

Background Paper

New Estimates of Extreme Poverty for Children

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with

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Abstract

This paper uses household surveys from 89 countries to estimate the rate of extreme poverty among children in the developing world. The estimates are based on the same surveys and welfare measures as official World Bank poverty estimates. Of children under age 18 years, 19.5 percent are estimated to live on less than \$1.90 per day, as opposed to 9.2 percent of adults ages 18 and above. Poverty rates are high for children ages 0 to 4 years, slightly

higher among ages 5 to 9 years, and steadily decline for successively older age groups. The analysis also examines the sensitivity of age-based poverty estimates to the use of alternative household equivalence scales when adjusting the international poverty line accordingly. Child poverty rates remain above 17 percent, and are greater than adult poverty rates, for all reasonable two-parameter equivalence scales.

This paper is a product of the Poverty and Equity Global Practice Group. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The authors may be contacted at dnewhouse@worldbank.org.

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New Estimates of Extreme Poverty for Children ¹

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1. Introduction

A wealth of evidence indicates that early childhood investments in human capital are critical for improving productivity and living standards. Poor families, however, often cannot afford to make these crucial investments in childhood health, nutrition and education. In part to monitor the extent to which poverty constrains human capital investment, the Sustainable Development Goals place particular emphasis on disaggregating poverty and other measures of welfare by age. This paper does so for children, in the context of the first Sustainable Development Goal, which aims to “By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.90 a day.”

How many of the extreme poor population are children and what are their characteristics? Unfortunately global child extreme poverty estimates, unlike global counts, are only calculated and published sporadically. Batana et al (2013), estimate extreme child poverty rates using household survey data from 73 countries, collected between 1992 and 2005. That study estimates that 38.4 percent of children younger than 18 lived on less than \$1.25 per day in 2000, as compared with 31.4 percent of people overall. Meanwhile, Olinto et al (2013) use data from 73 countries between 2000 and 2009, to which they apply the prevailing headcount poverty rates for 2010, measured using the 2005 Purchasing Power Parity (PPP) exchange rates. Their analysis finds that children under 18 comprise 47 percent of the poor, and that the poverty rate among children aged 12 and under in the developing world is 32 percent, compared to 19 percent for persons 13 years and older. Evans and Palacios (2015) apply a relative poverty line to a sample of 65 developing countries and find that on average children under 15 comprise 36 percent of the poor. Recent estimates by Watkins and Quattri (2016) were obtained by multiplying, for each country, the fraction of the population that are children times the number of poor, with an adjustment to account for the higher fertility rate among the poor. This yielded an estimate of 409.4 million children living in extreme poverty in 2012, implying that children comprised 45.6 percent of the poor. This figure, which was subsequently published by UNICEF (2016), could underestimate the extent of child poverty, by not fully adjusting for children’s higher poverty rates.² Overall, existing estimates vary considerably in their source data and age cut-offs, with corresponding differences in results.

This paper makes two main contributions. First, it presents new estimates of child poverty as of 2013, for a sample of 104 surveys collected since 2009 in 89 developing countries. These estimates define children as those below the age of 18, in accordance with the Convention of The Rights of The Child.³ These estimates of child poverty are the first estimates calculated using the Global Micro Database (GMD), which adds a set of harmonized household characteristics to the same surveys and welfare measures that are used to produce the poverty estimates published by the World Bank (Castañeda et al 2016). The 89 countries included in the database contain an estimated 84.2 percent of the population in the developing world, and 82.1 percent of the child population. Second, this analysis tests the robustness of age-group poverty rates with respect to different equivalence scales, while appropriately adjusting the poverty line to take into account the composition of families near the poverty line (Ravallion, 2015).

² The fertility adjustment was made on the basis of separate data from Demographic and Health Surveys. See Watkins and Quattri (2016), p.34.

³ Convention on the Rights of the Child, Part I, Article 1: “For the purposes of the present Convention, a child means every human being below the age of eighteen years unless under the law applicable to the child, majority is attained earlier.”

Poverty is defined based on whether per capita household welfare, converted to international dollars using the revised 2011 PPP conversion factors, falls below the \$1.90 per day poverty line (Ferreira et al, 2015).⁴ We consider all children in poor households to be poor and all children in non-poor households to be non-poor; therefore, as is standard, child poverty is defined as the percentage of children that live in poor households. This assumes all household members enjoy the same standard of living, which as discussed in section four below, may understate the full extent of child poverty.

The face of poverty is young, as children ages 0 and 17 comprise just over half the number of extreme poor in the sample. Given that 767 million persons are estimated to be extremely poor in 2013, our best estimate is that 385 million of them are children. That is, 19.5 percent of all children in the sample are poor, as opposed to 12.5 percent of all persons and 9.2 percent of adults. Poverty rates are 21 percent for 0 to 4 year olds, increase slightly to 21.5 percent among 5 to 9 year olds, and then steadily decline for successively older age groups. The extreme poverty rate for adults is 9.2 percent. We also examine moderate poverty, defined as those living between \$1.90 and \$3.10 per day. The sum of extreme and moderate poverty rates is substantially higher for children, 44.5 percent live on less than \$3.10 per day, as opposed to 26.6 percent of adults.

These results, based on household welfare per capita, immediately raise the fundamental question of how child poverty rates depend on adjustments for differences across households in size and composition.⁵ Per capita measures give children the same weight as adults when assessing household needs, and do not allow for larger households to benefit from economies of scale. Relaxing each of these assumptions will lower poverty rates for children relative to adults; the former by mechanically assuming that children require less expenditure to meet their minimum needs, and the latter by reducing poverty rates in larger households, which tend to have more children. Previous research by Batana et al suggested that extreme poverty rates for children in 2000 would fall drastically, from 38 percent to between 3 and 5 percent if different equivalence scales were used in place of the per-capita assumption (Batana et al, 2008).

This apparent sensitivity of child poverty rates to the choice of equivalence scale, however, results from a misleading comparison. The \$1.90 per day poverty line is a per capita line derived from the national poverty lines of 15 poor countries, which in turn are each developed using per capita consumption as the welfare measure (Ravallion, Chen, and Sangraula, 2009). When examining the sensitivity of child poverty rates to alternative household equivalence scales, welfare measured in terms of equivalent adults is more meaningfully compared with a poverty line adjusted using the same equivalence scale, based on the composition of a typical poor family (Ravallion, 2015). After adjusting the poverty line accordingly, poverty rates among children are only modestly sensitive to the choice of equivalence scale, and remain substantially higher than adult poverty rates for all reasonable “two parameter” equivalence scales.⁶

⁴ Poverty and extreme poverty are used interchangeably and both refer to welfare, measured in money-metric terms, falling short of the \$1.90 line. While poverty is recognized to be multi-dimensional, the use of a money-metric poverty line avoids the severe challenges in aggregating different dimensions of wellbeing into a common index (Thorbecke, 2007).

⁵ There is an extensive literature on the topic of household equivalence scales, but foundational articles include Deaton and Muelbauer (1986), and Pollak and Wales (1979), among many others.

⁶ Two parameter scales are characterized by an alpha that defines the unique scale factor applied to children when calculating adult equivalence, and a theta that adjusts for household economies of scale.

