Global poverty and inequality from 1980 to the COVID-19 pandemic

Authors: Mark W. Moses, MHS

Homi Kharas, PhD

Molly K. Miller-Petrie, MSc

Goli Tsakalos, MS

Laurie Marczak, PhD

Simon I. Hay, DSc

Christopher J.L. Murray, DPhil

Joseph L. Dieleman, PhD

Correspondence: Joseph L Dieleman

dieleman@uw.edu

Institute for Health Metrics and Evaluation

Words: 2,568

Version: March 18, 2021

Summary

The world made remarkable progress in reducing extreme poverty over the last twenty years. Recent progress has slowed,[1] however, and the economic damage wrought by the COVID-19 pandemic[1–3] imperils progress towards achieving the Sustainable Development Goals (SDGs) of eradicating extreme poverty and alleviating inequality by the year 2030. To track progress towards the SDGs, we collated—to the best of our knowledge—the largest collection of poverty and inequality related data and developed novel methods to construct comprehensive and comparable estimates of poverty and inequality from 1980 to 2019 in 204 countries and territories, across urban and rural settings, and by age; further, we forecast the effects of the COVID-19 pandemic on poverty out to 2021. We find that over the past four decades, the number of individuals living in extreme poverty declined dramatically, however, extreme poverty counts were rising in Sub-Saharan Africa. The Millennium Development Goal (MDG) era corresponded to the fastest observed reduction in extreme poverty and a period of more equitable growth. Progress made is jeopardized by the economic shock resulting from the COVID-19 pandemic. Estimates of poverty through 2021 highlight the effect of the global economic shock, the effect of governments' economic responses to the pandemic, and the need to build economies resilient to the next global threat.

Main

The 2015 United Nations' Sustainable Development Goals (SDGs) aspired to set a global course for peace and prosperity of all people and the planet by 2030[4]. The aims of the SDGs are enshrined in a set of 17 global goals that call for all signatory countries to realize their common responsibility in achieving a safer, more just, and sustainable world[5]. Progress on any one of the 17 SDGs does not occur in isolation as evidence suggests the SDGs are interconnected and progress on one goal may have spillover effects on progress on other goals[6]. Two goals that have the greatest positive spillover effects are the eradication of extreme poverty and alleviation of inequality[7–10].

In 2000, the precursors to the SDGs, the Millennium Development Goals (MDGs) set a target to cut in half the proportion of the world's population living in extreme poverty by 2015; the goal was achieved five years ahead of schedule[11]. Momentum from this achievement may not have been sustained[1], and the economic damage due to COVID-19 interventions may place the SDG goal of eradicating extreme poverty further out of reach[1].

Despite their global significance, efforts to measure progress on poverty eradication and alleviation of inequality remain imperfect. Existing global estimates of poverty and inequality are often made with limited data and rely on regional averages for imputation[1], and in many cases the underlying data used in estimation lacks comparability, limiting cross country comparisons[12,13]. To address these concerns, we amassed the largest collection of poverty and inequality related data, developed a novel procedure to standardize the data, and implemented a nonparametric estimation process to measure extreme poverty and inequality in 204 countries and territories between 1980 and 2019 in both urban and rural settings by age. Further, we assess the profound economic effects of the COVID-19 pandemic on poverty and the effect of government responses to the pandemic.

Tracking absolute and relative poverty from 1980 to 2019

The SDGs define extreme poverty as the number of individuals living in households spending less than $1.90 a day per person in 2011 purchasing power parity-adjusted (PPP) dollars[14] – a unit of measurement which adjusts for variations in the price of goods and services across countries and time. We estimated the total number of individuals living in extreme poverty decreased by over 1.3 billion from 1980 to 2019 (Fig 1C). The global decline in extreme poverty was driven especially by progress over the past forty years in China and India, where the number of individuals living in extreme poverty was reduced by approximately 850 and 350 million, respectively. The pace of this global decline slowed since 2009, however, due primarily to growing extreme poverty in Sub-Saharan Africa.

The extreme poverty rate—or the percentage of the population living in extreme poverty—declined from almost 45% in 1980 to 8.3% (UI 7.6-8.9%) in 2019 (Fig 1B). Globally, urban poverty rates were lower than rural poverty rates in all years of this study, but the gap between the two shrunk dramatically, especially between 1990 and 2010 when the global rural poverty rate fell sharply. Approximately 25% of individuals living in extreme poverty lived in urban settings in 2019—an increase from 15% in 1980.

The eradication of extreme poverty is defined as an extreme poverty rate of less than 3%[15]. In 2019, 121 out of 204 countries eradicated extreme poverty—an increase of 46 countries since 1980. Extreme poverty was concentrated in Sub-Saharan Africa: 32 of the 35 countries with extreme poverty rates above 25% were within Sub-Saharan Africa in 2019 (Fig. 1C). Burundi, Central African Republic, The Democratic Republic of the Congo, and Somalia were the only countries with extreme poverty rates exceeding 60% in 2019 (Fig 1C). Nigeria and India were the only countries with over 75 million individuals living in extreme poverty in 2019.

The extreme poverty line of $1.90 a day becomes less relevant as countries grow economically and the vast majority of populations move out of extreme poverty. Instead, the *relative* poverty rate becomes an increasingly valuable measure as it quantifies both country-specific poverty and serves as a

measure of inequality. The relative poverty rate is defined as the proportion of individuals living on less than 50% of the median standard of living (the value of all goods and services consumed)[14]. Because the median standard of living varies across countries and changes over time, the relative poverty line is country and year specific measure. The SDGs use relative poverty to measure progress towards alleviation of inequality (SDG 10.2.1). Between 1980 and 2019, the number of countries with a relative poverty rate exceeding 20% declined from 31 to seven. Six of the seven countries were in sub-Saharan Africa (Fig 1D).

Demography and poverty

The number of individuals living in extreme poverty fell over the past forty years despite the global population growing by over three billion[16]. As the population grew, two other important demographic changes occurred: (1) the world became more urban as the fraction of the world's population living in urban areas expanded from 40% to 55%[17], and (2) the world's population aged, with the median age of the population growing by over ten years[17]. In 1980, the shape of both the urban and rural population distributions followed a pyramid shape (Fig 2). By 2019, the population distribution in urban settings grew more stationary while the rural population distribution maintained a pyramid shape (Fig 2). The change in urban population distribution was driven by individuals making more than $11 a day—a result largely due to China's changing demographics (Extended Data Fig 1) and rising economic prosperity (Extended Data Fig 2). In 2019, nearly 4.3 billion individuals (55% of the world's population) lived on more than $11 a day—an increase of almost three billion since 1980; of these individuals, 70% lived in urban settings, 45% were between the ages of 15 and 45, 37% lived in China or India, and 50% lived in Asia more broadly.

From 1980 to 2019, the number of children under the age of 15 living in extreme poverty fell from approximately 890 million to 225 million, but still accounted for 40% of the population living in extreme poverty in 2019 (Fig 2). We estimate it would cost over USD2021 51 billion annually to lift every

child under the age of 15 out of extreme poverty and USD2021 98 billion to lift every individual out of extreme poverty in 2019.

The pace and pattern of growth

Over the last four decades, the world grew more equal as the standard of living of the poorest grew faster than that of the wealthiest—though the pattern of growth in the standard of living was not constant over time (Fig 3A). From 1980 to 2000, the growth in the standard of living followed the classical *S* shape pattern—popularly likened to the silhouette of an elephant[18–20]—where the growth in the standard of living of the poorest 50% and wealthiest 10% outpaced those in the middle (50-90th percentiles). By removing the contributions of China and India to the global pattern, the standard of living of the poorest three quarters of the world declined from 1980 to 2000, while the standard of living of the wealthiest grew (Extended Data Fig 3). Conversely, during the MDGs (2000-2015) and the SDGs (2016-2019), growth in standard of living of the poorest 50% far outpaced the growth in the standard of living of the wealthiest (with or without the contributions of China and India, Extended Data Fig 3), a critical condition for dramatically reducing global inequality. Despite this relative success, the absolute standard of living of the poorest three quarters of the global population grew by less than $1,000 a year; in contrast, the standard of living of the wealthiest grew by over $7,000 a year (Extended Data Fig 3).

