Appendix A
Summary of Methodology and Data Sources

Introduction

This appendix summarizes the data and methods behind the comprehensive wealth accounts. The methodology builds on the foundation laid in previous works by the World Bank, including *Expanding the Measure of Wealth* (World Bank 1997), *Where Is the Wealth of Nations?* (World Bank 2006), and *The Changing Wealth of Nations* (World Bank 2011; Lange, Wodon, and Carey 2018). The innovation in this edition includes the addition of blue natural capital (mangroves and fisheries) and improvements on the measurements of other assets.

The following sections provide a brief overview of the methodology and data sources for estimating each wealth component. Detailed documentation of the data and methodology, and the technical studies and background papers that underlie the updated methodology, are available on the wealth accounting page of the World Bank website.

Data are reported in constant 2018 US dollars, at market exchange rates.

Total Wealth

A nation’s wealth consists of a diverse portfolio of assets, which together form the productive base of the national economy. These assets include the following:

- *Renewable natural capital*, including forests (timber and ecosystem services), mangroves, fisheries, agricultural land (cropland and pasture-land), and protected areas
- *Nonrenewable natural capital*, including fossil fuel energy (oil, natural gas, and coal) and 10 metals and minerals
- **Produced capital**, including machinery, structures, equipment, and urban land

- **Human capital**, including the knowledge, skills, and experience embodied in the workforce

- **Net foreign assets**, including portfolio equity, debt securities, foreign direct investment, and other financial capital held in other countries.

Total wealth is calculated by summing up each component of wealth:

\[
\text{Total wealth} = \text{renewable natural capital} + \text{nonrenewable natural capital} + \text{produced capital} + \text{human capital} + \text{net foreign assets}.
\]

A few methodological concepts and assumptions should be highlighted up front, as they are applied broadly to renewable and nonrenewable natural capital. The general concept of asset valuation is that the value should equal the discounted sum of net benefits an asset is expected to generate over its lifetime. For natural capital, the net benefits are the resource rents: the total value of production (or revenues) minus the total cost of production. In calculating the net present value for renewable and nonrenewable natural capital, a discount rate of 4 percent is used across all resources and years (as in the previous wealth reports). The lifetime of the resource for renewable natural capital is capped to 100 years, following the practice of the UK Office for National Statistics, while the lifetime for nonrenewable natural capital is estimated directly based on reserves and extraction paths. Resource rents are smoothed as a lagged five-year average to avoid year-to-year price fluctuations. Resource rents for the core wealth accounts are assumed to remain constant in future years unless otherwise specified. This approach is supported by the System of Environmental-Economic Accounting (UN et al. 2014) in the absence of the ability to project future prices and extraction paths.

A country-specific gross domestic product (GDP) deflator is used for all natural capital components to bring the nominal values to constant 2018 US dollars at market exchange rates. The GDP deflator is a broad deflator that reduces price effects but may not eliminate all capital gains (or losses) that would be captured if a commodity-specific price deflator were to be applied.

Finally, the comprehensive wealth database generally draws on publicly available, global data sets. Although this approach has its limitations compared with country-specific assessments, it allows for consistency in cross-country analyses. Also, to maximize country coverage and gap-fill missing data, regional or income group averages are often applied. Countries that experienced economic and social crises, including population exodus during the period of study, typically have limited or unreliable macroeconomic and population data series, which require significant gap-filling. An example is República Bolivariana de Venezuela, where several key variables have an incomplete series. Missing values are filled by linearly extrapolating from past trends, an approach that may be sensible in countries with more stable macroeconomic and social environments, but less so in countries such as República Bolivariana de Venezuela.
Renewable Natural Capital

Forest Resources: Timber

The predominant economic use of forests has been as a source of timber. Timber resources are valued according to the present discounted value of rents from the production of timber over the expected lifetime of standing timber resources. Unlike fossil fuel energy and other nonrenewable resources, timber is a renewable resource, so the concept of sustainable use of forest resources is introduced when estimating how many years the current forest can generate timber rents. The lifetime of timber resources is determined by the rate of timber extraction ($Q$) relative to the rate of natural growth ($N$). If $Q > N$, then current rates of extraction are unsustainable and the lifetime of the resource is limited. If $Q \leq N$, then extraction is assumed to be sustainable and the lifetime of the resource is taken as 100 years. Starting with CWON 2021, the area of timber forest used in the calculation of annual natural growth is estimated by subtracting from the total forest area those forests located within protected areas, excluding protected area categories that could be used for sustainable timber production (that is, protected areas in International Union for Conservation of Nature categories five and six). The resulting timber forest area is broader than the more narrowly defined productive forest area used in CWON 2018 and previous data editions.

