FREDERICK S. PARDEE CENTER FOR INTERNATIONAL FUTURES
JOSEF KORBEL SCHOOL OF INTERNATIONAL STUDIES
UNIVERSITY of DENVER

UNDP

Pursuing the Sustainable Development Goals (SDGs) in a World Reshaped by COVID-19

December 2, 2020

Table of Contents

Executive Summary

The study, conducted by UNDP and the Pardee Center for International Futures at the University of Denver, assesses the impact of different COVID-19 recovery scenarios on the SDGs, evaluating the multidimensional effects of the pandemic over the next decade.

This study finds that 44 million people are expected to be pushed into extreme poverty by 2030 due to COVID-19. Reversing the trend is possible with a focused set of investments towards achieving the Sustainable Development Goals (SDGs), which could lift 146 million people out of extreme poverty compared with projected or expected levels.

Under a 'High Damage' scenario, where the recovery is protracted, the pandemic could be responsible for 251 million in poverty – 207 million on top of the expected COVID scenario – and it could increase the female poverty headcount by an additional 102 million. This scenario models a world in which economic growth is lower than current projections, and productivity is slower to recover, to highlight the great uncertainty surrounding these projections. In this scenario, more than 1 billion people worldwide could be living in extreme poverty by 2030.

However, the study also finds that a focused set of SDG investments over the next decade in social protection/welfare programmes, governance, digitalization, and a green economy could not only prevent the rise of extreme poverty, but actually accelerate the development trajectory the world was on before the pandemic. This ambitious, yet feasible 'SDG Push' scenario would lift an additional 146 million people out of extreme poverty, narrow the gender poverty gap, and reduce the female poverty headcount by 74 million, even taking into account the current impacts of the COVID-19 pandemic.

The study simulates concerted SDG interventions for both governments and citizens, such as improved effectiveness and efficiency in governance and changes in consumption patterns of food, energy and water. The proposed interventions also focus on global collaboration on climate change, additional investments in COVID-19 recovery, and the need for improved broadband access and technology innovation.

The study also concludes that ‘SDG Push’ investments hold significant potential to boost human development in fragile and conflict-affected states, given that the majority of the additional 146 million people who would be lifted from poverty live in such settings, including 40 million women and girls.

This publication is the first installation of a UNDP flagship report on the impact of COVID-19 on the SDGs. It focuses on the implications of the pandemic on poverty, education, health, nutrition and gender equality – also referred to as the ‘People’ Goals in the 2030 Agenda. In early 2021, subsequent publications will share new insights about impacts on other dimensions of the 2030 Agenda – with a focus on prosperity, peace and planet.

Introduction

The reports from this global flagship initiative will advance existing monitoring and forecasting initiatives in three ways. First, for selected goals and targets, especially core goals related to human development, the project provides projections for the path of progress that the world seemed to be on prior to the outbreak of the COVID-19 pandemic. Second, despite the still very high levels of uncertainty around the ultimate course of the pandemic, it considers its possible impacts on longer-term progress. Third, it explores the potential impact of a comprehensive and integrated cluster of initiatives intended to move us more quickly toward the goals in the post-COVID-19 world.

The initiative's primary foci are four of the five subthemes of the SDGs – People, Planet, Prosperity, and Peace. The results presented in this launch focus on People - poverty, hunger, health, education, and gender equality.

The first section of this methodological report lays out the scenarios developed for this initiative [1]. The second section provides information on the primary tool used for the analysis, the IFs forecasting system. The third section provides key findings of the initial scenario analysis which will be followed by a full report to be released early in 2021.

[1] For a full review of scenarios and parametric interventions refer to Annex 1

1.Uncertain Pathways to the SDGs: Scenarios

Progress toward the SDGs will be shaped by interactions between many global systems, COVID-19, and the special efforts that national societies and the global community are making to address the pandemic and (re)set themselves on accelerated sustainable development pathways. This initiative uses a set of scenarios to understand possible alternative development paths: the path we seemed to be on prior to COVID-19 (the 'No-COVID' scenario), the impacts of COVID-19 on that path as we now understand them (our COVID baseline scenario), the possibility that COVID-19's impact will prove worse than now anticipated (the 'High Damage' scenario), and a new social contract of an integrated push toward the SDGs that combines increased efficiency of government, behavioral changes, and big investments (the SDG Push scenario). The final SDG Push scenario illustrates how a concerted effort can accelerate global progress even when accounting for the pandemic. Given the temporal proximity of the 2030 horizon for achieving the SDGs and our realization that many or even most goals cannot reasonably be attained by all countries by that year, this study will also present results for the 2050 horizon.

1.1 The path we were on (No-COVID scenario)

For most of human history, measurements and even conceptualization of the portion and numbers of people living in extreme poverty or suffering undernutrition did not exist. The World Development Report 1990 introduced the dollar-per-day international poverty line using purchasing power parity across national currencies (Ravallion et al. 1991), a rate subsequently adjusted upward multiple times as analysis of purchasing power changed, in part due to inflation. Country-year measurements have increased steadily since that time, although they remain very limited relative to country-years without measurement.

Roughly speaking (drawing upon the World Bank's PovcalNet data and estimates), nearly 2 billion people globally fell below the current $1.90 poverty line throughout the 1980s, a number that had fallen only below 1.7 billion by 2000 and then declined considerably more rapidly to fewer than 0.7 billion by 2017. Global percentage rates decreased from 42.5% in 1981 to 9.2% in 2017. Although East Asia and the Pacific, especially China, accounted for significant portions of the declines, poverty reduction has occurred more generally worldwide, especially since the turn of the century.

[1] For a full review of scenarios and parametric interventions refer to Annex 1

Although it is all but impossible to separate the contributions made by special efforts encouraged by the Millennium Development Goals announced in 2000 and the Sustainable Development Goals adopted in 2015 from independent spread of economic growth globally, the conscious attention to poverty eradication and other goals by national societies and the global community have undoubtedly contributed to the acceleration of progress.