Countries also grew more equitably, on average, over the last 40 years (Fig 3B). From 1980 to 2000, within country inequality grew as the standard of living of the wealthiest increased slightly faster than the poor; but during the MDGs, the pattern reversed, as countries grew more equally (Fig 3B). This pattern of growth persisted during the first four years of the SDGs, however, the magnitude of annualized growth in the standard of living across all percentiles during the MDGs was almost twice as large as growth during the SDGs (Fig 3B). These conclusions remain robust even after adjusting for unaccounted consumption that arises due to difficulty in surveying the very wealthiest (see Supplemental Materials).

Inclusive growth

To build more equitable, resilient, and cohesive societies that protect the most vulnerable, SDG 10.1.1 calls for countries to both grow economically and reduce inequality by promoting *inclusive growth*[14]. Inclusive growth is achieved when there is both growth in the mean standard of living and a positive shared prosperity premium, which is the difference between the growth rate of the mean standard of living of the poorest 40% and the growth rate of the mean standard of living[1]. A positive shared prosperity premium can either indicate that growth in the poor's standard of living advances faster while the mean standard of living is growing, or during times of declining mean standard of living, that changes in the poor's standard of living remain protected.

Our analysis indicated that 149 out of 204 countries grew inclusively during the MDG era—three times the number of countries that grew inclusively from 1980 to 2000 (44 countries; Extended Data Fig 4). We estimate countries' failure to grow inclusively from 1980 to 2000 prevented approximately 210 million individuals from escaping extreme poverty. In comparison, inclusive growth during the MDGs lifted over 150 million individuals from extreme poverty. Despite the success of the MDGs, the number of countries that grew inclusively during the first four years of the SDGs declined slightly to 124 and the magnitude of the shared prosperity premium also receded (Extended Data Fig 4).

Estimating the effect of COVID-19 on poverty

The world and its economic systems were shocked by the COVID-19 pandemic in 2020[3,21]. The exact human and economic toll of the COVID-19 pandemic is unknown and ongoing. We estimate the economic fallout in the wake of the COVID-19 pandemic pushed approximately 47 million into extreme poverty and 103 million into relative poverty in 2020, compared to a scenario where economic trends preceding COVID-19 persisted (Fig 4). Governments responded quickly by providing $12 trillion in economic assistance during the first eight months of the pandemic,[21] and we estimate these funds prevented approximately 24 million from entering into extreme poverty and 91 million from entering into relative poverty in 2020. Our estimates suggest the failure to extend government assistance into

2021—at a proportional level to the assistance disbursed in 2020—would result in nearly 23 million individuals falling into extreme poverty and 72 million individuals falling into relative poverty in 2021. Finally, if countries had matched their MDG shared prosperity premium during the SDGs (2005-2021), the need for government assistance during the pandemic would have been substantially mitigated: in 2020, the continuation of MDG level of inclusive growth would have prevented almost 33 million cases of relative poverty and 14 million cases of extreme poverty—approximately 60% of the cases of extreme poverty prevented by governments' economic mitigation measures (Fig 4).

Discussion

Over the last four decades, the number of individuals living in extreme poverty declined by over 1.3 billion and the number of children under the age of 15 living in extreme poverty declined by 625 million. Still, in 2019, there were over 630 million living on less than $1.90 a day—approximately 40% of whom were children under the age of 15. The past four decades also led to more equitable growth in the standard of living, globally and within countries. The progress made to reduce extreme poverty correlates with progress made on broader measures of development[22,23] like reduction in child mortality[24,25], increased educational attainment[26], political inclusion[27], and expanded freedoms and agency[27]. The progress made on achieving a more equitable world and equitable societies is slightly counter to the conclusion of other analyses[20,28]—potentially due to our focus on measuring the standard of living, as opposed to income.

Starting in 2000, the MDGs set out to advance the standard of living of the poorest and most vulnerable through unprecedented global cooperation and investment to expand access to education and healthcare, reduce poverty, and alleviate inequality. During this time, we found almost three quarters of countries grew inclusively and extreme poverty reduced three times faster than either the preceding 20 years or the first four years of the SDGs. The failure to extend the level of MDG era inclusive growth into the first four years of the SDGs left millions more individuals vulnerable to the

economic damage caused by the COVID-19 pandemic. In response to the pandemic, many governments around the world quickly provided $12 trillion in economic relief,[21] and these funds helped to mitigate approximately 50% of the total cases of extreme poverty and 90% of the cases of relative poverty that can be attributed to the pandemic in 2020.

Governments have quickly responded economically to the pandemic but the responses has been uneven. While the average decline in GDP *per capita* in low- and middle income countries (LMICs) were similar to GDP *per capita* declines in high-income countries in 2020 (approximately 7% decline)[2], the average government response to the economic fallout in high-income countries was nearly three times larger than the response in LMICs—measured as government spending as a percentage of GDP (14% vs 5% of GDP)[21]. Hitherto, high-income countries have taken advantage of generous financial conditions to fund government responses and prevent catastrophic economic scaring[21]. In contrast, LMICs are financially constrained due to lack of access to financial markets, high borrowing costs, and worrisome levels of debt,[3,21] with over half of low-income countries in debt distress or at high-risk of distress[21]. These financial constraints limit LMICs from mounting a proportional health response and preventing cracks in economic foundations necessary for jumpstarting a recovery[3]. A lackluster response and recovery only increases the odds of setting off a debt crisis, further imperiling the poor and jeopardizing the global containment of an ever mutating, contagious virus[29] in an interconnected world.

To date, the financial assistance provided to countries lacks in size, scope, and maybe creativity.[30–32] Many LMICs will need more assistance in the form of grants, loans, and debt servicing relief to address their acute and unique challenges[33] and prevent impending economic calamity.[30] Fortunately, a growing chorus of leaders with power are planning "to go big"[34] and substantially enhance fiscal support for the most financially vulnerable countries. Post-pandemic, this mindset will likely need to be carried over to avoid a long plodding recovery. A sustained and vigorous financial commitment will help LMICs make investments[3,21] that recover the quarter of a billion jobs lost in the

pandemic—which largely supported the working poor[35]—and reclaim the pandemic-induced learning losses that are projected to cost future generations upwards of USD 10 trillion.[36] At this precarious moment, making significant investments now can help LMICs take advantage of their favorable demographics and spur a new era of inclusive growth[3,21,37,38] rivaling the MDGs and deliver on the goal to eradicate extreme poverty, alleviate inequality, and achieve sustainable development[7–10] that gives rise to more cohesive and resilient societies prepared to weather future shocks—whether they be in the form of economic crisis, conflict, political instability, another pandemic, or a warming world.

Methods

Data

We used household surveys detailing either the value of income received by households or consumed goods and services (exclusive of publicly provided education and healthcare services). Note, in this analysis we use the term consumption and standard of living interchangeably. Consumption and income measures are two distinct concepts. Cross-country analyses of poverty often note this distinction but make no adjustment and pool these data together[13]. In contrast, we standardised all data to be reflective of consumption by developing an income-to-consumption adjustment process using a boosted regression tree (see supplementary information). Consumption was our preferred measure as it directly reflects material wellbeing; measures of income are poorly predictive of material wellbeing in informal or subsistence-based economies. Further details of the adjustment process may be found in the methods annex.