The rest of this paper proceeds as follows. The next section describes the data and the methodology. The third section presents basic results on extreme poverty rates by age, and how these are divided by region and country. The following section considers how the estimated poverty rates for adults and children change when using different household equivalence scales, while the fifth and final section concludes.

2. Data and methodology

The analysis on child poverty presented below is derived from a combined sample of 104 surveys containing records on 7.7 million individuals from 89 developing countries, taken from the September 2016 vintage of the Global Micro Database (GMD). The GMD is a collection of globally harmonized household survey data recently developed by the Data for Goals group of the World Bank's Poverty and Equity Global Practice. Full details on the background of the GMD are given in Castañeda et al (2016). A crucial feature of the GMD is that the welfare aggregates are the same as those used to compute the poverty estimates published by PovcalNet and the World Development Indicators.⁷ These aggregates are based on household per capita income or consumption, depending on which concept is used to measure national poverty in a particular country. The sample of GMD used in this analysis consists of surveys collected in 2009 or later. The year 2009 was selected to balance the competing goals of increasing coverage while minimizing error due to extrapolating poverty figures forward when lining up to 2013.

Table 1 shows the sample's coverage in number of countries, of population and of child population, based on figures from the UNDESA Population Division. The bottom panel indicates that countries in the sample have a total population of 5.25 billion persons and 1.69 billion children. This represents around 82 percent of the developing world's child population in 2013, which was 2.05 billion. 85.4 percent of the 767 million extreme poor reported in PovcalNet are contained in the GMD sample.

Table 1: Coverage of PovcalNet and GMD. Population and Child Population in 2013

	World	Developing countries	GMD sample
Number of countries	214	190	89
Population (millions)	7157.3	6233.7	5249.1
Children (millions)	2239.6	2052.5	1686.1
Extreme poor (millions)	766.7	766.7	655.0
Percent of children that are poor			19.5%
Percent of extreme poor that are children			50.2%
Extremely poor children (millions)	384.9	384.9	328.7

Notes: See Appendix 1. The estimated number of extremely poor children is obtained by multiplying the total number of extreme poor by the percent of extreme poor in the sample that are children. As in PovcalNet, developed countries are assumed to contain no extremely poor persons.

⁷ The term welfare refers to either income or consumption per capita, depending on which measure is used by the country for their national estimates. For more information on how these welfare aggregates are constructed, see Ferreira et al (2015)

Table 2 shows the number of countries and associated populations in the GMD sample used for the analysis. In terms of child population, the GMD sample has high regional coverage of developing countries in South Asia, Latin America, Europe and Central Asia, and East Asia and the Pacific (above 84 percent); partial coverage of Sub-Saharan Africa (74 percent); very low coverage of Middle East and North Africa (3.9 percent); and no coverage of North America. As a result, the distribution of children by region is close to that of the world, but the sample heavily underrepresents the Middle East and North Africa (0.4 vs 6.9 percent) and slightly underrepresents Sub-Saharan Africa (20.7 vs 23 percent). South Asia is moderately overrepresented in the sample, as it accounts for 35.7 percent of the sample as opposed to 30.2 percent of the developing world child population. Because of underrepresentation in Middle East and North Africa we follow the World Bank and do not report that region separately in the results. However, this region accounts for a very low percentage of the extreme poor and therefore has a minor impact on the results.⁸

Table 2: Population and Child Population distribution in Sample of Global Micro Database, by income group, region and welfare type

	Number of countries	Population (millions)	Share of sample population (%)	Population of children (millions)	Share of sample child population (%)	Share of developing world child population represented in sample (%)
	89	5249.1	100.0	1686.1	100.0	82.1
Income Group						
Low Income	21	628.5	12.0	294.5	17.5	76.4
Lower Middle Income	29	2281.2	43.5	837.6	49.7	86.3
Upper Middle Income	26	2071.8	39.5	500.2	29.7	82.4
High Income	13	267.5	5.1	53.8	3.2	60.7
Region						
East Asia & Pacific	11	1889.3	36.0	458.7	27.2	89.9
Europe and Central Asia	24	424.7	8.1	93.8	5.6	84.5
Latin America & Caribbean	18	550.3	10.5	176.9	10.5	89.6
Middle East & North Africa	3	16.3	0.3	5.6	0.3	3.9
South Asia	7	1667.1	31.8	601.7	35.7	97.1
Sub-Saharan Africa	26	701.4	13.4	349.4	20.7	74.1
Welfare Type						
Consumption	59	4497.1	85.7	1452.5	86.1	N/A
Income	30	752.0	14.3	233.6	13.9	N/A

Source: GMD, UNDESA, WDI

⁸ In 2008, the most recent year MENA estimates are reported, the region accounted for 0.7 percent of the total number of extreme poor.

When classifying countries by income group, the sample has high coverage of low and upper middle income countries (more than 82 percent), partial coverage of low income countries (76 percent) and low coverage of high income countries. The two types of countries most underrepresented in the data – those in the Middle East and North Africa and high income countries – tend to have low poverty rates. Therefore, the sample overstates developing world poverty rates in the aggregate, though it is less clear how omitting these countries affects the comparison between child and adult poverty rates; this will be explored in future work. All subsequent tables and figures in this report are based on the GMD sample presented in Table 2.

The GMD sample is lined up to represent estimates of extreme poverty in 2013. Lining up the welfare aggregates in surveys to a common year makes them more comparable across countries, since the underlying surveys in both PovcalNet and the GMD were conducted in various years. Between 2009 and 2014, population generally increased and poverty generally fell; therefore failing to line up poverty estimates to a common year would give older surveys less weight overall, but greater weight when generating profiles of the global poor. Lining up the survey data to 2013 entails adjusting both the population and the poverty estimates. To adjust the population, we utilize population projections for each gender and age group provided by the United Nations Population Division (UNDESA), which are available by gender and five-year age cohort. As a result of the line-up, the sum of the survey weights for each gender and age group within each country match UNDESA's reported population of that group in 2013.⁹ The poverty estimates are constructed to equal those published by PovcalNet for each country. Full details of this 'lining up' procedure are given in Castañeda et al 2016.

Poverty rates among children and adults

How do the prevalence and depth of extreme poverty differ by age in the sample of 89 countries? Table 3 gives the prevalence results, which are striking. More than half of the extreme poor are children (aged under 18), even though children only comprise a third of the sample population. Among the extremely poor, children outnumber prime-age adults (aged 18-59) by a factor of 1.14, and the number of elderly aged 60 or more by a factor of 8.6. The extreme poverty rate for children is 19.5 percent, compared to 9.2 percent for adults, 9.5 percent for prime-aged adults aged 18-59, and 7 percent for people aged 60 or more. The large number of poor children reflects both the large share of youth in the population (32 percent) as well as high rates of child poverty (19.5 percent).

Poverty rates among children rise slightly for young children, then decline as age group increases. Children aged 5 to 9 are most likely to be poor, at 21.5 percent, followed by children age 0 to 4 at 21 percent, 18.7 percent of 10 to 14 year olds, and 14.6 percent of the oldest group of children aged 15 to 17. Lower poverty rates among older children may stem from the lifetime earning cycle of their parents (older parents with more working experience tend to earn higher income), the labor force participation of spouses and older children, and fewer dependants, although further investigation would be required to determine their relative importance.

⁹ These population estimates are for five-year age groups; we distribute the population uniformly across years of age within these groups.