That acceleration has characterized progress toward other goals also, especially with respect to human development areas such as nutrition and health improvement, educational advance, movement toward gender equality, and provision of human needs such as safe water, sanitation, and access to energy. This report will look across key targets of multiple goals. It will review the path we were on prior to the pandemic (our No-COVID scenario) as well as the path we may be on as a result of the pandemic (the COVID baseline scenario). The No-COVID and COVID scenarios can serve as useful benchmarks against which to assess both the possible setbacks from the pandemic and the possibilities for accelerating progress and achieving the goals despite them.

1.2 Impacts of COVID-19 on our progress (COVID baseline and High Damage scenarios)

The outbreak of COVID-19 and its spread around the world in 2020 led quickly to analyses about how recent decades of progress might immediately be disrupted, by estimating the numbers of people thrown into poverty and hunger. Studies have also often suggested the persistence of some or all of that disruption after 2021, but there remains great uncertainty surrounding the future of the pandemic and the trajectory and shape of the recovery. One way to deal with this uncertainty is to examine multiple scenarios. V, U, L, and K shaped descriptions of the immediate post-pandemic path have become common.

This project is less focused on the period of immediate emergence from the pandemic and more focused on the longer-term pandemic impact. Its perspective is through the lenses of two scenarios. The first, the COVID scenario, represents significant pandemic-period increases in poverty and hunger, as well as other interruptions of the No-COVID pathway toward the SDGs, and substantial longer-term negative consequences, but at levels considerably lower than those of the pandemic years (to be described). The second, the High Damage scenario, suggests both more considerable immediate consequences and greater persistence.

1.2.1 Mortality and GDP costs during the pandemic

Analysts focus much attention on the mortality and economic costs of the pandemic. Two principal sources for estimates of those are the Institute for Health Metrics and Evaluation (IHME) and the International Monetary Fund, respectively. Our scenarios build on their quantifications. With respect to mortality, estimates from the IHME for global deaths through February 2021, augmented by extrapolations for missing countries from data in the Johns Hopkins University database, range from 1.8 to 3.5 million. The central estimate used in our COVID scenario is 2.7 million. The IMF estimate for global decline in GDP in 2020 is 4.6% in absolute terms (IMF, World Economic Outlook, October 2020), making it an approximately 7.5% drop relative to a normal annual growth and a loss of about $6.7 trillion (in 2011 US dollars) due to reduced economic activity.

1.2.2 Uncertainties about the recovery and lasting impacts

Major uncertainties regarding economic recovery can be framed in terms of the pandemic's longer-term implications for production factors: labor, capital stock, and productivity. Distributional implications will also be fundamentally important.

The disease's impact on the work force is not likely to be great because COVID's mortality and morbidity is much higher for those already in or nearing retirement. Approximately 5,000 million humans are aged 15-64 (with 735 million aged 65 and older); the deaths now expected during the pandemic period are therefore a very modest portion of that working-age population, even were the mortality concentrated within that sub-population. A broader implication for the work force is a potential decline in participation rate associated with unemployment and disruption of skill acquisition during the pandemic, with a potential offset from increased household needs for income created by losses during the pandemic.

Similarly, forces affecting investment and capital stock may work in two directions, making some capital obsolete and encouraging increased investment in other areas. The shift of consumption from in-store purchases to on-line buying and of office work from dedicated space to home offices illustrate but certainly do not exhaust the implications for capital. Perhaps more important will be the disruption of belief in the reliability of regionally- and globally-scaled supply chains with limited redundancy pre-pandemic.

Further, disruption of government revenue and expenditure patterns influences annual fiscal balances and longer-term debt burdens with implications for changed taxing and spending patterns post-pandemic, as well as monetary authority decisions and interest rates.

Uncertainties with respect to labor and capital patterns post-pandemic will interact with their productivity within sectors and across larger economies. One near certainty is that much of the disruption of economic activity during the pandemic period is temporary rather than indefinite idling of labor and capital. The utilization of the pre-pandemic capacity of both will bounce back significantly post-pandemic, but to a highly uncertain degree.

In the face of such great uncertainty, the assumptions of the two scenarios of COVID-period impact and post-pandemic economic patterns, the COVID and the High Damage scenarios, differ significantly. As indicated, COVID builds in mortality projections built upon those of the IHME and the economic growth rates of the IMF. It assumes that 80% of the GDP growth losses in 2020-21 relative to longer-term patterns are temporary capacity utilization disruption, while 20% are loss of productivity gains that normally would have been attained in those years. Relative to the COVID scenario, the High Damage scenario additionally increases global mortality in 2020-2021 by nearly 1 million deaths, further decreases GDP growth rate across all countries by 1.5% in both years, assumes that 80% of GDP growth decline will persist as productivity loss, adds 20% of GDP to government debt levels, and increases Gini everywhere by 5% (roughly 0.015 points on the 0-1 index basis).

Some analytical basis for thinking about the transition from pandemic period to the longer term exists in the comparison of the current period with the aftermath of past economic crises including the Great Depression of the 1930s, the mostly Asian financial crises of the late 1990s, and the financial crisis or Great Recession of 2007-2009. Critical to the analysis in this report are insights gained from such analysis with respect to the longer-term tail of pandemic-period economic loss, the division of that loss between capacity utilization bounce-back and long-term productivity loss. For instance, looking at the aftermath of both the Great Depression and the Great Recession, Kozlowkski, Veldkamp, and Ventateswaran (2020) modeled with an assumption of about 4/9 long-term loss, calculating that the discounted value of those losses across time could be 10 times that of the pandemic period. They point to other studies that have explored financial balance sheet effects and very long-persistence post-crisis of low interest rates (see also Jordá, Singh, and Taylor 2020).

These scenario assumptions and specifications, especially in the High Damage variant, deserve the kind of country-specific specification of the pandemic period impact that post-pandemic data and analysis will eventually allow but which is currently not possible. Another important element of country specificity is the broader national context of the pandemic's unfolding. This study takes advantage of elaborated 186-country representation of the International Futures (IFs) forecasting system. See Section 3 for information about IFs and Appendix 1 for detail concerning the scenario interventions.