The underlying data that fed our analysis was from the World Bank PovCalNet[39], the United Nations-World Institute for Development Economics (UN-WIDER)[40], Luxembourg Income Study (LIS)[41], and Gallup World Poll surveys[42]. For select data sources we did not have access to underlying microdata, only tabulation. We interpolated and standardized reported tabulations, see methods annex for details. Tabulated data were often only presented at the national level which limited our ability to use these data to estimate poverty and inequality at more granular levels (e.g. by age and urban/rural). This limitation required us to develop a modeling procedure that made estimates at various levels of granularity that were then scaled to the national level. In total, our data covered 179 country-years and 150 countries within the past five years.

Modeling

Since not all data were available at the most granular level of analysis (e.g. urban/rural-age group level), we made estimates at four levels that were reflective of the data availability. These modeling levels

were the (i) national level, (ii) the urban and rural, (iii) urban and rural aggregated age group levels, and (iv) urban and rural granular age group levels. Aggregated age groups corresponded to 0-14, 15-19, 20-24… 60-64, and 65 years of age or older; granular age groups corresponded to 0-4, 5-9, 10-14, 15-20, … 60-64, 65-69, 70-74, 75-79, and 80 years of age or older. Age groups and urban and rural designations were determined by the underlining survey data.

For each of the four modeling levels, we grouped the data by age group-urban/rural level (or the lowest level of granularity possible) and calculated two measures from each group: the mean consumption and the consumption Lorenz curve, respectively denoted by μ and $L(p)$. The mean consumption reflects the average value of all goods and services consumed. The consumption Lorenz curve reflects the cumulative share of total consumption against the respective cumulative population percentiles. Together, mean consumption, μ, and the consumption Lorenz curve, $L(p)$, can be used to calculate the cumulative distribution of consumption, $F(x)$, by the following mathematical relationship

$$F^{-1}(x) = \mu * L(p)' \quad (1)$$

$F(x)$ is a smooth monotonically increasing function that reflects the percentage of the population living under specific thresholds denoted by x—or the poverty rate at x. Inversely, $F^{-1}(x)$ provides the level of consumption at population percentile x.

We estimated the mean consumption and consumption Lorenz curve at all four modeling levels in 204 countries from 1980 to 2021. In total, we estimated 14 models: the mean consumption and consumption Lorenz curve each estimated at the national level (1), urban level (2), rural level (3), urban aggregated age groups (4), rural aggregated age group (5), urban granular age groups (6), rural granular age groups (7).

We developed a novel two-step modeling procedure and applied it to estimate both the Lorenz curve and mean consumption model. In the first step of the modeling framework, we used a within-

between model to regress mean consumption—or in the case of the consumption Lorenz curve, cumulative share of total consumption at a given percentile—against a set of predictive covariates that include GDP *per capita*, log percentage of the population with 12 years of education, log prevalence of wasting, log natural resource exports as a percentage of GDP, log fraction of government expenditure over GDP, log fraction of consumption over GDP, and a measure of universal health coverage. These covariates were included on the basis of theoretical relationship, historical precedence, and statistical significance and were sourced from the Global Burden of Disease (GBD) study[24,43,44]. In the case of the Lorenz curve, covariate effects were allowed to vary across population percentiles. Further details on covariate selection and estimation process may be found in the supplementary information The within-between model was useful in our application as the model was capable of explaining within country variation—accounting for unobserved time-invariant country factors—and between country variation—useful in making predictions in countries where we had no survey data.

The within-between model may not have accounted for all measureable heterogeneity across time and within country or region. To help account for this heterogeneity, we smoothed the residuals from the within-between model over time in a series of cascading Gaussian Process Regressions (GPRs)[45]. In the case of the Lorenz curve, we smoothed over population percentiles in addition to time; in the case of models by age group, we additionally smoothed over age to benefit from the correlated age patterns. The GPR cascade flowed down a modeling cascade defined by the GBD geographical hierarchy. This modeling framework is similar to other modeling frameworks used to estimate globally relevant health and financial statistics[43,44]. A more complete description of the modeling framework is available in the supplementary information.

After estimation, we used our estimates of mean consumption, consumption Lorenz curve, and equation 1, to calculate seven cumulative consumption distributions (national, urban, rural, urban-age aggregated, rural-age aggregated, urban-age group, rural age-group). However, due to the independent

nature of the modeling, these cumulative consumption distributions may not be internally consistent across all modeling levels. We ensured internal consistency through a process of sequential scaling of all estimates to the national level estimates, as the national level estimates were supported by more data. Uncertainty was propagated fully throughout the modeling process. The supplementary information provides more details on these processes.

Forecasting

We forecasted the cumulative distribution of consumption in a panel regression model to predict poverty rates in 2020 and 2021. By modeling the cumulative distribution of consumption as the dependent variable, we account for both the magnitude of changes in consumption as well as the distribution of consumption. The panel model regressed estimates of the cumulative distribution of consumption at 99 percentiles (1^{st}-99^{th}) against the population percentiles, GDP per capita, and general government expenditure as a fraction of GDP (GGE) and the interaction between population percentiles and GDP per capita and GGE. Since our dependent variable was estimated, we inversed variance weighted the data to give more weight to estimates with greater certainty.

We developed a total of four forecast scenarios: (1) a scenario without COVID-19, (2) a scenario with COVID-19 without government intervention, (3) a scenario with COVID-19 but with government intervention, (4) and a scenario with COVID-19 that includes no government response but countries at least matched their MDG shared prosperity premium from 2016 to 2021.

For scenario 1, we used previously published forecast of GDP and GGE that neglect all impacts from COVID-19[46]. For scenario 2, we used forecast of GDP out to the year 2021 that account for the economic effects of the COVID-19 pandemic[2]; for GGE forecast to the year 2021, we used model predictions form a regressing GGE against GDP forecast sensitive to COVID-19. For scenario 3, we used

scenario 2's forecast of GDP and GGE but we added to the GGE forecast "above the line" government spending that was provided in response to the COVID-19 pandemic[21].

For scenario 4, we used predictions from scenario 2, however, we forced each country's cumulative distributions of consumption to at least match their MDG shared prosperity premium. We achieved this by first calculating each country's shared prosperity premium during the MDGs by differencing countries' annualized change in mean consumption of the poorest 40% and the annualized change in overall mean standard of living. Secondly, from 2015 to 2021, we calculated countries' shared prosperity premium for each year. If, for a given country-year between 2015 and 2021, the calculated shared prosperity premium was less than the country's shared prosperity premium during the MDGs, we inflated consumption levels of the bottom 40% to match the country's MDG shared prosperity premium level.

Reported statistics

All reported poverty counts were made using published population estimates[47] and UN Urbanization Project[17] estimates of the proportion of the population living in urban and rural areas by age[16,17]. Estimates of the relative poverty rate were made using country-specific poverty thresholds defined as 50% of the median consumption of the population. Relative poverty estimates for 2020 and 2021 were calculated using 2019 country-specific poverty thresholds, per recommendations for reporting relative poverty rates during times of extreme economic volatility[48].

Our estimates of the number of cases of poverty prevented by inclusive growth (or cases of poverty due to the failure to grow inclusively) were estimated similarly to the process described in forecast scenario 4. We first calculated the shared prosperity premium from 1980 to 2000 and the shared prosperity premium during the MDGs. To calculate the number of cases of poverty that could have been prevented by growing inclusively, we took all countries with a negative shared prosperity premium and inflated the consumption of the bottom 40% so the shared prosperity premium equaled

zero. We then compared poverty rates from the new cumulative distributions of consumption and to the previous poverty rates. To calculate the number of cases of poverty that were due to inclusive growth, we took all countries with a positive shared prosperity premium, deflated consumption levels of the bottom 40% until the shared prosperity premium equaled zero, and recalculated poverty rates from the new cumulative distribution of consumption.

Limitations

As with any modeling exercise, our analysis comes with limitations. For example, no uniform questionnaire exists to elicit household consumption or income. Inevitably, the lack of uniformity in questionnaires increases the variation of measures reported from surveys and potentially disrupted cross-country comparisons, and within-country trends. In many countries there is often infrequent data collection leading to large gaps in data. We minimized this limitation as much as possible by leveraging the largest collection of poverty and inequality related data. In India, as an example, similar "now casting" exercises of poverty rely on an Indian survey that was taken in 2011 to predict present poverty; in contrast, we leveraged six Indian surveys between 2011 and the present to predict and forecast levels of poverty in India.