Table 3: Population by age groups and extreme poverty

	Extreme poor (millions)	Headcount poverty rate	Share of extreme poor (%)	Share of population (%)
GMD Sample of developing countries				
Children 0-17	328.7	19.5	50.2	32.1
<i>Children 0-4</i>	<i>104.0</i>	<i>21.0</i>	<i>15.9</i>	<i>9.4</i>
<i>Children 5-9</i>	<i>101.1</i>	<i>21.5</i>	<i>15.4</i>	<i>9.0</i>
<i>Children 10-14</i>	<i>84.4</i>	<i>18.7</i>	<i>12.9</i>	<i>8.6</i>
<i>Children 15-17</i>	<i>39.1</i>	<i>14.6</i>	<i>6.0</i>	<i>5.1</i>
Adults (18 or more)	326.3	9.2	49.8	67.9
<i>Adults 18-59</i>	<i>288.1</i>	<i>9.5</i>	<i>44.0</i>	<i>57.6</i>
<i>Adults 60 or more</i>	<i>38.2</i>	<i>7.0</i>	<i>5.8</i>	<i>10.3</i>
Total	655.0	12.5	100.0	100.0

Source: GMD, UNDESA, WDI, PovcalNet

While these differences in poverty rates by age group are large, how precisely are they estimated? The sample consists of a roughly 7.7 million observations on individuals, randomly selected under each survey's design from a population of about 5.3 billion people living in the 89 countries included in the sample. Estimating proper standard errors, however, is complicated by the absence of identifiers for the primary sampling units for many of the surveys in the GMD. Without these identifiers, it is impossible to properly adjust for survey design when calculating standard errors and to give confidence intervals for the full sample. Therefore, Table 4 reports confidence intervals around average poverty estimates by age group, for the 49 countries for which the primary sampling units (PSU) can be identified. Average poverty rates are significantly higher in this subsample. The size of the confidence interval tends to be modest, however, ranging from 1 to 1.5 percentage points. A back of the envelope estimate is that the use of this subsample of 49 countries, instead of the full sample of 89, inflates the estimated size of the confidence interval by 1.42.¹⁰ This implies that the corresponding confidence intervals for the full sample would range from approximately 0.5 to 1 percentage point. With the exception of the small difference in poverty rates between the two youngest age groups, we therefore conclude that the declines in aggregate estimated poverty rates by age group reported in Table 3 are all statistically significant.

The welfare disadvantage faced by children, relative to adults, is also reflected in Figures 1 and 2, which give the cumulative and probability density functions of welfare by age group. Figure 1 indicates that the distribution for adults stochastically dominates that of children, meaning that poverty rates for children are higher at any poverty line. Furthermore, although the differences are smaller, children 10-17 are slightly better off than younger children throughout most of the distribution. Finally, Figure 2 demonstrates the fat left tail of the child welfare distribution, and the large mass of children that live on slightly less than the \$3.10 per day moderate poverty line.

¹⁰ 1.42 is approximately equal to the square root of the ratio of the number of observations in the full sample (7.7 million) to the number of observations in the subsample used in Table 9 (3.8 million). The square root of the ratio of 89 countries in the full sample to 49 in the subsample is 1.35. This estimate assumes that the samples in the 49 countries with PSI identifiers are on average as precise as the 40 that are missing this information. In addition, it slightly overstates the size of the confidence interval by failing to account for the slight gain in precision that would arise due to the lower estimated poverty rate in the full sample.

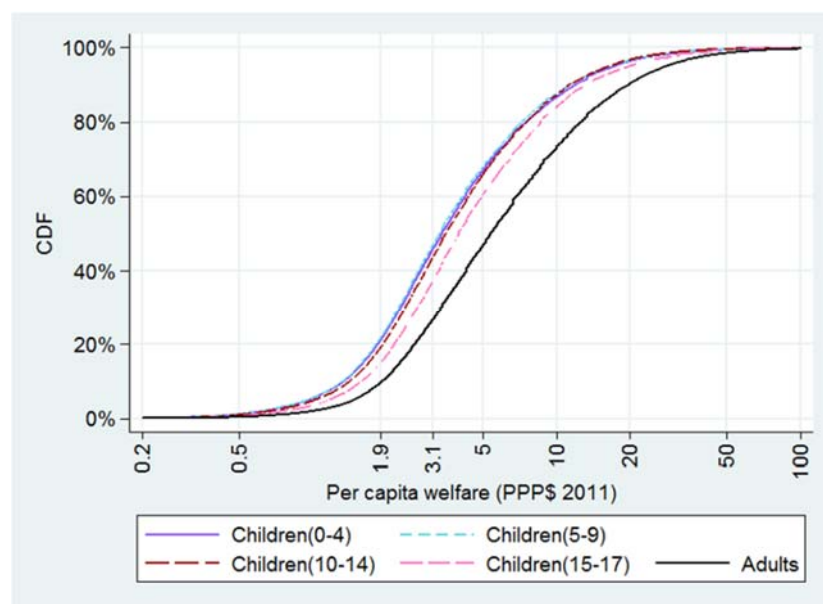
Table 4: Confidence Intervals for a subsample of 49 countries

	Headcount poverty rate (%)	Confidence interval (95%)		Observations	Population in GMD subsample with PSU (millions)
Children 0-17	26.9	26.4	27.4	1,459,342	1102.7
<i>Children 0-4</i>	<i>29.0</i>	<i>28.3</i>	<i>29.7</i>	<i>389,896</i>	<i>327.1</i>
<i>Children 5-9</i>	<i>29.3</i>	<i>28.7</i>	<i>30.0</i>	<i>426,571</i>	<i>312.4</i>
<i>Children 10-14</i>	<i>25.4</i>	<i>24.8</i>	<i>25.9</i>	<i>409,576</i>	<i>296.9</i>
<i>Children 15-17</i>	<i>20.9</i>	<i>20.3</i>	<i>21.4</i>	<i>233,299</i>	<i>166.2</i>
Adults	15.6	15.3	16.0	2,337,209	1770.2
<i>Adults 18-59</i>	<i>16.1</i>	<i>15.7</i>	<i>16.4</i>	<i>1,985,682</i>	<i>1540.9</i>
<i>Adults 60 or more</i>	<i>12.8</i>	<i>12.3</i>	<i>13.3</i>	<i>351,527</i>	<i>229.3</i>
Total	20.0	19.6	20.4	3,796,551	2872.9

Source: GMD, UNDESA, WDI, PovcalNet

Note: Includes 49 countries for which primary sampling unit is available for all observations. See Appendix 1. For Nicaragua and Peru we use only the surveys of 2009 and 2012, respectively, not the 2014 survey.

