36); the latter estimate is pulled upward by the higher GDP growth rates of the two most populous countries China and India with GDP growth rate estimates of 9.4 and 6.2, respectively (Figure 1).

Table 1. Profile of sample countries: Mean values for selected indicators

		Unweighted			Weighted	
Indicator	N	Mean	SD	% <mean	Mean	SD
Economic						
Gini index 2000*	109	0.397	0.102	55.05	0.397	0.075
Gini index 2006*	126	0.404	0.105	55.56	0.393	0.080
GDP growth rate 2000-04	125	3.81	2.68	49.60	5.36	2.86
GNI per capita PPP$ 2004	124	10065.65	10674.93	69.35	9140.81	10487.24
Direct foreign investment** 2004	124	3.76	5.68	71.77	2.02	2.63
Mortality						
Crude Death Rate 2004	126	10.44	5.27	63.49	8.49	3.85
Maternal Mortality Ratio 2000	125	312.34	427.17	69.60	265.83	305.73
Infant Mortality Rate 2004	125	42.16	39.52	62.40	38.32	28.56
Under 5 mortality rate 2004	125	61.94	66.30	62.40	52.91	47.28
Adult mortality rate (male) 2002-04	126	278.15	176.43	62.70	224.62	117.99
Adult mortality rate (female) 2002-04	126	208.59	191.94	69.05	155.50	120.68
Life expectancy at birth 2004	126	65.70	12.94	36.51	67.61	9.05
Health						
% underweight 1995-2004	92	17.09	13.61	55.43	21.53	17.45
% stunted 1995-2004	90	25.14	14.57	52.22	26.03	15.58
% undernourished 2001-03	101	18.05	14.68	57.43	15.28	9.78
% vaccinated against measles 2004	124	84.87	14.55	41.94	79.65	16.21
% vaccinated against DPT 2004	124	86.21	14.05	45.97	83.20	15.74
% with access to safe water	106	80.22	18.01	41.51	82.72	13.14
Work and Education						
Unemployment rate 2004	93	9.50	6.16	56.99	6.48	4.18
% enrolled primary 2004	106	87.79	13.41	35.85	88.85	11.17
% enrolled secondary 2004	95	65.05	27.37	40.00	67.55	24.69
Over-all Development						
GDI 2001	118	0.690	0.189	41.53	0.689	0.15
HDI 2001	126	0.694	0.186	39.68	0.696	0.15

* Indicates publication year of MDI, not survey year. ** % of GDP, net input

Change in within-country inequality

This analysis is exclusive to countries with gini coefficients reported in both the 2000 and 2006 World Development Indicators of the World Bank, with at least 3 years survey interval. Looking at unweighted estimates, we find that income inequality remained stable, with an insignificant increase (0.004). However, there are pattern differentials by income groups income inequality increased among middle and high income countries with highest percent increase seen in the high income group while it decreased among low income countries. In contrast weighted estimates show that over-all, income inequality has decreased, largely due to the decrease in inequality among low income countries and the decrease in inequality observed among high middle income countries. With the application of population weights, the percent decrease in inequality among low income countries is increased from 3.2 percent to 10.5 percent; the increase in inequality among low middle income countries is increased from 2.9 percent to 6.1 percent; while that of high middle income countries is reversed from an increase of 2.0 percent to a decrease of 6.9 percent. Percent increase in unweighted and weighted gini coefficients are similar among high income countries. Gleaning from Appendix Table A1 which shows a matrix of countries by change in gini coefficient according to income group, the degree of the changes in gini coefficient estimates may be induced by the decrease in inequality in India (for low income countries), the increase in inequality in China (for low middle income countries) and the decrease in inequality in Mexico and the Russian Federation (for high middle income countries).

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Table 5. Regression coefficients: Association between 2006 Gini coefficient and selected indicators (weighted by population size)

	GDP growth rate 2000-04	Maternal Mortality Ratio 2000	% under – nourished	Unemploym ent rate 2004	GDI 2001	HDI 2001
Gini[+]						
Model 1	0.213	-47.019	-3.207[*]	0.917	0.019	0.015
Model 2	-0.785[*]	89.389[*]	1.653	-0.164	-0.010	-0.012

[+] Gini coefficient unit: 0.1. Model 1 is crude, Model 2 adjusted for income group (dummy variable).
[*] P-value <0.05.