1.3 Accelerating progress toward the SDGs (SDG Push scenario)

National societies and the global community were broadly committed to reaching the SDGs prior to the pandemic. In the face of the pandemic, the next phase of UNDP's COVID-19 crisis response is designed to help decision-makers look beyond recovery, toward 2030, making choices and managing complexity and uncertainty in four main areas: Governance (building a new social contract), Social protection (uprooting inequalities), Green economy (rebalancing nature, climate, economy), and Digital disruption and innovation (for speed and scale). The structure encompasses UNDP's role in technically leading the UN's socio-economic response. The scenario also builds on the four levers for action identified by the first quadrennial Global Sustainable Development Report (UN 2019).

The final scenario of this report is the big SDG Push needed across those areas of action. The representation of the SDG Push scenario is simultaneously facilitated by the structure of the IFs system used to manifest it and constrained by the limitations of both the model system and the goal/target/indicator specification of the SDGs.

With respect to the latter set of limitations, there are considerable differences between the human development goals for which countries and the world have quantitative specificity of goals, targets, and indicators and the environmental sustainability goals where that often does not exist. For instance, the World Bank's association of the goals for eradicating poverty and hunger with reduction of those suffering from them to below 3% of the population (Ravallion 2013) is widely accepted. In contrast, the quantification for combatting climate change, sustainably using the oceans, and reversing land degradation is much less clear.

In part, that is because many environmental sustainability goals will require not only concerted effort on the part of individual countries but also considerable international collaboration to assess and accelerate progress —in the language of private and public goods, they are global public goods rather than nationally private ones. Although analysis with IFs can be undertaken across the goal set, the heavier focus of this project is, partly for this reason, more heavily upon human development.

The SDG Push scenario includes interventions across the four areas of action, many that apply to more than one. The scenario, built in part upon work by Moyer and Bohl (2018) and Moyer and Hedden (2020), integrates these scenarios into a single package rather than attempting sharp differentiation by areas. Still, they can be broadly grouped:

Governance (building a new social contract)

Reduced corruption, increased government effectiveness, and increased democracy (thereby also inclusivity)

Social protection (uprooting inequalities)

Increased enrollment into and completion of education at all levels, higher social transfers and increased protection of nutrition for less skilled and therefore lower income households, greater societal focus on improving access to safe water and sanitation, electricity, and modern cookstoves, and increased supportive government expenditures on education and health

Green economy (rebalancing nature, climate, economy)

Movement of calories consumed from meat to vegetables and fruits, reduction of agricultural waste in production, transport and processing, and consumption, increased agricultural yields allowing also increased forest area, reduced urban air pollution, increased efficiency of water and energy use, a carbon tax, accelerated technological advance and a policy emphasis on renewable energy

Digital disruption and innovation (for speed and scale)

Increased emphasis on tertiary education especially in science, increased governmental and societal spending on research and development, accelerated introduction of fixed and mobile broadband technology including mobile forms.

Scenario building requires many choices and caveats. For instance, interventions should be scaled at ambitious but achievable levels (Hughes 2013 similarly pointed to aggressive but reasonable levels). Subjective but informed judgment will shape definitions of those levels, and attention to successful country experience can be helpful. Also, most major policy interventions require phasing in and the scenario does that with initial steps already in 2021, again ambitiously. Further, even though the model system maintains financial and physical accounting as an aid to reasonableness, no society will likely ever be able to pursue all such changes simultaneously, making the SDG Push scenario one that frames the limit of possibilities (as the High Damage COVID scenario does in the opposite direction).

Appendix 1 shows the IFs parameter changes made to implement the SDG Push scenario in association with the four areas of action and indicates the magnitudes and geographic scope of the interventions.

2. Notes on Method

2.1. Approaches to forecasting progress on the SDGs

There remains less understanding than desired of how policy intervention sets dynamically and interactively affect the simultaneous pursuit of multiple SDGs by very disparate countries, the interacting methodological and substantive research frontiers that motivate this project. Some studies have primarily extrapolated historical trends in target and indicator variables with little or no attention to the drivers of that progress (e.g., Sachs et al. 2018). Other work has given more attention to a selected set of drivers, generally still related to individual goals/indicator variables (e.g., Bill and Melinda Gates Foundation 2018 with respect to poverty and health; Cuaresma et al. 2018 on poverty; Lucas et al. 2019 on child mortality).

Many studies identify a significant nexus of interrelated goals and possible interventions. Weitz, et al. (2014) examined the water, energy, and food nexus, giving particular attention to natural resources as enablers of development (p. 43). Obersteiner, et al. (2016) dug into the land resource and food price nexus. 2017). Sellers and Ebi (2017) elaborated narratives on the linkages of climate change and health. The CD-LINKS project identified the development-energy-climate nexus and recognized the special attention given by integrated assessment models (IAMs) to the impact on broader development goals of action to limit climate change (van Soest et al. 2019).

Moyer and Bohl (2018) and Moyer and Hedden (2020) studied multiple human development goals. Nexus work often uses alternative scenarios in computer models. Obersteiner et al. (2016) drew upon three of the five Shared Socioeconomic Pathways or SSP scenario set (Kriegler et al. 2012; O'Neill et al. 2017; O'Neill et al. 2014) and explored 14 policy strategies using runs of GLOBIOM (Global Biosphere Management Model).

Another set of studies turns directly to connections across the full SDG set, drawing on expert analysis. Nilsson et al (2016) proposed a 7-point (-3 to +3) scale to assess relationship strength. See ICSU (2015; 2017) for applications to goal subsets. Weitz, et al. (2017) built a cross-impact matrix across 34 targets (two per each of the 17 goals) for Sweden. Relevant also to this work, they found that effective institutions had the highest summed relationship with other targets. Pradhan, et al. (2017) statistically examined the intercorrelation of 122 indicators across SDG targets for 227 countries from 1983 to 2016.