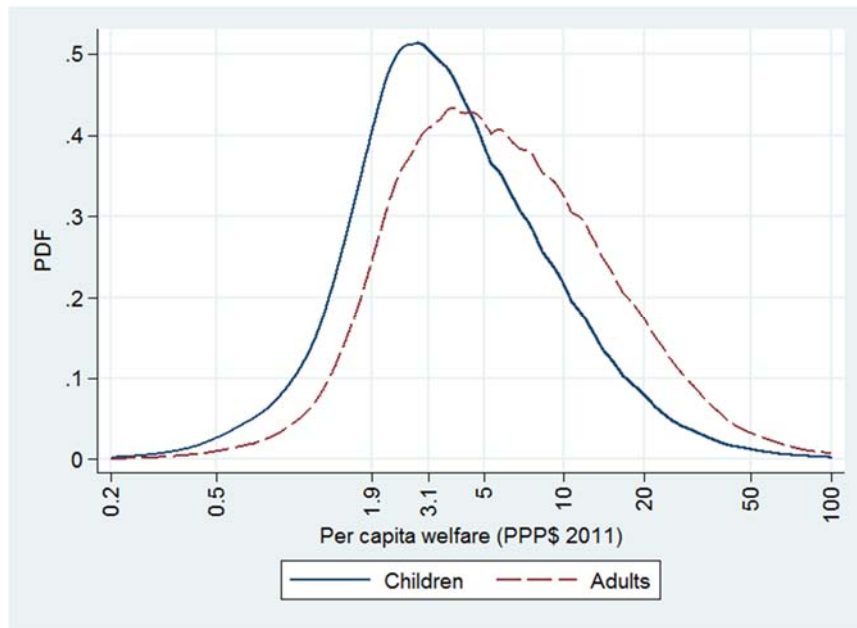
Figure 1: Cumulative density function of household per capita welfare, by age group



Source: GMD, UNDESA, WDI, PovcalNet

Note: Per capita welfare lower than PPP\$0.2 or higher than PPP\$100 have been excluded from the graph for presentation. Bangladesh, Cambodia, Jordan and Lao PDR have been excluded from graph since there is no information of PPP for 2011 for these countries.

Figure 2: Probability density function of log-welfare of children (0 to 17) and adults



Source: GMD, UNDESA, WDI, PovcalNet

Note: Per capita welfare higher than PPP\$0.2 or lower than PPP\$100 have been excluded from the graph for presentation.

Bangladesh, Cambodia, Jordan and Lao PDR have been excluded from graph since there is no information of PPP for 2011 for these countries.

The analysis so far has only considered headcount poverty rates, which fail to consider how far children and adults lie below the poverty line relative to adults. An alternative measure, the relative poverty gap, is equal to the following:

$$(1) P_1 = \frac{1}{N} \sum_{i=1}^{EP} \frac{(1.9 - y_i)}{1.9}$$

where P_1 is the relative poverty gap measure, y_i is the per capita expenditure of individual i , N is the number of individuals in the country, and EP is the number of people that are extremely poor. In other words, poverty gaps measure the distance from individuals' welfare to the poverty line, positive for the poor and zero for the non-poor.

The average poverty gap is reported in Table 5 both in absolute terms and, following equation (1), as a percentage of the poverty line. Over the entire sample, the average poverty gap in PPP terms is 7 cents, with the child poverty gap at 11 cents and adult poverty gap at 5 cents. The corresponding relative poverty gaps are 3.7 percent overall, 2.6 percent for adults, and 6 percent for children. When weighing by population shares, children account for over half (52.4 percent) of the total poverty gap, with infants 0-4 contributing almost 17 percent. Summing across the population, the poverty gap amounts to \$212 million for children, which is about the same as the total gap for adults. In short, the larger headcount rates observed for children are also reflected in larger poverty gaps.

Table 5: Mean welfare and poverty gaps

	All	Adults (18 or more)	Children (0-17)	Infants (0-4)
Poverty Gaps				
Mean poverty gap (PPP\$ per capita per day)	\$0.07	\$0.05	\$0.11	\$0.12
Relative poverty gap index (% of poverty line)	3.7	2.6	6.0	6.6
Population weighted relative poverty gap index (%)	3.7	1.8	1.9	0.6
<i>contribution of each group to relative poverty gap index (%)</i>	100.0	47.6	52.4	16.8
Welfare of the poor (PPP\$ per capita per day)				
Mean welfare of extreme poor	\$1.34	\$1.35	\$1.32	\$1.31
<i>as percentage of PPP\$1.90 poverty line</i>	70.4	71.3	69.5	69.1
Median welfare of extreme poor	\$1.42	\$1.44	\$1.40	\$1.39
<i>as percentage of PPP\$1.90 poverty line</i>	74.9	76.0	73.5	73.0
Aggregate poverty gap (millions PPP\$)				
Per day	364.0	172.1	191.9	61.8
Per year	132,862	62,821	70,041	22,548
Headcount poverty rate (%)	12.5	9.2	19.5	21.0
Number of poor (millions)	655.0	326.3	328.7	104.0
Total population (millions)	5249.1	3563.0	1686.1	495.3

Source: GMD, UNDESA, WDI, PovcalNet

Finally, we examine the incidence of poverty defined according to a higher poverty line of \$3.10 per day (2011 PPP). Table 6 displays the results, which corroborate Figures 1 and 2 in showing the high rates of poverty among children at the higher poverty line. Over 44 percent of all children age 0-17 live on less than \$3.10 per day, as opposed to 26.6 percent of all adults. Furthermore, children make up about 44 percent of all extremely or moderately poor, even though they comprise less than a third of the global population.

Table 6: Extreme or moderate poverty for adults and children

	Moderate or extreme poor (millions)	Moderate or extreme headcount poverty rate (%)	Share of moderate or extreme poor (%)	Share of sample population (%)
Children 0-17	749.6	44.5	44.2	32.1
Adults 18 and above	947.2	26.6	55.8	67.9
Total	1696.9	32.3	100.0	100.0

Source: GMD, UNDESA, WDI, PovcalNet

Note Moderate or extreme poverty rate includes all children living in households with welfare per capita lower than \$3.10 per day. The 750 million extreme or moderate poor children shown in the table include the 329 million extremely poor children.

3. Child poverty by country characteristics and region

How are these high rates of child poverty distributed across countries, regions, and country income groups? As seen in Table 7, the vast majority – 94 percent – of poor children live in low income or lower middle income countries; India alone accounts for nearly 30 percent of all poor children. Not

surprisingly, child poverty rates are highest in low-income countries, where 41.6 percent of children are extremely poor. The percentage decreases to 22.2 percent for lower middle income countries and 3.9 percent for upper middle income countries.

Table 7: Extreme child poverty by country income status (India and China shown separately)

	Extreme poor children (millions)	Children headcount poverty rate (%)	Share of extremely poor children (%)	Share of sample child population (%)
Low income	122.6	41.6	37.3	17.5
Lower middle income	186.3	22.2	56.7	49.7
<i>Of which: India</i>	99.7	22.1	30.3	26.8
Upper middle income	19.5	3.9	5.9	29.7
<i>Of which: China</i>	5.8	2.0	1.8	16.7
High income	0.3	0.6	0.1	3.2
Total	328.7	19.5	100.0	100.0

Source: GMD, UNDESA, WDI, PovcalNet

Note: Totals reflect sample of 89 countries.

Table 8 shows similar figures by region. Sub-Saharan Africa (SSA) stands out as the region with the highest child poverty rate, at 48.7 percent. Over half, 51.7 percent of all extremely poor children in the sample, live in an SSA country, despite the region only containing 20 percent of the child population. Poverty rates in South Asia (SAR) are also high, as 19.7 percent of the children in the region are poor. SSA and SAR, combined, account for over 87 percent of the extremely poor children. While there are 170 million poor African children in the sample, this seriously understates the true number of poor children in Africa because the sample covers only 26 of the 48 countries, or 74 percent of the children, in the region. If the African child poverty rate were applied to all African countries, the estimated number of poor children in SSA would rise to 229 million.