Conclusion

The study finds significant association between income inequality and some human development indicators. In general, we can say that within country income inequality have detrimental effects on economic growth and maternal mortality, supporting efforts geared towards reduction of inequality. As regards to the change in inequality, it appears that overall inequality has slightly decreased (weighted) in recent years, supporting studies that predicted decreasing trend (i.e. Melchior, Telle, and Wiig 2000 in Firebaugh 2003). The unweighted estimate however is also consistent with reports[1-5] stating increasing within country inequality as evidenced by increasing number of countries or regions experiencing increased inequality.

Using weighted or unweighted analysis, or whether using crude or adjusted estimates resulted to different, even opposing results. The implications of these methodological differences underscore the need for caution in interpreting and comparing results across studies.

There are obviously data issues that limit the validity of this study. As with other studies that rely on aggregate level data from countries that employed different data collection designs, the degree of measurement error may be relatively high. The need to strengthen data collection and reporting at the national and international levels cannot be overstated. Despite the considerable efforts of international organizations to collect, process and disseminate social and economic statistics and to standardize definitions and data collection methods, many problems remain in the coverage, consistency and comparability of data across countries and over time. While the data in the reports demonstrate the wealth of information available, they also show many gaps in data on critical human development issues. For example, not all countries have data on income inequality.[3] Nonetheless, these may not be the most accurate data to use for cross-country analysis but this is what most policy-makers use in formulating plans and making decisions.

Grouping countries according to the pattern of change in the level of inequality, Table 3 shows that low income countries are most likely to have decreased inequality greater than 0.02 gini coefficients while middle income countries are more likely to have increased inequality greater than 0.02. This 0.02 cut-off point is arbitrary.

With the inconsistency in the weighted and unweighted findings, it is helpful to examine again the distribution of gini coefficients in 2000 & 2006 reports (although this include the 126 countries) shown in Figure 1. It appears that there is movement of countries towards lower gini coefficients (both unweighted and weighted figures), supporting the findings of the weighted analysis

Table 2. Change in Gini coefficient among countries with at least 3 years survey interval, by income group[+]

	Low Inc	Low Mid Inc	High Mid Inc	High Inc	All
Unweighted					
Gini coef 2000	0.405	0.426	0.408	0.312	0.389
Gini coef 2006	0.392	0.439	0.416	0.324	0.393
Difference	-0.013	0.013	0.008	0.012	0.004
% change[++]	-3.219	2.941	2.006	3.801	1.099
Weighted					
Gini coef 2000	0.382	0.417	0.475	0.351	0.401
Gini coef 2006	0.342	0.442	0.442	0.360	0.395
Difference	-0.040	0.025	-0.033	0.009	-0.006
% change[++]	-10.53[*]	6.099[*]	-6.903[*]	2.524[*]	-1.472[*]

[+] n=87 countries, total population 5,328 million, average survey interval 6.5 years
[++] Computed as: ((Gini coefficient 2006 – Gini coefficient 2000)/Gini coefficient 2000)*100

Table 3. Distribution of countries/individuals by change in Gini coefficient, by income group[+]

Gini	Low Inc	Low Mid Inc	High Mid Inc	High Income	All countries
Unweighted[*]					
Decreased >0.02	44.00	20.83	23.53	4.76	24.14
Difference within 0.02	28.00	45.83	29.41	66.67	42.53
Increased >.02	28.00	33.33	47.06	28.57	33.33
Total	100.00	100.00	100.00	100.00	100.00
Weighted					
Decreased >0.02	72.98	21.28	58.44	0.57	40.57
Difference within 0.02	22.42	12.55	21.36	80.55	26.13
Increased >.02	4.60	66.17	20.20	18.88	33.3
Total	100.00	100.00	100.00	100.00	100.00
N	25	24	17	21	87

[+] n=87 countries, total population 5,328 million, average survey interval 6.5 years.
[*] Pearson chi-square p-value <.05

Association between income inequality and selected development indicators: Pearson correlation coefficients

Table 4 presents unadjusted unweighted and population size weighted pair-wise Pearson correlation coefficients between the gini coefficient and the selected human development indicators reported in 2006. For the economic indicators, unweighted and weighted correlation coefficients show inconsistent results. Unweighted estimates show weak but statistically significant inverse relationship between inequality and annual GDP growth rate and per capita GNI; weighted estimates does not support these findings.