Rents from timber in a given year are calculated as the rental rate times total revenue, where total revenue is unit price times the quantity of timber extraction. Data sources for estimating timber wealth are described in table A.1.

Forest Resources: Ecosystem Services

Timber revenues are not the only contribution forests make. Nontimber forest benefits—ecosystem services—such as minor forest products, hunting, recreation, and watershed protection—are significant benefits not

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Data sources and notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>• UN Food and Agriculture Organization (FAO), FAOSTAT database, <a href="http://www.fao.org/faostat/en/#home">http://www.fao.org/faostat/en/#home</a> Timber production is the sum of coniferous industrial roundwood, nonconiferous industrial roundwood, and woodfuel.</td>
</tr>
<tr>
<td>Unit price</td>
<td>• FAOSTAT database                                                                                                       Unit price is proxied by export unit value. Regional averages are then used to help correct the observed volatility in prices at the country level.</td>
</tr>
<tr>
<td>Rental rate</td>
<td>• Estimates by Applied Geosolutions 2015                                                                                   A regional rental rate is applied to total revenues in the absence of country-specific production cost data. This rental rate additionally accounts for the price differential between export prices and domestic stumpage prices.</td>
</tr>
<tr>
<td>Life of resource</td>
<td>• FAO 2015, Global Forest Resources Assessment is used for data on total forest area and its breakdown, net annual increment, and growing stock of timber.</td>
</tr>
</tbody>
</table>

usually accounted for, which leads to the undervaluation of forest resources. This edition of *The Changing Wealth of Nations* builds upon the forest ecosystem services wealth introduced in the previous wealth report and presents results from the updated meta-analysis study that predicts annual, per hectare values for each service category per country based upon a spatially explicit metaregression model (Siikamäki et al. 2021). Compared to the previous report, this updated study broadens the coverage of forest ecosystem service values and employs machine-learning algorithms in its predictive models. Additionally, the study now provides a time series of ecosystem services values.

The annual value of forest ecosystem services is estimated by multiplying total forest area in a given year by the sum of the per hectare monetary values for the three benefit categories: nonwood forest products; recreation, hunting, and fishing; and watershed protection. The capitalized value of forest ecosystem services is equal to the present value of annual services, discounted over 100 years. No distinction is made between natural and planted forest. Monetary values are adjusted for inflation using country-specific GDP deflators. Also, values are estimated for the given year’s forest area, assuming no change in forest cover in the future. See table A.2.

### Mangroves

The asset value of mangroves is explicitly included in the World Bank’s core wealth accounts for the first time in this wealth edition. As a type of forest, partial mangrove asset values are implicitly included in the forest asset accounts already. However, forest asset value is based only on value for timber, nontimber forest products, watershed services, and recreation services. Mangroves also provide a critical ecosystem service that is not currently included: protection from coastal flooding.²

The value of mangroves for coastal flood protection was estimated in several steps, which are further elaborated in Beck et al. (2021). First, a combined set of process-based storm and hydrodynamic models are applied

- to identify the area and depth of flooding,
- using model scenarios with and without reefs and mangroves,
- for five storm frequency events, 1 in 5, 10, 25, 50, and 100 years driven by local storm data.
These flood extent and depth data are then overlaid on historical data on populations and the value of CWON produced capital assets, down-scaled to 90 by 90 meters to identify a probabilistic distribution of flood damages (risk) and avoided damages (habitat benefits). All models were run for three years with data on the historical distribution of mangroves (1996, 2010, 2015), aggregated to the national level, then extrapolated and/or interpolated to provide annual values for 1995 to 2018.

Coastal flood risks and mangrove benefits were estimated for more than 75 nations covering approximately 700,000 kilometers of tropical and subtropical coastlines. Countries with fewer than 100 hectares of mangrove cover were dropped, and average values per hectare were capped at US$50,000 per hectare (to eliminate outliers). Table A.3 presents the data sources.

**Fisheries**

The asset value of marine fisheries is included in the World Bank’s core wealth accounts for the first time in this wealth edition. Fisheries wealth is calculated as the discounted value of the stream of rents expected over the lifetime of the asset. Landed value is based on estimates of the Sea Around Us (SAU) project, which is more comprehensive and detailed than the United Nations Food and Agriculture Organization’s (FAO’s) fisheries data. SAU also has calculated fishing costs and subsidies, which are used to estimate financial and economic rent.