Further, our definition of urban and rural followed administrative definitions, opposed to population density cutoffs. This decision was made because surveys we draw upon most often classify respondents as urban and rural based of the country's administrative definition. In the estimation process, these heterogeneous definitions or urban and rural are hopefully accounted for by the country level effects used in our regressions. While the estimates of urban and rural poverty may not be perfectly comparable across countries, these administrative definitions may be of more relevance to country-level officials compared to globally defined and imposed definitions of urban and rural. Admittedly, a more significant issue in comparing urban and rural estimates of poverty is the variation in

price levels. While our data uses World Bank developed urban and rural PPPs for populous countries like India, China, and Indonesia, urban and rural PPPs are not widely available for many countries.

Importantly, our measurement of poverty reflected individuals living in households spending less than $1.90 a day. This definition ignores intra-household allocations. Although this is common practice in poverty research, this simply means our measure of poverty is more reflective of the actual household unit than the actual individual. Additionally, we could further improve upon our income-to consumption adjustment process by accounting for attributes of survey instruments used to elicit levels of consumption—instead of our current approach of treating all instruments uniformly. Finally, our forecast of poverty to the year 2021 are heavily reliant on forecasted GDP per capita and the tracking of government responses to the pandemic. Given the unique nature of the pandemic, our forecast model based on historical data likely does not capture all of the effects of the pandemic on poverty. In the future, integrating high-frequency data into the estimation process could facilitate real-time poverty estimation.

Data and Code availability

The underlying data in this study were sourced from four sources: the World Bank (http://iresearch.worldbank.org/PovcalNet/povOnDemand.aspx), the UNU-WIDER inequality database (https://www.wider.unu.edu/project/wiid-%E2%80%93-world-income-inequality-database), the LIS database (https://www.lisdatacenter.org), and Gallup World Poll (https://www.gallup.com/178667/gallup-world-poll-work.aspx). The code base used in this analysis may be accessed with the following link https://cloud.ihme.washington.edu/s/8JZfgKMANKXTM7D.

Figure titles and notes

Figure #1: Global extreme poverty counts and rates from 1980 to 2019 and maps of extreme and relative poverty in 2019.

Panel A displays global extreme poverty counts—number individuals in households spending less than a $1.90 a day per person-- by country/region and urban/rural from 1980 to 2019. The darkly shaded areas represent urban areas and the lightly shaded regions represent rural area. Panel B display global extreme poverty rates—or the percentage of the world's population living in households spending less than $1.90 a day per person—over time by urban and rural areas. The dashed lines in Panel B represent 95% uncertainty intervals. Panel C and D respectively display absolute extreme and relative poverty rate estimates in 2019. Countries that have eradicated extreme poverty—extreme poverty rate of less than 3%--are colored in grey.

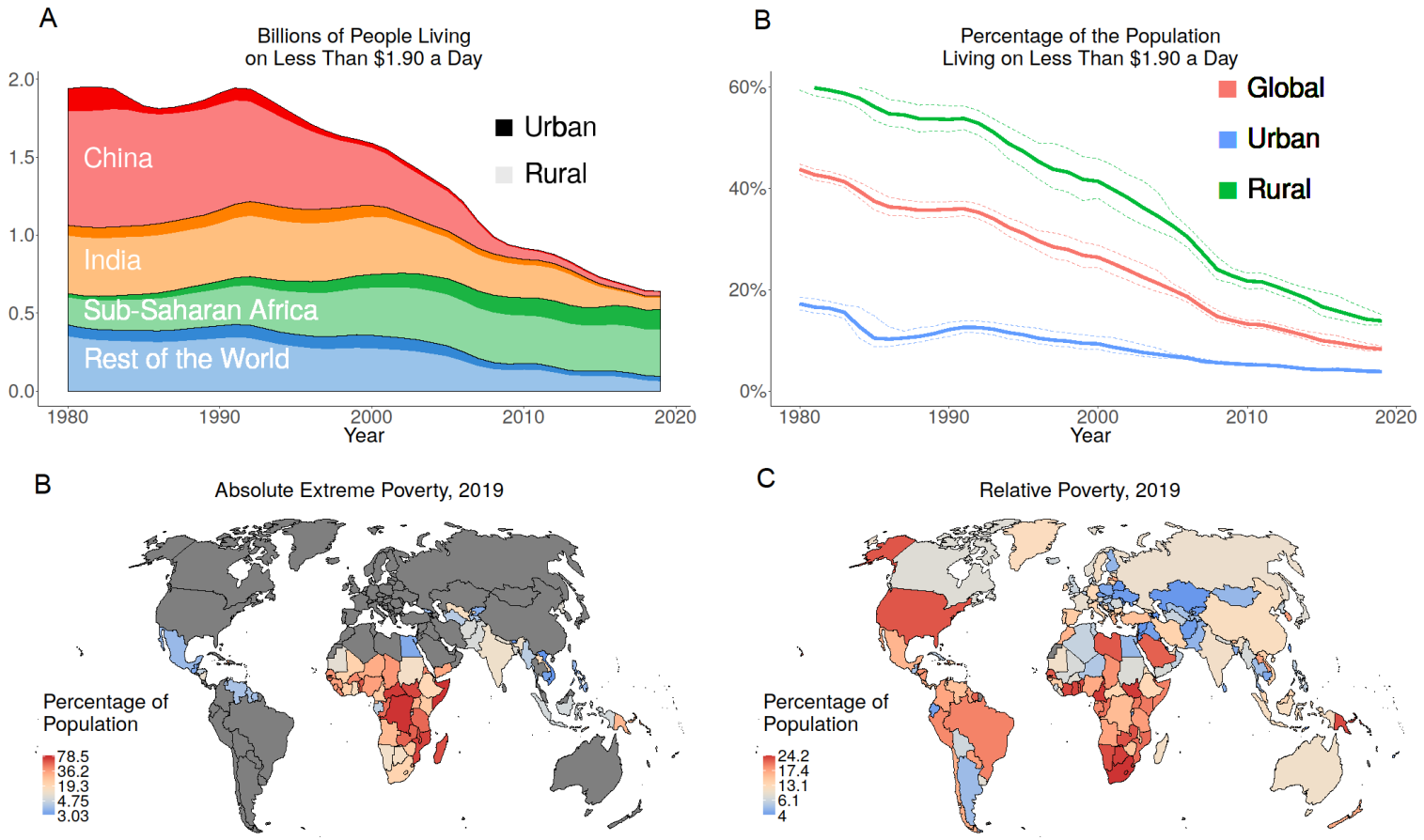


Figure #2: Population pyramid by poverty threshold in 1980 and 2019 by rural and urban globally.

Figures display the number of individuals living under each threshold. Thresholds values of $1.90, $3.20, $5.50, and $21.70 a day are established by the World Bank. The threshold of $11 dollars is the lower bound of the global middle class.