Similarly for the association between income inequality and mortality indicators, we find that the weighted analyses do not support any significant association, including that of life expectancy at birth. On the other hand, unweighted estimates show significant negative associations income inequality significantly increases death rates across all stages of the life cycle and decreases life expectancy at birth ($r = -0.446$, $p<0.05$). This relationship is not apparently shown in Figure 3, with most of life expectancy at birth clustering at 65 years or higher.

For the selected health indicators, weighted and unweighted correlation coefficients show different directions of association. While unweighted estimates support that income inequality is positively associated with undernourishment among the population and is negatively associated with measles and DPT vaccinations among children 12-23 months, the opposite is true for weighted estimates. In addition, weighted correlation coefficients show modest negative association between inequality and underweight and stunting for children under 5 years.

Higher income inequality is significantly associated with higher unemployment and lower secondary school enrolment both in the unweighted and weighted analyses. Highest correlation coefficient ($r=-0.492$ unweighted; $r=-0.230$ weighted) is obtained for the association between gini coefficient and percent enrolled in secondary school.

For the United Nations summary development indices, unweighted and weighted estimates do not relay the same pattern. Unweighted analysis show statistically significant negative association between income inequality and the gender-related development index (GDI) and the human development index (HDI). Weighted analysis does not support any significant association. When the 5 most populous countries are excluded in the weighted analysis, we see significant negative association; this however covers only about 2.5 percent of the world population. Figure 5 shows scatterplots with gini coefficients and the development indices.

To sum, we see at most modest correlation between income inequality and various human development indicators (range for unweighted r: 0.029 to 0.492; range for weighted r: 0.028 to 0.639). Unweighted and unweighted estimates show inconsistent direction of association for most indicators.

Table 4. Pearson correlation coefficients between 2006 Gini coefficient[+] and selected indicators.

Indicators	Unweighted	p-value	Weighted	p-value
Economic				
GDP growth rate 2000-04	-0.240	0.007	0.060	0.509
GNI per capita PPP$ 2004	-0.352	0.000	-0.115	0.204
Direct foreign investment 2004	-0.131	0.147	0.120	0.184
Mortality				
Crude Death Rate 2004	0.200	0.025	-0.064	0.476
Maternal Mortality Ratio 2000	0.324	0.000	-0.123	0.171
Infant Mortality Rate 2004	0.350	0.000	-0.099	0.270
Under 5 mortality rate 2004	0.337	0.000	-0.082	0.362
Adult mortality rate (male) 2002-04	0.466	0.000	0.106	0.240
Adult mortality rate (female) 2002-04	0.490	0.000	0.108	0.229
Life expectancy at birth 2004	-0.446	0.000	-0.028	0.760
Health				
% underweight 1995-2004	-0.063	0.549	-0.639	0.000
% stunted 1995-2004	0.029	0.789	-0.556	0.000
% undernourished 2001-03	0.226	0.023	-0.259	0.009
% vaccinated against measles 2004	-0.346	0.000	0.256	0.004
% vaccinated against DPT 2004	-0.340	0.000	0.221	0.014
% with access to safe water	-0.184	0.059	-0.130	0.183
Work and Education				
Unemployment rate 2004	0.224	0.031	0.175	0.094
% enrolled primary 2004	-0.158	0.106	0.116	0.235
% enrolled secondary 2004	-0.492	0.000	-0.230	0.025
Over-all Development				
GDI 2001	-0.345	0.000	0.101	0.276
HDI 2001	-0.365	0.000	0.080	0.375

[+] 2006 indicates year of publication, not survey year.

Association between income inequality and selected development indicators:

Regression coefficients

Table 5 presents crude (model 1) and income group adjusted (model 2) regression coefficients weighted by population size for the association between gini coefficient and selected indicators annual GDP growth rate, maternal mortality rate, percent undernourished, unemployment rate, GDI and HDI. Of these associations, only the negative coefficient of inequality and percent undernourished is statistically significant; for every 0.1 increase in gini coefficient, rate of undernourishment in the population decreased by about 3.2 percent. However, when a dummy variable for income group was included in the model, we find that the association with undernourishment is reversed and becomes statistically not significant. Further, we find that inequality significantly decreases GDP growth rate and increases maternal mortality ratio. For every 0.1 increase in gini coefficient, annual GDP growth rate decreases by 0.78 and maternal mortality ratio increases by 89 per 100,000 live births. Unemployment rate, GDI and HDI levels were not found to be associated with the level of inequality in both models.