For the core wealth accounts, the lifetime of fisheries stock is set to 100 years, as with other renewable natural capital. Indicators of fish management status are estimated and will be incorporated in future work to reassess assumptions about the lifetime of fish stocks. The impact of two scenarios about climate change on fish abundance, spatial distribution, and maximum catch potential (MCP) are estimated using an integrated assessment model developed for the Intergovernmental Panel on Climate Change. The estimated MCP is linked to a bioeconomic model to assess the impact on landed value, rents, and asset value.

The calculation of fisheries wealth requires data on marine fisheries production (catch), ex-vessel price of each exploited species, and fishing costs. The data sources for each indicator are included in table A.4.

---

**TABLE A.3 Data Sources for Mangroves**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Data sources and notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total mangrove area</td>
<td>• Global Mangrove Watch database, <a href="http://www.globalmangrovewatch.org">www.globalmangrovewatch.org</a></td>
</tr>
<tr>
<td>Annual service values per hectare</td>
<td>• Modelled by Beck et al. 2021</td>
</tr>
</tbody>
</table>

For the detailed methodology for calculating fisheries wealth, please refer to chapter 6 in this report, “Blue Natural Capital: Mangroves and Fisheries,” and the supporting technical document by Lam and Sumaila (2021).

### Agricultural Land

Agricultural land constitutes a considerable portion of total wealth in developing countries, particularly in the low-income group. For the purposes of the World Bank wealth accounts, agricultural land is conceptually divided into cropland and pastureland. There are potentially two alternative methods for estimating land wealth. The first method uses information from sales of land. The second method uses information on the annual flow of rents the land generates from crop and livestock production and takes the present value of such rents in the future. Given that information on land transactions is often missing, the second method is used. The value of cropland and pastureland is calculated as the present value of crop and pasture rents, discounted over 100 years.

For the first time, this wealth report accounts for the impact of soil degradation and climate change on future crop yield growth rates. Gerber et al. (2021) generated new country-specific crop-yield growth rates estimated at the grid-cell level, accounting for the impacts of future changes in precipitation, temperature, and degradation (driven by salinization, unsustainable irrigation, and erosion). This is an improvement over CWON 2018, which assumed fixed crop-production growth rates. Future crop production is based on projections of the yields of 10 major crops, which together comprise 83 percent of calories produced on cropland.

For livestock products, future rents are assumed to grow at a fixed annual rate of 1.475 percent for low- and middle-income countries and 0.445 percent for high-income countries.

The area of agricultural land is assumed to be constant: that is, wealth is estimated for the current area of land, not taking into account changes in the area of land that may affect rents in the future. See table A.5 for production and price data sources.

---

TABLE A.4 Data Sources for Fisheries

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Data sources and notes</th>
</tr>
</thead>
</table>
| Catch                            | • Sea Around Us database, www.seaaroundus.org  
Data are collected on marine capture production (tonnes) of each country from 1991 to 2018 at species group level and spatialized. |
| Ex-vessel price and landed values| • Sea Around Us database, www.seaaroundus.org  
Ex-vessel prices are the prices that fishers receive directly for their catch, or the price at which the catch is sold when it first enters the supply chain. |
| Fishing costs and subsidies      | • Fisheries Economic Research Unit (FERU) at the University of British Columbia (UBC) (Lam and Sumaila 2021), updated to cover years 1991 to 2018 |
| Fisheries management status      | • FERU at the UBC (Lam and Sumaila 2021), updated to cover years 1991 to 2018                                                                      |

Rental Rates

Cropland rents are estimated per crop product as production multiplied by the unit price multiplied by the rental rate. For crops, the rental rates are constant over time and crop products and are region-specific (Evenson and Fuglie 2010).

Pastureland rents are also estimated per livestock product as production multiplied by the unit price multiplied by the rental rate. However, rents from livestock products are different for livestock raised in extensive versus intensive production systems. Intensive systems are characterized by high output of animal products per unit surface area, and extensive systems use land areas of low production and under conditions of moderate grazing. For livestock raised in extensive production systems, the rental rate is assumed to be twice that for intensive systems. The same regional rental rates assumed for crop products are assumed for livestock products in intensive systems. Therefore, when calculating pastureland rent, the rent is weighted according to the country’s share of livestock production in extensive systems and intensive systems.