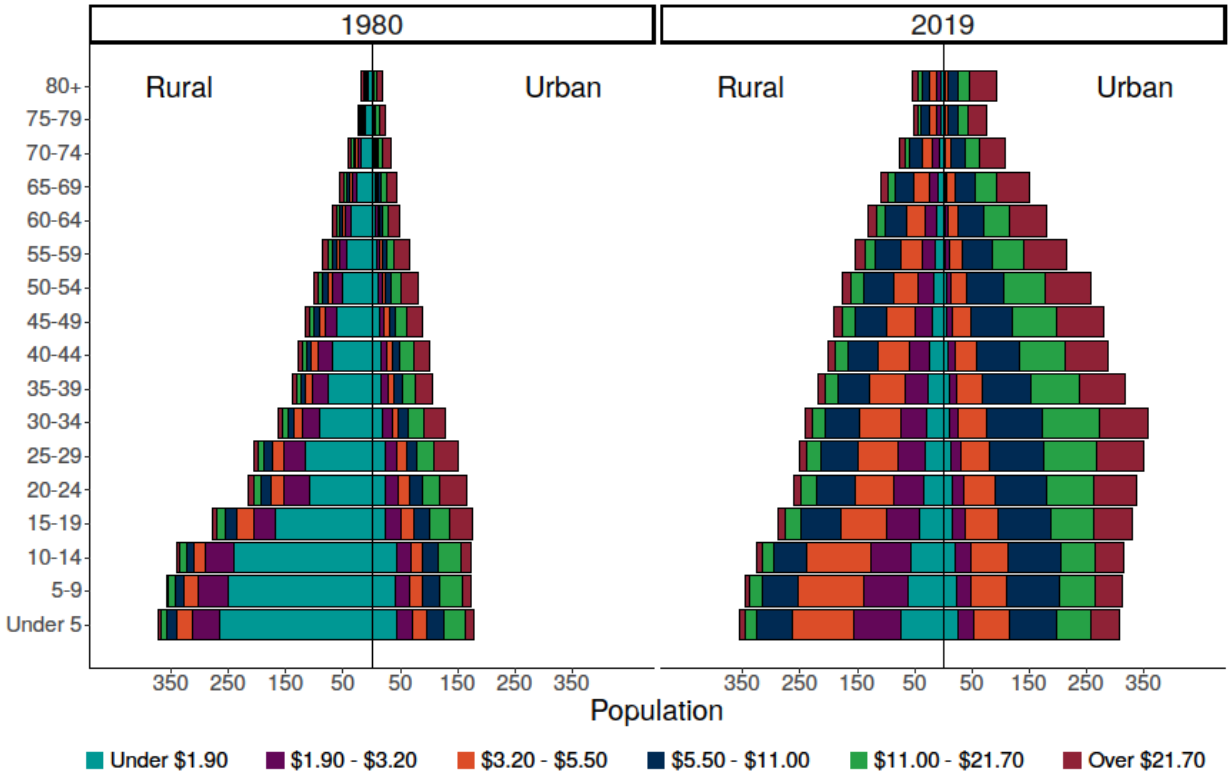


Figure #3: Annualized growth across standard of living percentile both globally and the average across countries.

Panel A displays the annualized growth in the standard of living across global standard of living percentiles in four time periods. Figure was created by simulating the world's population at 1000th the scale. A population proportional number of simulants was generated from each country's cumulative distribution of consumption; for a given year, all countries simulants were pooled together, ranked from poorest to wealthiest, and percentile standard of living levels were then calculated. The annualized change within a percentile is the line displayed in Panel A. Panel B was generated similarly to Panel A, excepts simulants were not pooled across countries. Instead, annualized changes across time in the standard of living for each percentile were calculated within a specific country, and then we averaged the annualized change across countries for each percentile.

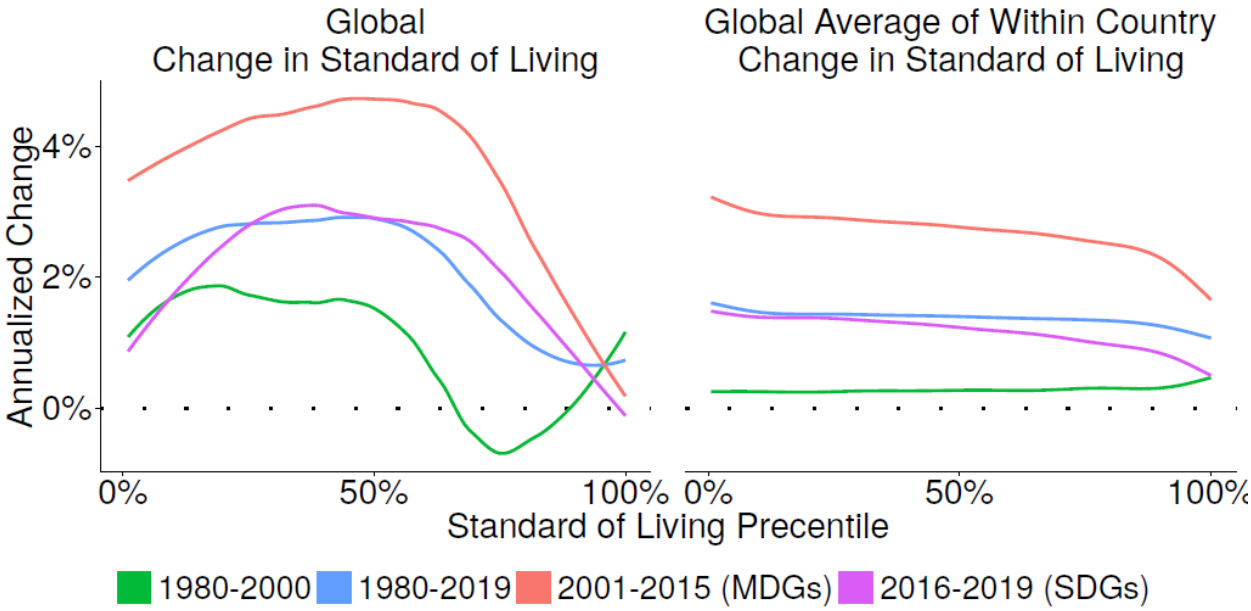
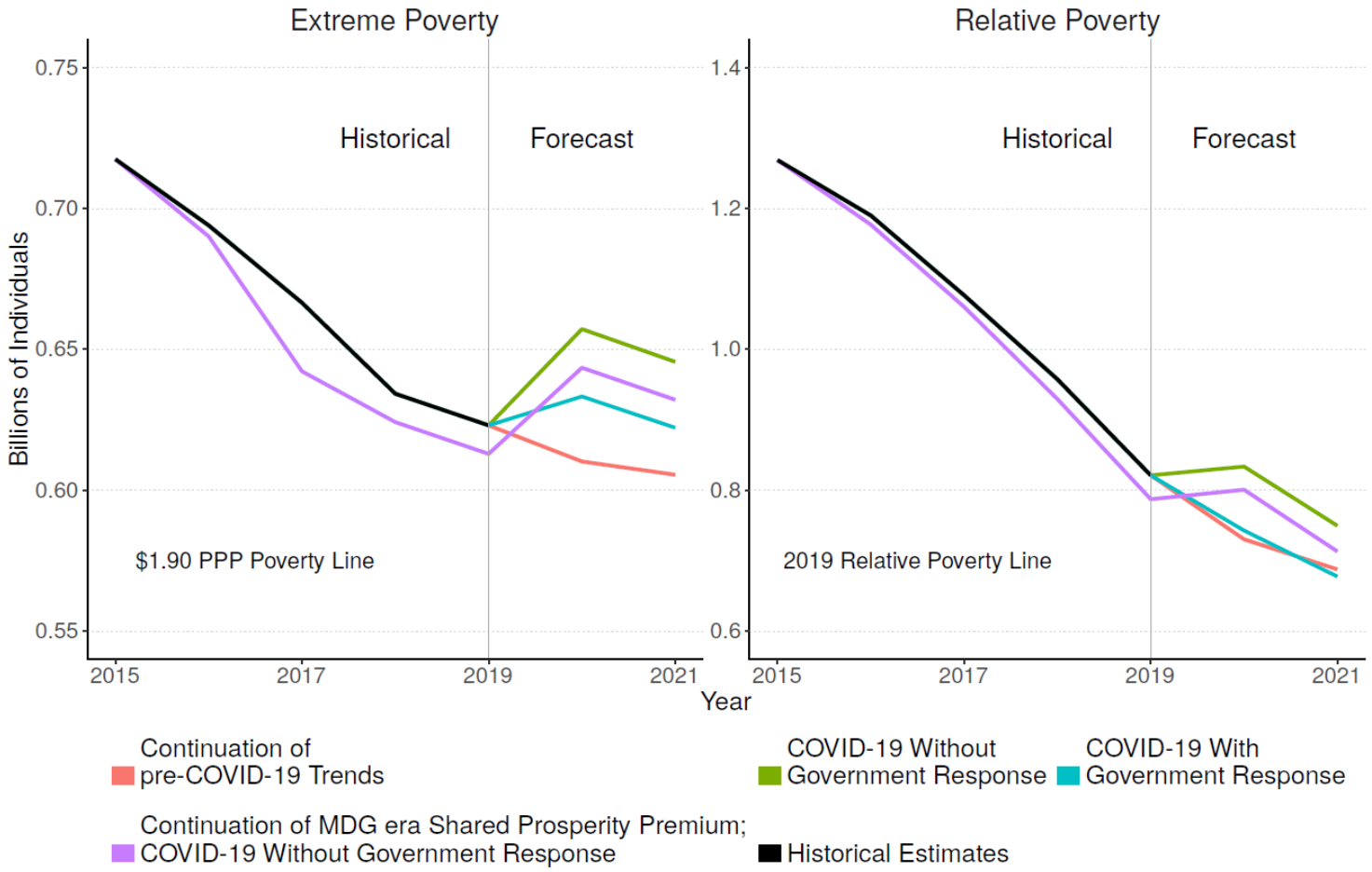