Table 8: Extreme child poverty by country region (India and China shown separately)

	Extreme poor children (millions)	Children headcount poverty rate	Share of extremely poor children (%)	Share of sample child population (%)
East Asia Pacific	25.6	5.6	7.8	27.2
<i>which includes China</i>	5.8	2.0	1.8	16.7
South Asia	117.2	19.5	35.7	35.7
<i>which includes India</i>	99.7	22.1	30.3	26.8
Sub-Saharan Africa	170.0	48.7	51.7	20.7
Latin America and Caribbean	14.3	8.1	4.4	10.5
Europe and Central Asia	1.3	1.4	0.4	5.6
Total	328.7	19.5	100.0	100.0

Source: GMD, UNDESA, WDI, PovcalNet

Countries affected by fragility, conflict and violence are likely to have factors that increase poverty risk, due to lower and interrupted economic development and problems of governance. These factors also affect the availability and regularity of household surveys that are used to measure poverty. The GMD sample does however allow a simple comparison of countries that have ‘fragile’ status and others. Table 9 shows that extreme child poverty in such countries is nearly 58 percent, which is much higher than the 17 percent rate in other, ‘non-fragile’ countries.

Table 9: Extreme Child Poverty and Shares in Fragile States

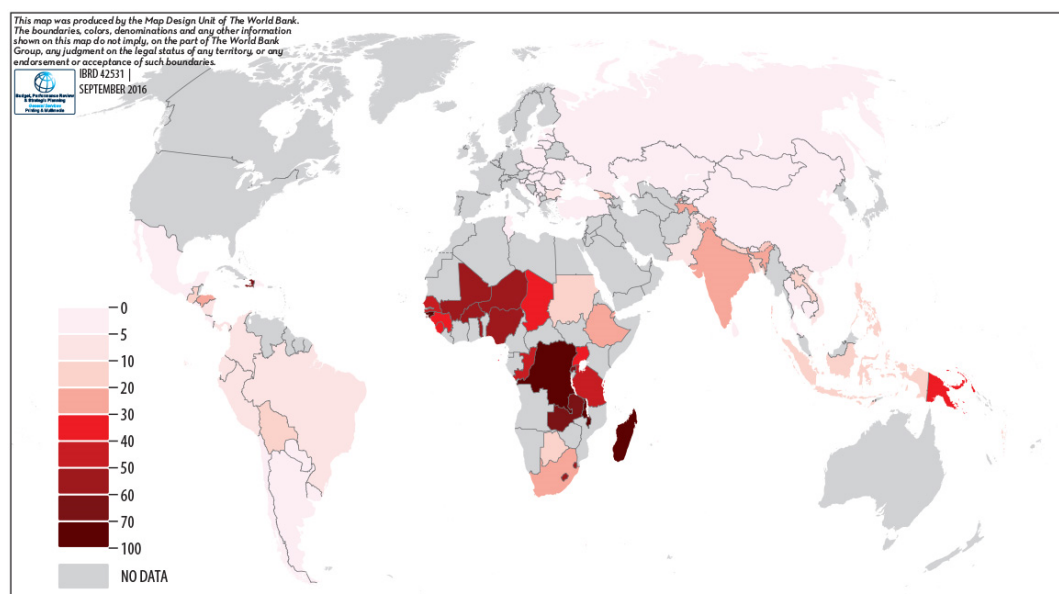
	Number of countries	Extreme poor children (millions)	Children headcount poverty rate (%)	Adults headcount poverty rate (%)	Share of extremely poor children (%)	Share of child population (%)
Not fragile states	78.0	272.1	17.1	8.1	82.8	94.2
Fragile states	11.0	56.5	57.7	46.7	17.2	5.8
Total	89.0	328.7	19.5	9.2	100.0	100.0

Source: GMD, UNDESA, WDI, PovcalNet

Notes: Coverage of fragile states in GMD represents under half of all children living in fragile states (98 of 217 million) and these estimates should be interpreted accordingly. Fragile states included are: Chad, Dem. Rep. Congo, Guinea-Bissau, Haiti, Kosovo, Madagascar, Mali, Sierra Leone, Sudan, Togo, West Bank and Gaza. Fragile states without information are: Afghanistan, Bosnia and Herzegovina, Burundi, Central African Republic, Comoros, Cote d'Ivoire, Eritrea, The Gambia, Iraq, Kiribati, Lebanon, Liberia, Libya, Marshall Islands, Micronesia, Myanmar, Solomon Islands, Somalia, South Sudan, Syrian Arab Republic, Timor-Leste, Tuvalu, Yemen, and Zimbabwe.

Taking a global view of the country-level situation for extreme child poverty, Figure 3 displays a map of the estimated headcount ratio of every country in the sample, and confirms that child poverty rates tend to be highest in Sub-Saharan Africa, particularly central Africa, with significantly lower rates in much of South Asia, followed by the rest of the developing world.

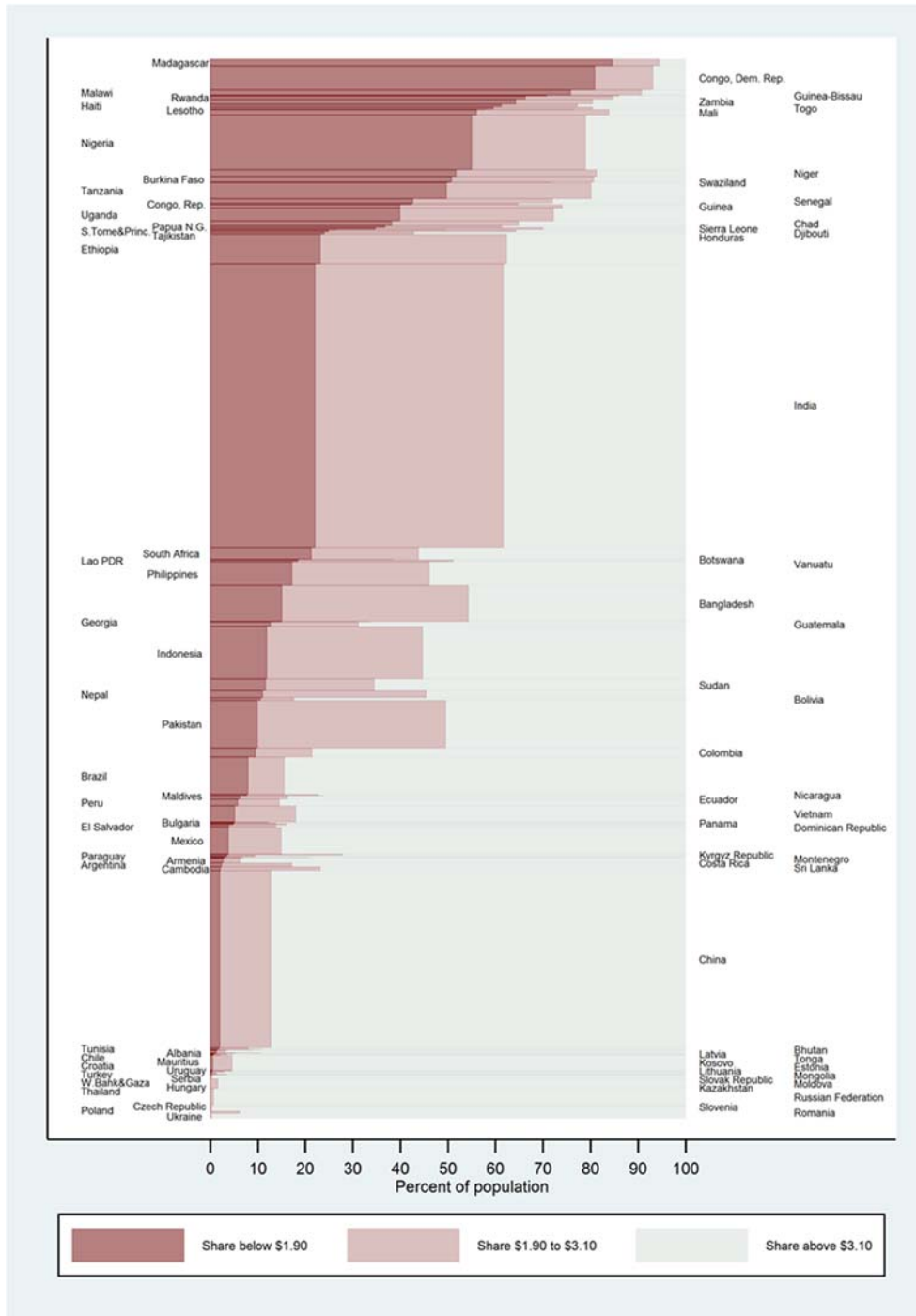
Figure 3: Map of extreme child poverty rates by country