The share of livestock produced in extensive versus intensive systems is apportioned according to the percentage of ruminant meat produced in grazing systems, as estimated by the FAO for its Global Livestock Environmental Assessment Model. The FAO estimates the percentage of meat produced in grazing systems for 228 countries and other administrative regions. Where country-level estimates of meat production in grazing systems by the FAO are not available, regional averages are applied (weighted by the total area of pastureland).

Protected Areas

Areas protected for conservation and preservation of ecosystems provide a range of services to the country. For instance, wildlife reserves can generate significant revenues for developing countries, in particular from international tourism activities. And about one-third of the world’s big cities get
their drinking water from sources in or downstream of protected areas, saving billions of dollars in supply and treatment costs thanks to forests and wetlands that regulate the flow of water and remove contaminants (Dudley et al. 2010). Valuing such ecosystem services on a global basis, however, is difficult. For this reason, protected areas are valued in the World Bank wealth accounts using a simplified approach. Under this approach, the quasi-opportunity cost of protection per unit area of land contained in terrestrial protected areas is estimated as the lower of cropland and pastureland’s wealth per hectare. This value per hectare is then multiplied by the country’s total terrestrial protected area, to arrive at the asset value of protected areas. This is likely to be a lower bound on the true value of protected areas.

**Nonrenewable Natural Capital**

**Fossil Fuel Energy and Mineral Resources**

Nonrenewable natural capital valued in the World Bank wealth accounts includes fossil fuel energy and mineral resources. The value of a nation’s stock of a nonrenewable resource is measured as the present value of the stream of expected rents that may be extracted from the resource until it is exhausted. The present value of rents from fossil fuel energy and mineral resources is estimated under the restrictive assumption that rents remain constant in future years.

The fossil energy resources valued in the World Bank wealth accounts are petroleum, natural gas, and coal. Metals and minerals valued in the wealth accounts comprise bauxite, copper, gold, iron ore, lead, nickel, phosphate rock, silver, tin, and zinc.

Calculating the present value of future rents of nonrenewable natural capital requires data on annual production, prices, production costs, and proven reserves. From existing reserves and current rates of production, the time to exhaustion of the resource is assumed. Data sources for

<table>
<thead>
<tr>
<th>Resource</th>
<th>Indicator</th>
<th>Data sources and notes</th>
</tr>
</thead>
</table>
| Oil and natural gas       | Production| • Rystad Energy, UCube (upstream database), https://www.rystadenergy.com/energy-themes/oil--gas/upstream  
|                           |           | • IEA, “World Conversion Factors,” IEA World Energy Statistics and Balances database  
|                           |           | Production data from different sources are selected following a few decision rules, such as best coverage over time and median values among estimates. (continued on next page)
### TABLE A.6 Data Sources for Fossil Fuel Energy and Mineral Resources (continued)

<table>
<thead>
<tr>
<th>Resource</th>
<th>Indicator</th>
<th>Data sources and notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil and natural gas</td>
<td>Unit rent</td>
<td>• Rystad Energy, UCube (upstream database) Country data from Rystad Energy on unit revenues and costs for oil and natural gas are used to calculate average rental rates by region. Average rental rates are weighted by production.</td>
</tr>
<tr>
<td>Coal</td>
<td>Proven reserves</td>
<td>• US Energy Information Administration, International Energy Statistics • BGR (German Federal Institute for Geosciences and Natural Resources) 2015, Reserves, Resources, and Availability of Energy Resources</td>
</tr>
<tr>
<td>Metals and minerals</td>
<td>Unit cost</td>
<td>• S&amp;P Global Market Intelligence for copper, gold, iron ore, lead, nickel, silver, and zinc, <a href="https://www.spglobal.com/marketintelligence/en">https://www.spglobal.com/marketintelligence/en</a> • Country-specific case studies from various sources (assumed to be representative for the region) and cost index based on global average production costs from S&amp;P for bauxite, phosphate rock, and tin.</td>
</tr>
<tr>
<td>Metals and minerals</td>
<td>Unit price</td>
<td>• World Bank, Global Economic Monitor Commodities database</td>
</tr>
</tbody>
</table>


Implementing and estimating each of these elements are listed in table A.6, and users should refer to the technical documentation for more detailed information.
Produced Capital

Produced capital consists of manufactured or built assets such as machinery, equipment, and physical structures. Estimates of produced capital stocks in the World Bank wealth accounts also include the value of built-up urban land, which is valued as a mark-up on other produced assets.