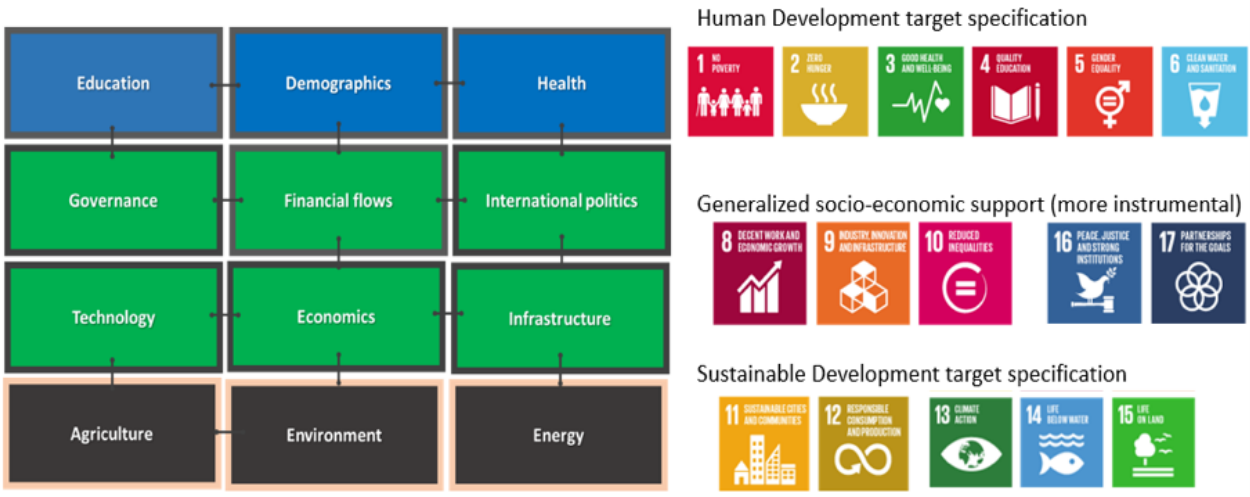
2.2. The methodological advantages of international Futures (IFs)

This study uses the International Futures (IFs) system to explore the long-term impacts of COVID on prospects for reaching the SDGs and of potential for extensive efforts to overcome the pandemic's damage and accelerate progress toward the goals. Three aspects of the IFs structure facilitate such analysis of the SDGs, adding to the contributions of earlier work: its country-specific representation, its comprehensive system representation, and its treatment of fiscal and physical resource constraints attainment (Hughes 2019; pardee.du.edu/wiki/Main_Page).

Country specificity.
Representing 186 countries and their interactions, the IFs structure enhances its utility in analysis of important immediate and longer-term secondary effects of scenario interventions. Results of this project provide information on global progress toward the goals, on progress across the World Bank country income categories, and by UN region. They further provide insight into the numbers of countries attaining goals in 2030 and 2050 and into the relationship of attainment failure to state fragility.

Comprehensive system representation with extensive causal linkage elaboration.
The extensive framework of the SDGs calls for integrated model-based analysis across the issue domains of human development, socio-political change (including advance in the capabilities and outputs of government), and biophysical sustainability. Figure 1 shows how the models within IFs correspond to the SDGs. Causal connections within and across component models, including endogenous representation of many drivers of economic productivity, facilitate consideration of variables and dynamics linking and underlying the SDGs and of policy orientations. Representation of temporal dynamics annually over the long-run facilitates understanding of lags in achieving change.

Figure 1. The models of the International Futures (IFs) system and related SDGs



Note: Blue indicates models in IFs primarily focused on human development; green represents socioeconomic development; black shows models especially important to sustainable development

Fiscal and physical resource competition accounting
Trade-offs often lie in competition for resources. Governments (or households) cannot spend the same money on education, health, infrastructure, subsidies for renewable energy, and the military). Social accounting matrices (SAMs) like that within IFs represent fiscal accounting within and among governments, households, and firms. On the physical side, IFs maintains accounting for land uses, fossil fuel resources, and age-sex specific demographics underlying labor supply.

Most obviously, lower GDP levels during and after the pandemic generate lower income levels and reduce consumption and savings potential. Reduced consumption directly affects poverty and nutrition levels. Reduced savings can affect investment and capital formation across issue areas as diverse as education, water and sanitation, and the broader economy and its future growth. All of these accounting-constrained dynamics shape the impacts of COVID on progress toward the SDGs.

The majority of the studies on the impact of COVID-19 are relatively short-term in nature, looking at the immediate effect in 2020/2021. This study is one of the few model-based studies looking at the possible impact on the longer-term progress of the SDGs to 2050. Given the nature of the impact of COVID that is deeply impacting all aspects of livelihood and society, it is important to explore not just the apparent linkages between poverty and its proximate drivers of economic and population growth and distribution but also drill down into the deep drivers, including the development of human capital (education and health), the character and effectiveness of overnance, and knowledge extension and diffusion.

2.3. Poverty calculations within International Futures (IFs)

Elimination of poverty is the first and most fundamental of the SDGs. Review of its treatment within IFs can illustrate the benefits of the system's country specificity, integrated system representation, and fiscal accounting.

Forecasts of poverty rates and numbers in alternative IFs scenarios are produced within a dynamically recursive general equilibrium economic model that utilizes a social accounting matrix (SAM) structure to represent financial flows within and among households, government, and firm agent categories. The economic model is bi-directionally hard-linked to a demographic model representing population by age and sex, and to a set of other models including education, health, governance, agriculture, and energy. The 186 countries of IFs are linked via trade, investment, migration, and remittance flows.

Poverty calculations in each annual time step most directly use the variables household consumption per capita at purchasing power parity per capita, a Gini coefficient, and an assumption of log-normal income distribution. The resultant poverty rates applied to population totals determine numbers in extreme poverty.

Gini can change in IFs with exogenous assumptions or in response to the relative population shares of and changing income shares of skilled and unskilled households. Household consumption levels are determined within the SAM and therefore are affected by household shares of value added (GDP in the aggregate) and its division between net savings and consumption, as well as by net flows to or from government. GDP growth can be driven exogenously or determined endogenously.