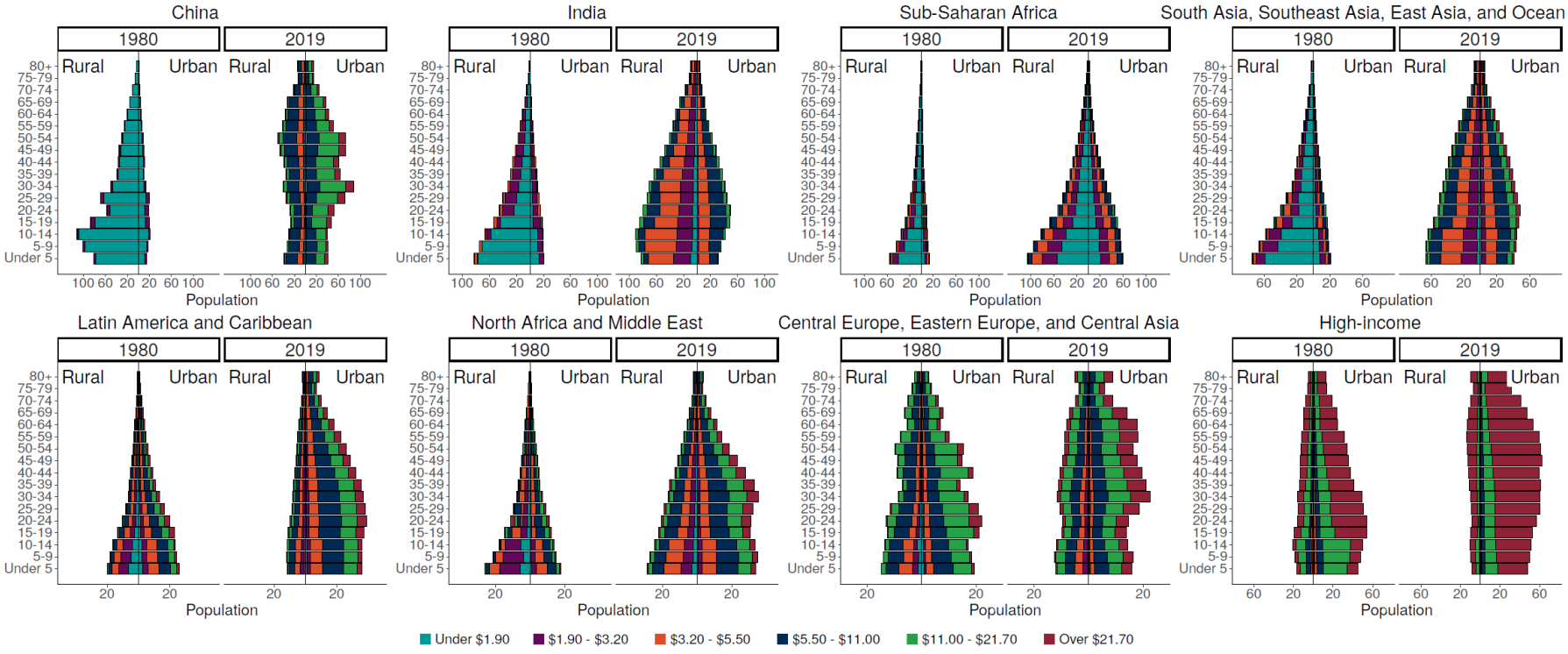
Figure #4: Extreme and relative poverty forecast scenarios.

Analysis is limited to 175 countries where the International Monetary Fund tracks "above the line" government spending in response to the pandemic. These 175 countries encompass 99% of the world's population and 97% of the world's extremely impoverished in 2019. Government spending in response to the pandemic in these 175 countries was forecasted out to the year 2021



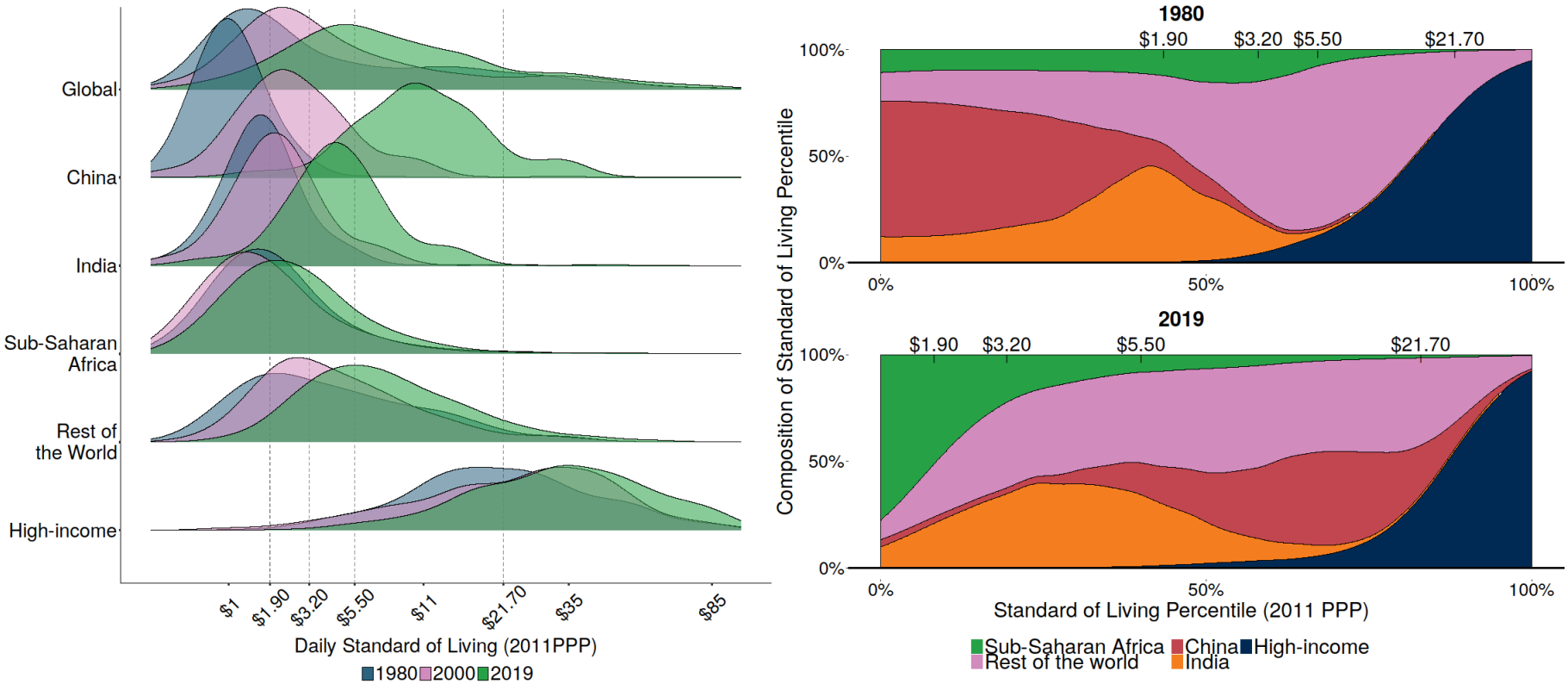
Extended Data Figure #1: Population pyramid by poverty threshold in 1980 and 2019 by rural and urban globally across regions and country.