Source: GMD, UNDESA, WDI, PovcalNet

Looking more closely at child poverty rates by country, Figure 4 presents estimates of extreme and moderate headcount rates by country, in descending order of most to least poor.

Figure 4: Share of children that are extremely poor, moderately poor, and non-poor, by country



Source: Global Micro Database and Povcalnet

Notes: Extreme poverty is defined as household per capita income or consumption less than \$1.90. Near-poverty is defined as those between \$1.90 and \$3.10, and non-poor is defined as those living on \$3.10 or more per day.

The vertical size of the rectangle for each country in Figure 4 is proportional to the size of the population. Madagascar has the largest estimated extreme poverty rate for children, followed by the Democratic Republic of Congo, Malawi, Guinea-Bissau, and Zambia. At the bottom are the high income countries included in the sample for ‘developing countries’. India stands out due to its large population and high estimated incidence of extreme and moderate poverty rates for 2013 – respectively 22 percent and 39.6 percent – among children.

Poor children tend to live in large households, as two out of three extremely poor children live in households with six or more members; more than one-third in large households of 8 or more (Table 11). The poor are overrepresented in the latter group, which contains less than 20 percent of the child population.

Table 11: Extreme child poverty by household size

Household size (number of members)	Extreme poor children (millions)	Children headcount poverty rate	Share of extremely poor children (%)	Share of child population in sample (%)	Percentage of children in group
Three or less	13.9	5.5	4.2	14.9	15.5%
Four	33.7	9.0	10.2	22.3	33.8%
Five	53.2	16.2	16.2	19.5	36.7%
Six	59.4	23.5	18.1	15.0	41.2%
Seven	49.1	30.3	15.0	9.6	45.2%
Eight	39.3	36.1	12.0	6.5	47.1%
Nine	26.3	38.6	8.0	4.1	48.2%
Ten or more	53.7	38.8	16.3	8.2	49.1%
Total	328.7	19.5	100.0	100.0	32.1%

Source: GMD, UNDESA, WDI, PovcalNet

The increased risk of extreme child poverty from larger household size is however not clearly associated with ‘multi-generational’ households in which elderly people co-reside with their adult children and grandchildren, a far more common practice in developing countries. Table 12 shows that extreme child poverty rates do not differ greatly according to whether children live solely with prime age adults (often their parents), or in three-generation households, or live solely with elderly people. However, over three-quarters of extreme child poverty (78.5 percent) is in two-generation households, suggesting that large households in this group are a major factor in extreme poverty risk. Only a fifth of extremely poor children live in three-generation households. Overall, these patterns highlight the importance of the sensitivity tests of our results to assumptions about economies of scale of households’ expenditure in the next section.

Table 12: Extreme child poverty by Household Age Composition

	Extremely poor children (millions)	Children headcount poverty rate (%)	Adults headcount poverty rate (%)	Share of extremely poor children (%)	Share of sample child population (%)
2 generation (people aged 18-59 and children 0-17)	257.9	19.7	12.5	78.5	77.5
Elderly and children (people aged >=60 and 0-17)	3.0	21.0	13.4	0.9	0.9
Three generation (people aged >=60, 18-59, and 0-17)	67.1	18.8	13.0	20.4	21.1
Only children	0.6	7.4	.	0.2	0.5
Total	328.7	19.5	9.2	100.0	100.0

Source: GMD, UNDESA, WDI, PovcalNet

4. Sensitivity to alternative equivalence scales

The estimates of poverty by age group reported are based on per capita consumption, and therefore rest on the fundamental assumption that per capita consumption reflects individual economic welfare both within and across households. This assumption, while standard, has been widely questioned on three main grounds. First, it ignores potential disparities in resource allocation within the household. Since we do not have access to data from a large number of countries on consumption associated to specific household members, it is difficult to address this issue. However, failing to account for intra-household inequalities likely understates child poverty; Dunbar et al (2011) estimate that child poverty rates in Malawi would increase from 91.3% to 97.4% when unequal allocations within the household are considered. Similarly, Bargain et al (2013) find that per capita measures of consumption underestimate child poverty estimates for Côte d'Ivoire, especially for larger households, once both intra-household allocation and economies of scale are considered. Second, the use of per capita consumption ignores the relative difference in the costs of satisfying children's and adults' needs; specifically, food needs of children, especially younger children, are less than those of adults, although other needs of children, such as for schooling and healthcare may be higher. Finally, households with more members are able to achieve greater economies of scale on household goods such as rent, utilities, some durable goods, and other shared aspects of household activity and expenditure. Together, the latter two assumptions -- that adults and children have equal-cost relative needs and that there are no economies of scale -- have been relaxed by employing 'equivalence scales' that adjust household size, typically according to their member's age and the number of total members.¹¹ These equivalence scales are commonly expressed using two key parameters: α for the relative cost of children, and θ to control for economies of scale, according to the following formula:

$$(2) \quad m_h = (n_{ah} + \alpha n_{ch})^\theta$$

Where m_h is the number of equivalent adults in household h , n_{ah} is the number of adults in household h , and n_{ch} is the number of children in household h . The parameters α and θ can take values between zero and one; lower values of α are used to reflect children's lower expenditure needs relative to adults; lower

¹¹ Some equivalence scales also adjust for differing needs by gender and other factors such as disability.

values of θ express higher economies of scale in households' expenditure. When α and θ are set equal to one the number of equivalent adults is equal to the household size. Deaton and Zaidi (2002) emphasize the importance of checking for sensitivity to equivalence scale assumptions when comparing poverty estimates for different age-groups, specifically children. They suggest comparing poverty estimates for every sensible range of α and θ , we follow this approach.