When endogenous, the production side uses a Cobb-Douglas production function, drawing labor from the demographic model and endogenously representing productivity change as a function of variables from other models in IFs including education, health, infrastructure, and governance quality. Assisting in the representation of short-term dynamics and the impacts of disruptions like the pandemic to economic equilibration, a capacity utilization variable augments the endogenous production calculation. For more detail on the poverty calculations and broader model see Hughes et al. (2009), Hughes (2019), and https://pardee.du.edu/wiki/Main_Page .

Within the UNDP/Pardee Center project on Pursuing the SDGs in a World Reshaped by COVID, GDP growth in all scenarios is represented exogenously through 2021. In the COVID scenarios, the basis for those growth rates are values from the IMF's World Economic Outlook (October 2020), modified by a reduction of 1.5% in the High Damage scenario during the pandemic years. In the No-COVID scenario, the exogenous growth rate values through 2021 come from the IMF's World Economic Outlook prior to the pandemic. From 2022 through the forecast horizons, the endogenous calculations of IFs determine economic growth rates. The estimates of household income and consumption in all years use the SAM structure and are endogenous. The basic Gini calculation for all years and scenarios is endogenous, but in the High Damage scenario, an exogenous factor increases Gini by 5% in the years following the pandemic.

3. Project Analysis Results

Results from this project are being produced in two stages. In early December 2020, an initial release of results focuses on poverty, hunger, health, education, and gender equality, of which we present a summary below. The final project report in early 2021 will review and expand those results across additional SDGs. Some revisions can be expected with at least minor changes in our knowledge about the pandemic, as scenarios potentially change, and as model specifications adapt.

Breakdown of poverty forecast results with comparison to estimates made by the World Bank (baseline and downside estimates)

People living in poverty (2020)	*Results relative to:* No COVID	COVID Baseline	World Bank (June)
COVID Baseline	94		99
High Damage	194	99	115
SDG Push	98	3.7	

People living in poverty (2030)	*Results relative to:* No COVID	COVID Baseline	World Bank (June)
COVID Baseline	44		52
High Damage	251	207	76
SDG Push	-102	-146	

People living in poverty (2050)	No COVID	COVID Baseline
COVID Baseline	57	
High Damage	296	238
SDG Push	-283	-340

Source: Author's computation and World Bank. 2020. Poverty and Shared Prosperity 2020: Reversals of Fortune. Washington, DC: World Bank.

- The study finds that an ambitious, yet feasible, set of investments in social protection, governance, digitalization, and green economy over the next decade could not only avoid the rise of extreme poverty, but actually accelerate the development trajectory the world was on before the pandemic. This 'SDG Push' scenario would lift 146 million people out of extreme poverty, narrow the gender poverty gap, and reduce female poverty headcount by 74 million, even taking into account the current impacts of the COVID-19 pandemic.

- While not all countries will meet the goal of eradicating extreme poverty, as many as fourteen additional countries, a 26 percent increase, would achieve this target by 2030 with a bold push to deliver on SDGs. This is a remarkable pathway that we were not on before the pandemic.

- The study also concludes that SDG Push investments hold significant potential to boost human development in fragile and conflict-affected states, given the majority of the 146 million people that would be lifted from poverty live in such settings, including 40.2 million women and girls.

Detailed findings:

Under a 'Baseline COVID' scenario,

- 94 million people are already pushed into poverty because of the pandemic in 2020. In 2030, an additional 44 million people will still live in poverty as a result of the impact of the pandemic.
- This will increase the total projected number of people in extreme poverty from 861 million (in a No COVID scenario) to 905 million people by 2030.
- Of the additional 44 million people living in extreme poverty, half (22 million) are to be women and girls.
- By 2030, 7.9 million more people, including more than 1.5 million children, will be malnourished than projected in a No COVID scenario.
- The upper secondary graduation rate in 2030 is 1 percent lower than expected in a world without COVID.
- The maternal mortality rate increases by 2.3 points to 88.69 deaths per 100,000 childbirths compared with 86.3 in a No COVID world.

Under a 'High Damage' scenario,

- COVID is likely to push an additional 207 million people into poverty in 2030 on top of the Baseline COVID scenario, pushing the total number of people in extreme poverty over 1 billion in 2030.
- The effects in a high damage world ripple across all human development indicators. On top of the damage of the COVID scenario:

    - Female poverty headcount increases 102 million.

    - An additional 37 million people are likely to be malnourished, of which 4 million will be children under 5 years of age.

    - The rate of children completing secondary school would decrease by almost 2 percentage points in 2030, from 66% in the COVID baseline scenario to 64% in the high damage scenario.

Under a 'SDG Push' scenario,

- Targeted intervention would reduce the number of people living in extreme poverty by 146 million in 2030 relative to current COVID trends and by 340 million by mid-century.
- The benefits of the 'SDG Push' scenario are also reflected in other outcomes by 2030:

    - Approximately 128 million adults and 16 million children are lifted out of malnutrition.The proportion of children completing secondary school also rises from the estimated completion rate of 66 percent to 70 percent.

- While not all countries will meet the goal of eradicating extreme poverty, as many as fourteen additional countries, a 26 percent increase, would achieve this target by 2030 with a bold push to deliver on SDGs. This is a remarkable pathway that we were not on before the pandemic.

Fragile and conflict-afflicted states,

- 57% of the additional people pushed into extreme poverty by 2030 live in fragile and conflict-affected states.
- However, fragile countries see the biggest gains in terms of SDG progress in the 'SDG Push Scenario' 55% of the 146 million people lifted from poverty in the SDG Push scenario live in fragile and conflict-affected states.
- 54% of the women and children lifted out of poverty (an estimated 40 million) are living in fragile settings.

About the study

Scenarios were developed in collaboration with Pardee Center and UNDP Economists and Policy Experts from UNDP's SDG Integration, Strategic Policy and Engagement Team, and Human Development Report Office. The data is based on internationally recognized global best practices and updated GDP forecasts by IMF and World Bank. The data in IFS have been validated with many countries through training exercises and collaboration with governments.

International Futures is the product of more than 40 years of peer-reviewed, and ongoing, academic research at the University of Denver. The models for the various modules are developed by trained modellers and researchers, and are subject of peer-reviewed academic publications - https://pardee.du.edu/node/483.