Figures display the number of individuals living under each threshold. Thresholds values of $1.90, $3.20, $5.50, and $21.70 a day are established by the World Bank. The threshold of $11 dollars is the lower bound of the global middle class.



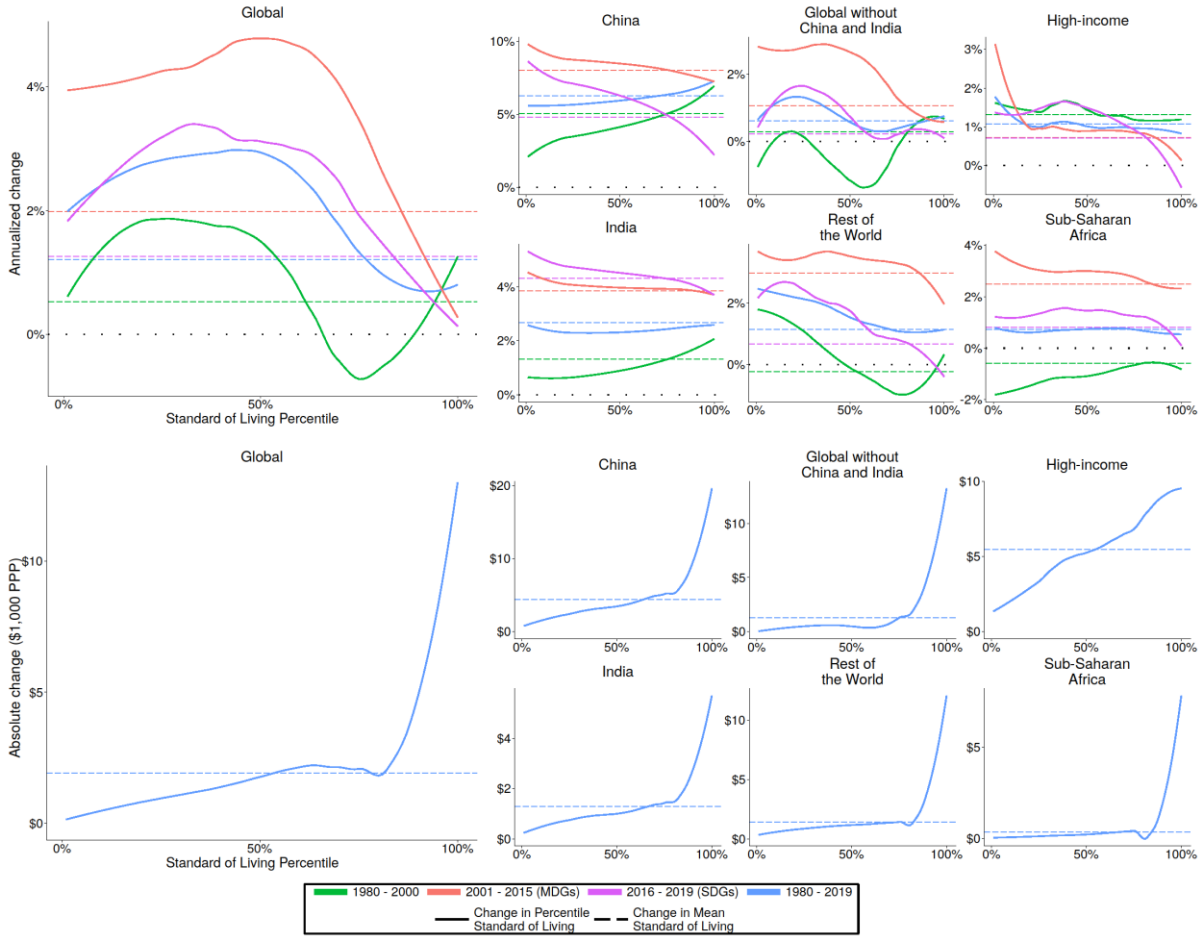
Extended Data Figure #2: Global distribution of consumption and composition within global standard of living percentiles across time and regions and countries.

Panel B displays the composition—or percentage—of individuals from each regions or each country within a global standard of living percentile for each time period. The bottom x-axis in panel B reflects the global standard of living percentile; the top x-axis in panel B reflects the position of the absolute poverty thresholds within each time period.



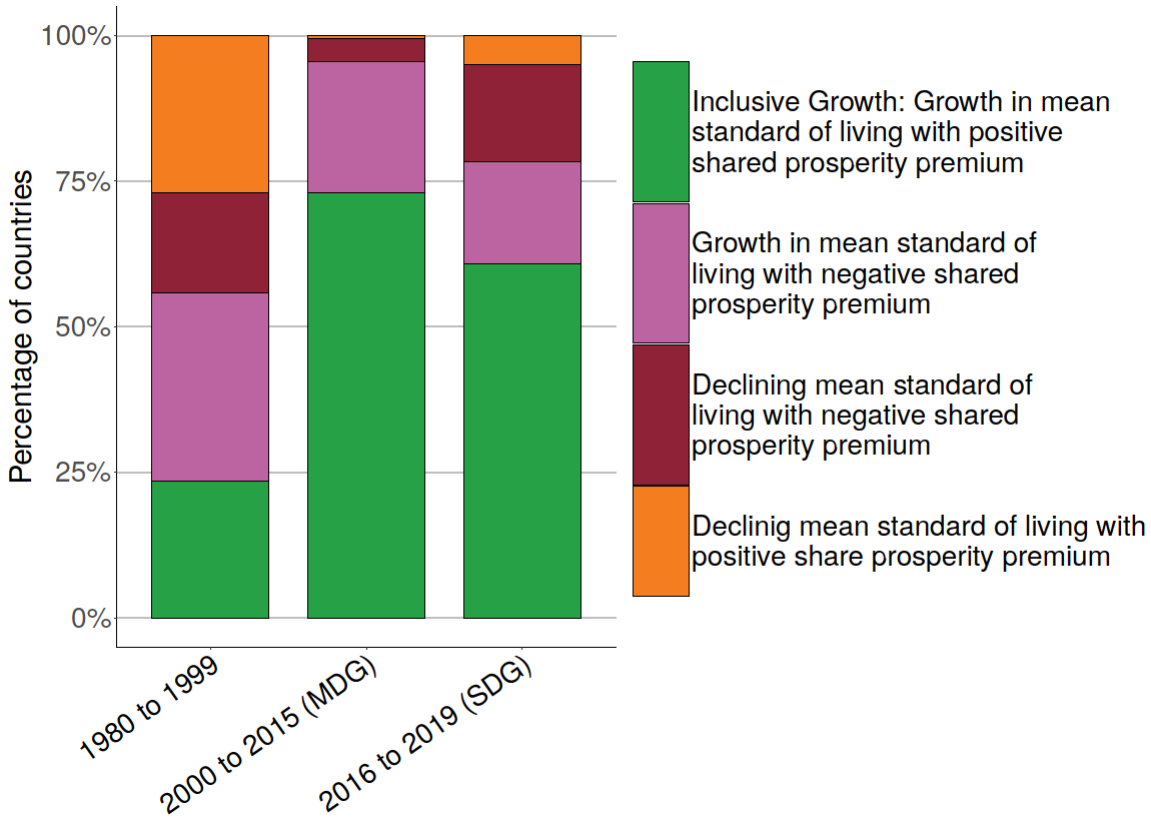
Extended Data Figure #3: Annualized percentage change and absolute global growth across standard of living percentile by region and country.