Several estimation procedures can be considered for the calculation of physical capital stocks. Some of them, such as the derivation of capital stocks from insurance values or accounting values or from direct surveys, entail enormous expenditures and face problems of limited availability and adequacy of data. Other estimation procedures, such as accumulation methods and, in particular, the perpetual inventory method, are cheaper and more easily implemented because they require only investment data and information on the assets’ service lives and depreciation patterns. These methods derive capital series from the accumulation of investment series and are the most popular. The perpetual inventory method is, indeed, the method adopted by most Organisation for Economic Co-operation and Development (OECD) countries that estimate capital stocks (Böhm et al. 2002; Mas, Perez, and Uriel 2000; Ward 1976). This method is also used in the estimates of capital stock.

For most countries, estimates of physical capital are obtained directly from the Penn World Table (PWT) 9.1 database (Feenstra, Inklaar, and Timmer 2015). The PWT authors use the perpetual inventory method to estimate produced capital stocks for 182 countries between 1950 and 2017. For the World Bank wealth accounts, the PWT capital stock data are expressed in constant 2018 US dollars at market exchange rates, using the PWT’s asset-specific investment deflators to bring the data to real terms. The value for 2018 (not included in PWT 9.1) is estimated using 2018 investment data from the World Bank’s World Development Indicators and depreciation rates from PWT 9.1.

The physical capital estimates include the value of structures, machinery, and equipment, because the value of the stocks is derived (using the perpetual inventory method) from gross capital formation data that account for these elements. In the investment figures, however, only land improvements are captured. Thus, the final capital estimates do not entirely reflect the value of urban land.

Drawing on Kunte et al. (1998), urban land is valued as a fixed proportion of the value of physical capital. Ideally, this proportion would be country specific. In practice, detailed national balance sheet information with which to compute these ratios was not available. Thus, as in Kunte et al. (1998), a constant proportion equal to 24 percent is assumed; therefore the value of urban land is estimated as 24 percent of produced capital stock (machinery, equipment, and structures) in a given year.
Human Capital

The estimates of human capital follow the lifetime income approach developed by Jorgenson and Fraumeni (1989, 1992a, 1992b). According to this approach, human capital is estimated as the total present value of the expected future labor income that could be generated over the lifetime of women and men currently living in a country. Human capital is estimated by gender and type of employment (employed or self-employed).

The implementation of the lifetime income approach for estimating human capital requires data by age and gender on population, employment and labor force participation, education, earnings profiles, and survival rates.

### TABLE A.7 Data Sources for Human Capital Calculations

<table>
<thead>
<tr>
<th>Indicator/variable</th>
<th>Data sources</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual earnings</td>
<td>International Income Distribution database (I2D2)</td>
<td>Annual earnings are calculated utilizing the Mincerian regression results. The (relative) earnings profile by age, education, and gender are derived for each country and year given the corresponding data availability.</td>
</tr>
<tr>
<td>Education attainment</td>
<td>I2D2</td>
<td>Years of education by age and gender are derived for each country and year.</td>
</tr>
<tr>
<td>Employment rates</td>
<td>I2D2</td>
<td>The employment rate and self-employment rate by age, gender, and education level are calculated for each country and year. These rates have to be calculated by the employed (or self-employed) persons divided by the whole population that includes the employed, self-employed, unemployed, and the people out of the labor force.</td>
</tr>
<tr>
<td>School enrollment rates</td>
<td>I2D2</td>
<td>Whether an individual by age, gender, and education is enrolled in school or not; used for the probability of remaining employed in future years.</td>
</tr>
<tr>
<td>Employment</td>
<td>International Labour Organization (ILO), <a href="https://www.ilo.org/global/statistics-and-databases/lang--en/index.htm">https://www.ilo.org/global/statistics-and-databases/lang--en/index.htm</a></td>
<td>The ILO employment data are used as control totals for scaling up employment from the I2D2 database. ILO employment data are also used for filling data gaps when necessary.</td>
</tr>
<tr>
<td>Compensation of employees, GDP</td>
<td>United Nations National Accounts database, <a href="https://unstats.un.org/unsd/snaama">https://unstats.un.org/unsd/snaama</a></td>
<td>The compensation-of-employees data are used as input to control totals for scaling up annual earnings estimates from the I2D2 database and for filling the data gaps. In addition, the GDP data are used for expressing variables as a percent of GDP.</td>
</tr>
<tr>
<td>Labor share of earnings of the self-employed</td>
<td>Penn World Table database, <a href="https://www.rug.nl/ggdc/productivity/pwt/?lang=en">https://www.rug.nl/ggdc/productivity/pwt/?lang=en</a></td>
<td>Penn World Table estimates of the labor component of the earnings of the self-employed out of total earnings of the self-employed. Used as input to control total labor earnings.</td>
</tr>
<tr>
<td>Total labor earnings</td>
<td>United Nations National Accounts database and Penn World Table database</td>
<td>Compensation of employees plus labor earnings of the self-employed. This combined labor earnings estimate is used as control total for scaling up earnings estimates from I2D2 to national level.</td>
</tr>
<tr>
<td>Survival rates</td>
<td>Global Burden of Disease Collaborative Network (GBD 2020)</td>
<td>Survival rates are calculated utilizing the death rates obtained from the GBD Study. The GBD database includes global, regional, and national age- and sex-specific mortality for 369 diseases and injuries in 204 countries and territories.</td>
</tr>
</tbody>
</table>