There is a voluminous theoretical and empirical literature on setting and using equivalence scales and we do not address the ongoing debate on the appropriate choice of equivalence scales. Instead, we turn to the more recent and most directly relevant literature that has discussed how much equivalence assumptions affect the prevalence of 'extreme poverty' in cross-national profiles, the relative position of children versus other age groups in such profiles, and on testing alternative equivalence assumptions when assessing extreme poverty. Children most often live in large households in developing countries (Deaton and Paxson, 1998) and this makes an assessment of both household size and composition essential for robustness and sensitivity of results when considering sub-groups of population or international comparisons (Haughton and Khander 2009).

Accordingly, previous estimates of 'extreme poverty' by age have sought to assess how results change when employing different equivalence scales; Batana et al (2013) use three alternative scales to compare to the baseline per-capita equivalence assumption and find that child poverty rates fall dramatically in doing so. The comparisons reported in Batana et al, however, did not adjust the prevailing \$1.25 per day poverty line when utilizing different equivalence scale. This is problematic because the international poverty line, whether set at \$1.25 (2005 PPP) or \$1.90 (2011 PPP), are based on the national poverty lines of 15 poor countries expressed in per capita terms. (Ferreira et al, 2015) The selection of national poverty lines in each country is based on consumption patterns of households presumed poor by observing their caloric intakes, and not on the consumption of single-member households.

Ravallion (2015) notes that any comparison of per capita to adult-equivalent expenditure must choose a "pivot household", or a reference household for which consumption per adult equivalent remains unchanged independently of the parameters selected. By construction, a poor pivot household will remain considered poor regardless of the assumed parameters. In Batana et al (2015), the de facto pivot household was a single adult household. Ravallion (2015), following Deaton and Zaidi (2002), consider this assumption inadequate; he proposes "that the poverty comparisons should be anchored to the typical circumstances of households near the poverty line". He therefore proposes to use the demographic characteristics of a typical household in the neighbourhood of the poverty line to set a pivot household and adjust the international poverty line from per capita to adult-equivalent terms with each set of parameters.

We follow this approach to test the conclusion that child poverty rates remain higher than adult poverty rates under alternative equivalence scales. In particular, we examine the sensitivity of the extreme poverty estimates to both children's relative cost and household economies of scale (α and θ respectively). Households' equivalent size follows equation (2), with alpha and theta lying between zero and one. We test robustness with respect to six values of α and θ : 1, 0.8, 0.6, 0.4, 0.2, and 0.¹² We additionally test the

¹² On the extremes $\alpha=1$ assumes that children require the same consumption as adults to achieve the same utility, while $\alpha=0$ is a hypothetical case where children are "free". On the other side, $\theta=1$ assumes no public goods within

case where θ is equal to 0.5 and α is equal to 1, which corresponds to the “square root scale” recently used by the OECD.¹³ In total, we consider 32 unique values of α and θ that are tested, with results shown in Table 13.

The pivot household contains six people, three adults and three children. This corresponds to the median number of adults and children in households with welfare between \$1.70 and \$2.10 per day in the sample. In each of the 32 scenarios, the poverty line of \$1.90 is multiplied by the ratio of household size to the number of equivalent adults, for the pivot household. For example, the equivalent household size for a household with three adults and three children is 5.4 when $\alpha=0.8$ and $\theta=1$, as shown in row 2 of Table 15. Multiplying \$1.90 by 6 and dividing by 4.6 gives an effective poverty line for that equivalence scale of 2.1 which is then used to re-estimate child and adult headcount poverty rates.

The results of this sensitivity test confirm that children have higher poverty rates under every two-parameter equivalence assumption, apart from those estimated at the extreme assumption that children have no monetary welfare requirements, equivalent to an α parameter equal to zero. The estimated poverty rates, however, are always much greater than the very low headcount rates of between 6 and 3 percent reported by Batana et al (2013) who assume a pivot household of one adult. By adjusting poverty lines and reflecting indicative household composition at the margins of poverty, we find a lower bound child poverty headcount rate of between 17.2 to 20.9 percent across all values of α and θ of 0.2 or more. This lower bound of 0.2 is far lower than any commonly used equivalence scale and lower than any of the scales used by Batana et al (2013). Poverty rates using the “square root scale” of θ and α equal to 0.5 and 1, respectively, are 11.6 percent for adults and 18.6 percent for children. We therefore conclude that higher extreme child poverty rates are robust to any sensible two-parameter equivalence scale.

5. Conclusion

This paper presents new evidence on child poverty and its sensitivity to alternative adult-equivalence scales. The analysis is based on a data set of 89 countries taken from the Global Micro Database, a new database that adds harmonized household characteristics to the same surveys and welfare aggregates that are used to calculate official World Bank poverty estimates. The results confirm that children are disproportionately poor. The poverty rate among children in the sample aged 0 to 17 is estimated to be 19.5 percent, which is over twice the 9.2 percent rate for adults 18 and above. The estimated global poverty rate for 0 to 4 and 5 to 9 year olds is 21 and 21.5 percent, respectively, and declines for each successively for older age group. Furthermore, an estimated 44.5 percent of children live on less than \$3.10 per day, as opposed to 26.6 percent of adults.

the household (the consumption of one member prevents the consumption of another of the same good), while $\theta=0$ would imply that all goods consumed by the household are public goods.

¹³See: http://www.oecd.org/els/soc/CO_2_2_Child_Poverty.pdf

Table 13: Children and adults headcount poverty rates considering equivalence of scale

Parameters		Equivalence Adjusted		Headcount poverty rates (%)			
Theta	Alpha	Reference household equivalent size	Poverty line (PPP\$)	Total	Adults	Children	Difference (Child-Adult)
1.0	1.0	6.0	1.9	12.5	9.2	19.5	10.3
	0.8	5.4	2.1	12.8	9.9	19.1	9.2
	0.6	4.8	2.4	13.3	10.8	18.5	7.7
	0.4	4.2	2.7	14.1	12.3	17.9	5.6
	0.2	3.6	3.2	15.4	14.5	17.2	2.8
	0.0	3.0	3.8	17.1	17.4	16.4	-1.0
0.8	1.0	4.2	2.7	12.9	9.8	19.3	9.5
	0.8	3.9	3.0	13.2	10.5	19.0	8.5
	0.6	3.5	3.3	13.7	11.4	18.6	7.1
	0.4	3.2	3.6	14.4	12.7	18.1	5.4
	0.2	2.8	4.1	15.3	14.3	17.3	3.0
	0.0	2.4	4.7	16.6	16.7	16.5	-0.2
0.6	1.0	2.9	3.9	13.8	11.0	19.5	8.5
	0.8	2.8	4.1	14.1	11.7	19.3	7.6
	0.6	2.6	4.4	14.5	12.4	19.0	6.5
	0.4	2.4	4.8	15.1	13.4	18.6	5.2
	0.2	2.2	5.3	15.8	14.7	18.0	3.2
	0.0	1.9	5.9	16.6	16.3	17.0	0.7
0.5	1.0	2.4	4.7	14.4	11.9	19.7	7.8
0.4	1.0	2.0	5.6	15.1	12.8	20.1	7.3
	0.8	2.0	5.8	15.4	13.3	19.9	6.6
	0.6	1.9	6.1	15.8	13.9	19.8	5.9
	0.4	1.8	6.4	16.1	14.5	19.4	4.9
	0.2	1.7	6.8	16.5	15.4	19.0	3.6
	0.0	1.6	7.3	17.0	16.5	18.2	1.7
0.2	1.0	1.4	8.0	16.9	15.0	20.9	5.9
	0.8	1.4	8.1	17.1	15.3	20.9	5.6
	0.6	1.4	8.3	17.2	15.5	20.8	5.2
	0.4	1.3	8.6	17.4	15.8	20.6	4.8
	0.2	1.3	8.8	17.6	16.3	20.3	4.1
	0.0	1.2	9.2	17.7	16.7	19.7	3.0
0.0	1.0	1.0	11.4	18.8	17.4	21.9	4.6

Notes: Alpha refers to the scale factor applied to children under 18. Theta refers to the assumed household economies of scale. The reference household is the median number of adults and children of all households with welfare between \$1.70 and \$2.10 per day (in 2011 PPP terms). The reference household contains three adults and three children.