IFs uses publicly available historical datasets from reputable sources such as UN agencies, IMF, World Bank, OECD, other academic research programmes (for example GTAP from Purdue University, Environmental Performance Index from Yale University and Columbia University), inter-governmental data (Eurostats), and other non-governmental institutions (such as EIU). The full list of data sources included in IFs is available here: https://pardee.du.edu/database-international-futures-ifs. It must be noted that as a data-driven tool, IFs is affected by the well-known limitations in data availability and data quality from international sources. The tool applies statistical methods to estimate missing data from historical datasets.

UNDP has continuously invested in the International Futures tool, supporting enhancements in the models and an alignment of the IFs tool to the SDGs. The IFs model has supported other flagship reports in UNDP including the report on the Impact of War in Yemen. It underpinned analysis of potential policy choices in RBEC, RBA and RBAS country offices, as well as in several MAPS engagements, providing an evidence-base for recommendations of SDG accelerators through policy simulations. UN-Women and UNDP have collaborated with Pardee Center on a new model to forecast the gender gap in poverty. In July 2020, the SDG Integration Team launched a training attended by 125 staff from 48 country offices in all regions, regional hubs and central bureaux, on how to use IFs to assess the medium to long term impact of COVID-19 on the SDGs. Pardee Centre is currently utilizing the IFs model to assess COVID impact in Africa as part of a collaboration with RBA.

This project is a continuing effort with collaboration between the United Nations Development Programme and the Frederick S. Pardee Center for International Futures, Joseph Korbel School of International Studies, University of Denver.

The core team for this report comprised Barry B. Hughes, David K. Bohl, Taylor Hanna, Kaylin McNeil, and Jonathan Moyer of the Frederick S. Pardee Center for International Futures.

From UNDP, the core team was led by Laurel Patterson, Babatunde Abidoye, Serge Kapto, Joanna Felix, Lars Jensen, Maria Marta Rey Mdh, Youngeun Kang, and Tasneem Mirza.

A full report with results for the remaining SDG subthemes of planet, prosperity, peace will be published in early 2021.

References

Alkema L, Chou D, Hogan D, et al. Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. Lancet. 2016;387(10017):462-474. doi:10.1016/S0140-6736(15)00838-7.

Altinok, Nadir, Noam Angrist, and Harry Anthony Patrinos. 2018. Global Data Set on Education Quality (1965-2015). World Bank: Policy Research Working Paper 8314. http://documents1.worldbank.org/curated/en/706141516721172989/pdf/WPS8314.pdf

Antony, Grace Maria and Avula Laxmaiah. 2008. "Human development, poverty, health & nutrition situation in India," The Indian Journal of Medical Research 128: 198-205.

Azevedo, Joao Pedro, Amer Hasan, Diana Goldemberg, Syedah Aroob Iqbal, and Koen Geven,. 2020 (June). "Simulating the Potential Impacts of COVID-19 School Closures on School and Learning Outcomes: A Set of Global estimates." World Bank Group. http://pubdocs.worldbank.org/en/798061592482682799/covid-and-education-June17-r6.pdf. For a summary, see also Azevedo, Joao Pedro, Amer Hasan, Koen Geven, Diana Goldemberg, Syedah Aroob Iqbal. 2020 (July 30). "Learning losses due to COVID-19 could add up to $10 trillion," Brookings. https://www.brookings.edu/blog/future-development/2020/07/30/learning-losses-due-to-covid-19-could-add-up-to-10-trillion/

Gates Foundation. 2020. 2020 Goalkeepers Report: COVID-19 A Global Perspective. Bill & Melinda Gates Foundation.

Headey, Derek, Rebecca Heidkamp, Saskia Osendarp, Marie Ruel, Nick Scott, Robert Black, Meera Shekar, Howarth Bouis, Augustin Flory, Lawrence Haddad, Neff Walker, on behalf of the Standing Together for Nutrition consortium. 2020. "Impacts of COVID-19 on childhood malnutrition and nutrition-related mortality," The Lancet 396: 519-21. doi.org/10.1016/ S0140-6736(20)31647-0. Available at https://www.thelancet.com/action/showPdf?pii=S0140-6736%2820%2931647-0.

Hughes, Barry B., Mohammod T. Irfan, Haider Khan, Krishna B. Kumar, Dale S. Rothman, and José R. Solórzano. 2009. Reducing Global Poverty. Vol. 1 of the Patterns of Potential Human Progress series. Boulder, CO, and New Delhi, India: Paradigm Publishers and Oxford University Press.

Hughes, Barry B. 2013. Development-Oriented Policies and Alternative Human Development Paths: Aggressive but Reasonable Interventions. UNDP HDRO Occasional Paper 2013/05.

Hughes, Barry B. 2019. International Futures: Building and Using Global Models. London: Elsevier Academic Press. ISBN: 9780128042717.

Jordá, Óscar, Sanjay R. Singh, and Alan M. Taylor. 2020. "The Long Economic Hangover of Pandemics," Finance & Development 57(2): 12-15. https://www.imf.org/external/pubs/ft/fandd/2020/06/long-term-economic-impact-of-pandemics-jorda.htm

Kozlowski, Julian, Laura Veldkamp, and Venky Venkateswaran. 2020 (August 3). "Scarring Body and Mind: The Lon-Term Belief-Scarring Effects of COVID-19," Research paper from the St. Louis Federal Reserve Bank. https://research.stlouisfed.org/wp/more/2020-009

Lutz, Wolfgang, Anne Goujon, Samir KC, Marcin Stonawski, and Nikolaos Stilianakis, eds., Demographic and Human Capital Scenarios for the 21st Century. Luxembourg: Publications Office of the European Union.

Moyer, Jonathan D., and David Bohl. 2018. "Alternative Pathways to Human Development: Assessing Trade-Offs and Synergies in Achieving the SDGs." Futures 105 https://doi.org/10.1016/j.futures.2018.10.007.