Panel A displays the annualized growth in the standard of living across global standard of living percentiles in four time periods. Figure was created by simulating the world's population at 1000th the scale. A population proportional number of simulants was generated from each country's cumulative distribution of consumption; for a given year, all countries simulants were pooled together, ranked from poorest to wealthiest, and percentile standard of living levels were then calculated. The annualized change within a percentile is the line displayed in Panel A. Absolute growth was determined similarly to annualized percentage change, except the annual absolute growth was calculated.



Extended Data Figure #4: Percentage of countries growing inclusively across three time periods.

Shared prosperity premium was calculated by subtracting the growth rate of the mean standard of living from the growth rate of the mean standard of living of the bottom 40%.



References

1. World Bank. *Poverty and Shared Prosperity 2020: Reversals of Fortune*. (2020).
2. International Monetary Fund. *World Economic Outlook, October 2020: A Long and Difficult Ascent*.
3. World Bank. *Global Economic Prospects*. (2021).
4. Osborn, D., Cutter, A. & Ullah, F. *Universal Sustainable Development Goals*.
5. The United Nations General Assembly. *Transforming our world: the 2030 Agenda for Sustainable Development*. (2015).
6. Nilsson, M., Griggs, D. & Visbeck, M. Policy: Map the interactions between Sustainable Development Goals. *Nat. News* **534**, 320 (2016).
7. Weitz, N., Carlsen, H., Nilsson, M. & Skånberg, K. Towards systemic and contextual priority setting for implementing the 2030 Agenda. *Sustain. Sci.* **13**, 531–548 (2018).
8. Pradhan, P., Costa, L., Rybski, D., Lucht, W. & Kropp, J. P. A Systematic Study of Sustainable Development Goal (SDG) Interactions. *Earths Future* **5**, 1169–1179 (2017).
9. Fuso Nerini, F. *et al.* Connecting climate action with other Sustainable Development Goals. *Nat. Sustain.* **2**, 674–680 (2019).
10. Lusseau, D. & Mancini, F. Income-based variation in Sustainable Development Goal interaction networks. *Nat. Sustain.* **2**, 242–247 (2019).
11. United Nations. The Millennium Development Goals Report 2015. (2015).
12. Deaton, A. *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*. (World Bank Group, 2018).
13. Lahoti, R., Jayadev, A. & Reddy, S. G. The Global Consumption and Income Project (GCIP): An Introduction and Preliminary Findings. 26.
14. United Nations. SDG Indicators. https://unstats.un.org/sdgs/metadata/.
15. World Bank. *Poverty and Shared Prosperity 2018: Piecing Together the Poverty Puzzle*. (2018).

16. Vollset, S. E. *et al.* Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: a forecasting analysis for the Global Burden of Disease Study. *The Lancet* S0140673620306772 (2020) doi:10.1016/S0140-6736(20)30677-2.
17. United Nations, Department of Economic and Social Affairs, & Population Division. *World urbanization prospects: the 2018 revision*. (2019).
18. Bui, Q. The Geography of U.S. Inequality. *The New York Times* (2016).
19. Shooting an elephant. *The Economist* (2016).
20. Milanovic, B. & Lakner, C. Global Income Distribution: From the Fall of the Berlin Wall to the Great Recession | The World Bank Economic Review | Oxford Academic. *World Bank Econ. Rev.* (2012).
21. International Monetary Fund. *Fiscal Monitor: Policies for the Recovery*. (2020).
22. Sen, A. *Development As Freedom*. (New York: Anchor Books, 2000).
23. Ross, B., Brinley, J., Caponio, J., Trott, C. & Wilson, E. *Charting pathways out of multidimensional poverty: Achieving the SDGs*.
24. Wang, H. *et al.* Global age-sex-specific fertility, mortality, healthy life expectancy (HALE), and population estimates in 204 countries and territories, 1950–2019: a comprehensive demographic analysis for the Global Burden of Disease Study 2019. *The Lancet* **396**, 1160–1203 (2020).
25. Burstein, R. *et al.* Mapping 123 million neonatal, infant and child deaths between 2000 and 2017. *Nature* **574**, 353–358 (2019).
26. Friedman, J. *et al.* Measuring and forecasting progress towards the education-related SDG targets. *Nature* **580**, 636–639 (2020).
27. Lührmann, : Anna *et al. Democracy Report 2020: Autocratization Surges-Resistance Grows*. (2020).
28. Alvaredo, F., Chancel, L., Piketty, T., Saez, E. & Zucman, G. The Elephant Curve of Global Inequality and Growth. *AEA Pap. Proc.* **108**, 103–108 (2018).

29. Tegally, H. *et al.* Emergence and rapid spread of a new severe acute respiratory syndrome-related coronavirus 2 (SARS-CoV-2) lineage with multiple spike mutations in South Africa. *medRxiv* 2020.12.21.20248640 (2020) doi:10.1101/2020.12.21.20248640.
30. European Network on Debt and Development. *The G20 Debt Service Suspension Initiative*. (2020).
31. Cohen, C. *et al. The Role of State-Contingent Debt Instruments in Sovereign Debt Restructurings*.
32. Communiqué: G20 Finance Ministers and Central Bank Governors, April 15, 2020. http://www.g20.utoronto.ca/2020/2020-g20-finance-0415.html.
33. Kharas, H. & Dooley, M. *COVID-19's legacy of debt and debt service in developing countries*. 32.
34. Lawder, D. Yellen urges G7 to 'go big' on stimulus, says U.S. committed to multilateralism. *Reuters* (2021).
35. International Labour Organization. *COVID-19 and the world of work: Sixth edition*. (2020).
36. Azevedo, J. P., Hasan, A., Goldemberg, D., Iqbal, S. A. & Geven, K. *Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes: A Set of Global Estimates*. (World Bank, Washington, DC, 2020). doi:10.1596/1813-9450-9284.
37. World Bank. *Africa Cities: Opening the World*. (2017).
38. World Bank. *Beyond the gap: how countries can afford the infastructure they need while protecting the planet*. (2019).
39. World Bank. PovcalNet. http://iresearch.worldbank.org/PovcalNet/home.aspx.
40. UNU-WIDER : World Income Inequality Database (WIID). *UNU-WIDER* https://www.wider.unu.edu/project/world-income-inequality-database-wiid (2020).
41. LIS Cross-National Data Center in Luxembourg. https://www.lisdatacenter.org/.
42. Gallup. *Gallup World Poll*.

43. James, S. L. *et al.* Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet* **392**, 1789–1858 (2018).
44. Chang, A. Y. *et al.* Past, present, and future of global health financing: a review of development assistance, government, out-of-pocket, and other private spending on health for 195 countries, 1995–2050. *The Lancet* **393**, 2233–2260 (2019).
45. GPflow: a Gaussian process library using tensorflow: The Journal of Machine Learning Research: Vol 18, No 1. https://dl.acm.org/doi/abs/10.5555/3122009.3122049.
46. Micah, A. E. *et al.* Health sector spending and spending on HIV/AIDS, tuberculosis, and malaria, and development assistance for health: progress towards Sustainable Development Goal 3. *The Lancet* **396**, 693–724 (2020).
47. Vollset, S. E. *et al.* Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: a forecasting analysis for the Global Burden of Disease Study. *The Lancet* **396**, 1285–1306 (2020).
48. OECD. *Society at a Glance 2019 OECD Social Indicators: OECD Social Indicators*. (OECD Publishing, 2019).