Source: GMD, UNDESA, WDI, PovcalNet

Where do poor children live? Child poverty rates, like those for adults, are much higher in rural areas. Nearly one out of three children in rural areas is extremely poor, and over 81 percent of poor children live in rural areas. Nearly 88 percent of poor children are located in Sub-Saharan Africa or South Asia, and child poverty rates tend to be much higher in Sub-Saharan Africa than in the rest of the developing world. This illustrates the magnitude of the challenge of ensuring that children in rural areas, and in Africa and South Asia, benefit from valuable early childhood investments in human capital.

A fundamental question involves the robustness of these estimates of child poverty with respect to the use of alternative equivalence scales. The new \$1.90 per day poverty line, like the \$1.25 line that it is based on, is a per capita line. It is derived from the national poverty lines of 15 poor countries, which in turn are each developed using per capita consumption as the welfare measure. Following Ravallion (2015), we apply alternative equivalence scales to both the consumption aggregate and the poverty line, for a typical household in the neighbourhood of the poverty line. After making this adjustment, child poverty rates are quite robust with respect to the choice of two-parameter equivalence scale. Child poverty rates do not dip below 17 percent until children are given one-fifth of the weight of adults to account for their lower expenditure needs, which is not realistic. In short, higher child poverty rates are robust to any sensible two-parameter equivalence scale.

The analysis leaves open three main areas for future work. First, we plan to explore the characteristics of poor children in greater detail, and analyse the variation across child poverty rates across countries and, wherever possible, to also consider non-monetary aspects of child poverty. Second, we plan to explore in detail the relationship between welfare and school attendance. This will help shed light on whether there is a particular level of welfare at which school attendance rises sharply, and how this varies for boys and girls at different ages. Finally, a limitation of the current data set is that the lack of temporal coverage limits the analysis to a single cross-section. Subsequent improvement in historical coverage will allow us to document trends in child poverty to better understand which countries and types of households have most rapidly reduced child poverty.

Appendix 1: Data and Statistical Appendix

Sample

The study uses a sample of 104 surveys from the September 2016 vintage of the Global Micro Database (GMD); only surveys between 2009 and 2014 are selected. The sample is composed of 89 developing countries. The GMD sample is lined up to represent the estimates of extreme poverty in 2013. When a survey of 2013 is unavailable, two surveys are selected, one before and one after 2013, and their results are weighted according to the relative distance to 2013 (Castañeda et al, 2016); if only surveys before 2013 are available, we use the latest available. The countries and years selected are showed in Table A1.

Table A1: Developing countries and survey years in GMD sample

Countries (89)	Survey years
Armenia, Bulgaria*, Chile, China, Czech Republic, Dominican Republic*, Estonia, Georgia*, Honduras*, Croatia, Hungary, Kazakhstan*, Kosovo, Lithuania, Latvia*, Moldova, Montenegro*, Pakistan*, Poland*, Romania*, Serbia, Slovak Republic, Slovenia*, Ukraine (24)	2013 only
Argentina, Bolivia, Brazil*, Colombia, Costa Rica*, El Salvador, Ecuador, Mexico*, Paraguay*, Peru*, Uruguay, Vietnam (12)	2012 and 2014
Guatemala*, Indonesia (2)	2011 and 2014
Nicaragua (1)	2009 and 2014
Albania*, Bhutan, Democratic Republic of the Congo*, Djibouti, Guinea*, Haiti, Kyrgyz Republic, Cambodia, Lao PDR, Mongolia, Mauritius*, Panama*, Philippines, Russian Federation, Sri Lanka*, Thailand, Turkey, Uganda* (18) 7	2012 only
Chad*, Republic of the Congo*, India*, Niger*, Senegal*, Sierra Leone*, Tanzania*, Togo* (8)	2011 only
Bangladesh*, Ethiopia*, Guinea-Bissau*, Lesotho*, Madagascar*, Malawi* , Mali*, Nepal*, Nigeria*, Rwanda*, São Tomé and Príncipe*, Tunisia, Vanuatu, South Africa*, Zambia* (15)	2010 only
Burkina Faso*, Botswana, Maldives, Nicaragua*, Papua New Guinea, West Bank and Gaza, Sudan*, Swaziland*, Tajikistan, Tonga (9)	2009 only

*Countries for which GMD has surveys' PSU.

Lineup

The lineup procedure followed three steps:

1) Calibrate the sample of each survey to represent the national population in 2013 according to UNDESA. The calibration is made to represent UNDESA's population divided by 5-year age groups and gender. The survey weights are calibrated using maximum entropy estimation, and then rescaled to equal the exact UNDESA figures.¹⁴ The number of children aged 15-17 within the 15-19 age-group is determined by each survey's age distribution within the group. For Kosovo we use population estimates

¹⁴ Command maxentropy in Stata®14. This technique is used so as, to the extent possible, maintain constant weights within households. See Wittenberg, Martin. "An Introduction to maximum entropy and minimum cross-entropy estimation using Stata". The Stata Journal 10 (2010) for a description of the methodology.

from WDI and for Argentina we do not line up the population since the surveys used are not nationally representative.

2) Line up welfare per capita to reflect growth between the year of the survey and 2013. Depending on the country we look at growth estimates of household final consumption expenditure or GDP per capita. We assume that welfare per capita of every household moves at a same growth rate.

3) In order to keep consistency with PovcalNet poverty estimates, we adjust the poverty line in each country to replicate PovcalNet's poverty rates.

Child Population

Developing countries in this study include all countries except Australia, Belgium, Cyprus, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States. The world's number of countries, 214, reflects the number of countries according to WDI.

In Tables 1 and 2 the number of children in the World and in developing countries include three fifths of UNDESA's population in the 15 to 19 age bracket (we assume that the population in the age bracket is uniformly distributed by age). No such assumption is maintained for the child population in the GMD sample. For 24 countries, UNDESA's population is unavailable and we use WDI's population instead. For these countries, UNDESA population totals for children are estimated using averages across all other countries in the same region and income group.

China

China is a special case because the World Bank does not have access to individual level records from the Chinese Household Budget Survey (HBS), which is the source of official Chinese poverty statistics. The World Bank's international poverty estimates for China are instead based on an approximate distribution derived from grouped data, which cannot be used for poverty profiling. This study therefore utilizes household level data from the 2013 Chinese Household Income Project Survey (CHIPS), made available to the public by Beijing Normal University. The poverty rate for urban and rural China, derived from the 2013 HBS, is then applied to the CHIPS data to generate profiles of the extreme and moderate poor in China.

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