Moyer, Jonathan D., and Steve Hedden. 2020. "Are we on the right path to achieve the sustainable development goals?" World Development 127. https://doi.org/10.1016/j.worlddev.2019.104749

Ravallion, Martin. 2013. "How Long Will It Take To Lift One Billion People Out Of Poverty?" World Bank Research Observer 28 (2): 139-158

Ravallion, Martin, Gaurav Datt and Dominique van de Walle, 1991, "Quantifying Absolute Poverty in the Developing World," Review of Income and Wealth 37: 345-361. They estimated (p. 360) 1137 million below $1/day.

Roberton, Timothy, Emily D Carter, Victoria B Chou, Angela R Stegmuller, Bianca D Jackson, Yvonne Tam, Talata Sawadogo-Lewis, Neff Walker. 2020. "Early estimates of the indirect effects of the COVID-19 pandemic on maternal and child mortality in low-income and middle-income countries: a modelling study," Lancet Global Health doi.org/10.1016/ S2214-109X(20)30229-1

Takemoto, Maira L. S., Mariane O. Menezes, Carla B. Andreucci, Roxana Knobel, Liduına A. R. Sousa, Leila Katz, Eduardo B. Fonseca, Claudia G. Magalhaes, Wanderson K. Oliveira, Jorge Rezende-Filho, Adriana S. O. Melo and Melania M. R. Amorim. 2020. "Maternal mortality and COVID-19," The Journal of Maternal-Fetal & Neonatal Medicene. doi/full/10.1080/14767058.2020.1786056

UNGA. 2015. "A/RES/70/1: Transforming Our World: The 2030 Agenda for Sustainable Development." United Nations General Assembly. Available at https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf.

United Nations. 2019. Global Sustainable Development Report 2019: The Future is Now - Science for Achieving Sustainable Development, UN, New York, https://doi.org/10.18356/5d04ad97-en

United Nations, Department of Economic and Social Affairs, Population Division. 2020. World Mortality 2019. New York: United Nations. ST/EAS/SER.A/437.

United Nations Development Programme. 2020. Beyond Recovery: Towards 2030. New York: UNDP. https://www.undp.org/content/undp/en/home/librarypage/hiv-aids/beyond-recovery--towards-2030.html

World Bank. 2020. Reversals of Fortune: Poverty and Shared Prosperity. Washington, DC.: World Bank. https://openknowledge.worldbank.org/bitstream/handle/10986/34496/9781464816024.pdf

Annex 1: Parametric interventions in the scenarios

Scenarios in IFs represent the interaction of the highly integrated models with parametric interventions. Because of the structures of IFs outlined earlier (notably country-specificity, extensive representation of interacting systems in component models, and fiscal and resource accounting constraints), parametric interventions have complicated relationships with model forecasts or projections (terms used interchangeably in this project), even for the variables most directly affected by the interventions. Most interventions involve multipliers on the underlying endogenous variable calculations within IFs, not overriding specifications of values for those variables. Thus, as the dynamics of the model unfold and the set of interventions within any scenario have their impacts, the underlying endogenous calculations will be affected; the impacts of the multipliers can be reduced or increased by the endogenous dynamics.

One important example of this relates to interventions directed at increasing governmental expenditures in targeted areas such as education and health. As indicated in textual body description, the social accounting matrix structure of IFs assures relationship between governmental spending and revenues. Although the model realistically allows some deficit spending, it also tracks the accumulation of governmental debt across time and represents the necessity for governments to address fiscal deficit increases and debt growth via reduced spending (which occurs partially in issue areas targeted for growth as well as others) and increased revenues (which then affect finances of firms and households, including their savings, investment, and consumption). Flows of resources from abroad, including foreign aid and remittances, also affect the finances of governments and households. In short, the accounting system often means that the model “fights” specific intervention specifications, and that it especially constrains attempts, as in the SDG Push scenario, to increase spending in multiple arenas. Country specificity, such as initial government debt levels and fiscal balances, will also add to the complexity of scenario impact unfolding.

This example illustrates only one of the constraints that the model imposes on intervention efforts. Those also occur around land use, household food consumption patterns, energy production and consumption character, and much more. Even interventions in health can produce complex results because reductions or increases in some forms of mortality (not least COVID-induced) can be offset in part by changing mortality rates elsewhere.

On the flip side of the coin, many interventions affect the dynamics of positive feedback loops rather than the negative loop constraints from accounting systems. For instance, improvements in education, health, and infrastructure can each or all contribute to acceleration of improvements in economic productivity, growth in economies and government revenues, improved prospects for further investment in the area(s) targeted, and therefore further acceleration of progress.

The scenario descriptions below (mostly phased in over time starting in 2021), with their indications of magnitudes of change in specific parameters, must therefore be understood as directional intentions of change and indications of priority levels, not as description of magnitude of direct results of scenario interventions. The reports of this project on the progress of SDG-related variable change will indicate the resultant magnitudes of that progress, often quite different from the magnitude of the interventions. While the intervention magnitudes are individually scaled to be ambitious but potentially achievable (given historical experience of at least some high performing countries), the model helps us understand the potential effects of them if pursued in combination across the areas of intervention.

Description of scenarios and parameters in the IFs model for the assessment of COVID-19 in SDG Achievement

Scenarios in IFs represent the interaction of the highly integrated models with parametric interventions. Because of the structures of IFs outlined earlier (notably country-specificity, extensive representation of interacting systems in component models, and fiscal and resource accounting constraints), parametric interventions have complicated relationships with model forecasts or

Description of scenarios and parameters in the IFs model for the assessment of COVID-19 in SDG Achievement

No COVID: This scenario represents the path the world was on before the COVID pandemic. Patterns of development within each country in demographics, economics, and across all SDG variables reflect model structures and parametric specifications that generate not simple extrapolations of patterns prior to 2019, but the results of dynamic change building on historical patterns.

COVID: The COVID scenario includes a set of changes to parameters in the IFs model on top of the No-COVID scenario:

- The most recent country-specific GDP growth projections made by the IMF (WEO, Oct 2020) to reflect the economic impact of COVID.
- A TFP shock adjustment parameter is set at 0.2 throughout the horizon to represent the 20% portion of pandemic-era GDP loss that has a long-term effect on productivity; the other 80% of GDP is assumed to represent shorter-term decline in capacity utilization the rebounds after 2021; the division is informed very generally by the experience of previous crises.
- Increased communicable disease mortality rate to account for COVID-19 deaths by country: data on COVID-19 deaths from IHME were converted to a population-wide mortality rate. Mortality interventions affect the population the year after they are introduced, which is why this intervention is made in 2019 to take effect in 2020.
- Increased mortality from communicable diseases by age group, normalized to the population-wide rate noted above. (This parameter tells IFs how to distribute increased mortality by age group).
    - The youngest cohorts (0-9 and 10-19) have the lowest mortality rate per infection, which increases by age group as follows:
        - Ages 20-29 at 0.003
        - Ages 30-39 and 40-49 at 0.005
        - Ages 50-59 at 0.013
        - Ages 60-69 at 0.04
        - Ages 70-79 at 0.125
        - Ages 80+ at 0.22

High Damage: This scenario represents a future in which the recovery trend is slower, and the economic damage is greater than the estimates provided by the IMF in October. In this scenario:

- A further reduction of 1.5% is introduced in the projected growth rate from the IMF October WEO report by country (for 2020- 2021).
- 80% of the COVID-induced GDP shock will persist as a loss in productivity throughout the period, preventing a full recovery to the pre-COVID growth trajectory.
- Inequality (measured by a domestic Gini coefficient) is increased by 5% from the initial shock and throughout the model forecast horizon.
- Government debt as a portion of GDP is increased by 20% in the initial shock (2020), simulating the additional debt countries will take on.
- The increased mortality from communicable diseases remains the same as in the COVID scenario.

SDG Push: Includes a set of interventions to simulate the impact that focused investments on social protection, promoting a green economy, strengthening governance structures, and addressing digital disruption may have on our road not just to recovery but to accelerated progress thereafter:

- Social Protection
    - Improved diets via additional calorie allocation to those most in need.
    - Increased numbers of improved modern cookstoves by 500 million units over a 12-year period.
    - A targeted doubling of the public health budget.
    - Increase welfare transfers from governments to households for unskilled workers by 50% in a 13-year period for the whole world; and doubling government to household welfare transfers for unskilled workers in the WB low-income group over a 13-year period.
    - Increased access to water and sanitation:
        - Percentage of population with access to piped water doubles over 30 years (world) and increases by 50% over 30 years (WB low-income countries). The more substantial intervention outside of low-income countries is because the intervention works on closing the remaining gap with universal access, a process that becomes more demanding as it progresses.
        - Percent of population with access to improved sanitation doubles over 30 years (world) and increases by 50% over 30 years (WB low-income countries).
    - Ratio of female to male wages by country reaches 1 by 2050 (simulates all countries reaching wage parity over 30 years; ratio left alone if it already exceeds 1).

- Governance
    - The scenario simulates improved governance participation by 30% over a 13-year period via Polity project index.
    - Improves governance effectiveness (quality) by 30% over 13-year period - World Bank's governance effectiveness index.
    - Reduces government corruption by 30% over 15-year period - Transparency International index.

- Green economy
    - Water demand is reduced by 30% over 32 years in the world.
    - Electricity transmission and distribution loss (as a percent of production) drops by 40% over 13 years in the world.
    - Reduction of particulate matter in urban air (urban air pollution) of 30% over 35 years in the world.
    - Increase in forested land area- simulating impact of reforestation in the world.
    - A carbon tax is introduced at $200 per ton over 13 years for OECD countries; and at $50 per ton for non-OECD countries in a 13-year period.
    - Energy demand per unit of GDP decreases by 1.4% annually, slowly declining to a rate of 1.3% by 2050, reducing the energy intensity of the economy.
    - Simulating increased cleaner and more sustainable energy production sources by:
        - Annual rate of energy production cost reduction for coal set to 0.002, reflecting recognition of the external costs of coal in its true total cost
        - Annual rate of energy production cost reduction for nuclear set at 0.0035, assuming new and safer nuclear technologies will continue to emerge
        - Annual rate of energy production cost reduction for other renewable energy set to 0.01 (continued encouragement of technological progress)
    - Energy demand in OECD countries falls a further 10% over 68 years, relative to endogenous calculation.
    - Energy demand in non-OECD countries falls a further 38% over 78 years, relative to endogenous calculation.
    - Increased electricity access, tripling the upward push in the percentage of the world population with access to electricity over a 12-year period.
    - Increasing electricity access in low income countries by 50% over a 12-year period.

- World agricultural production loss of crops, meat, ocean fish catch, and aquaculture is reduced by 30% over 30 years.
- World agricultural transportation and processing loss is reduced by 30% over 30 years.
- World agricultural food loss at the consumption stage is reduced by 30% over 30 years.
- High income economies increase their agricultural yields by 20% over 15 years.
- Upper-middle-income economies Increase their agricultural yields by 20% over 15 years.
- Lower-middle-income economies Increase agricultural yields in 50% over 50 years.
- Low-income economies double agricultural yields over 50 years. This intervention results in yields that follow historical patterns. This, in combination with improved diets/calories intervention (incentive), results in yields that grow more rapidly.
- Countries currently catching more than 2 mmt of fish annually reduce their fish catch by 25% over 50 years.

- Digital disruption/innovation- Relies on improved education, human capital, and access to digital technologies
  - Lower secondary graduation rates are tripled in a 12-year period starting in 2021.
  - Targets a 5% annual increase in lower secondary graduation starting in 2021.
  - The rate of science and engineering graduates in increased by 10 percentage points over a 13-year period.
  - Doubles the total of lower secondary graduation rates over a 13-year period starting in 2021.
  - Targeting a doubling of budgetary allocation to education.
  - Targeting a doubling of budgetary allocation to R&D.
  - Targeting a doubling of budgetary allocation to infrastructure.
  - Private research and development spending as a percent of GDP increased by 20% over 13-year period.
  - Access to broadband grows 50% over 19 years.
  - Access to mobile broadband grows 50% over 19 years.