The data sources for each variable are included in table A.7. For the detailed methodology of calculating human capital, please refer to chapter 7 in this report, “Human Capital: Global Trends and the Impact of the COVID-19 Pandemic,” and supporting technical documents.

**Net Foreign Assets**

Net foreign assets (NFA) are a measure of the cross-border assets and liabilities held by a country’s residents. A country’s external asset position, or NFA, is calculated as

\[ NFA = FA - FL, \]  
(A1.1)

where \( FA \) are total foreign assets and \( FL \) are total foreign liabilities. Total foreign assets are

\[ FA = \text{equity}_a + FDI_a + \text{debt}_a + \text{derivatives}_a + \text{forex}, \]  
(A1.2)

where \( \text{equity}_a \) is portfolio equity assets, \( FDI_a \) is foreign direct investment assets, \( \text{debt}_a \) is debt assets, \( \text{derivatives}_a \) is financial derivatives assets, and \( \text{forex} \) is foreign exchange reserves (excluding gold). Similarly, total foreign liabilities are

\[ FL = \text{equity}_l + FDI_l + \text{debt}_l + \text{derivatives}_l, \]  
(A1.3)

where \( \text{equity}_l \) is portfolio equity liabilities, \( FDI_l \) is foreign direct investment liabilities, \( \text{debt}_l \) is debt liabilities, and \( \text{derivatives}_l \) is derivatives liabilities.

The primary data source for NFA is the updated and extended version of the External Wealth of Nations Mark II database developed by Lane

---

**TABLE A.8 Adjusted Net Saving’s Components and Primary Data Sources**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Primary data sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross national savings (GNS)</td>
<td>Calculated as gross national income less total consumption, plus net transfers, a standard item in the System of National Accounts.</td>
<td>World Bank, World Development Indicators</td>
</tr>
<tr>
<td>Consumption of fixed capital (CFC)</td>
<td>Calculated as the replacement value of capital used up in the process of production, also a standard item in the System of National Accounts.</td>
<td>United Nations, OECD, and Penn World Table, with missing data estimated by World Bank staff</td>
</tr>
<tr>
<td>Current public expenditure on education (EDU)</td>
<td>Standard savings measures only count as an investment that portion of total expenditure on education (usually less than 10 percent) that goes toward fixed capital such as school buildings; the rest is considered consumption. Within the ANS framework, which considers human capital to be a valuable asset, expenditures on its formation cannot be labeled as simple consumption. As a lower-bound first approximation, the calculation thus includes current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment.</td>
<td>UNESCO: data extrapolated from the most recent year available</td>
</tr>
</tbody>
</table>

(continued on next page)
### TABLE A.8 Adjusted Net Saving’s Components and Primary Data Sources (continued)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Primary data sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net forest depletion (NFD)</td>
<td>Calculated as the product of unit resource rents and the excess of roundwood harvest over natural growth. If growth exceeds harvest, this figure is zero.</td>
<td>See “Forest Resources: Timber” section earlier in this appendix</td>
</tr>
<tr>
<td>Depletion of fossil energy resources (END)</td>
<td>Calculated as the ratio of the value of the stock of energy resources to the remaining reserve lifetime. It covers coal, crude oil, and natural gas.</td>
<td>See “Fossil Fuel Energy and Mineral Resources” section earlier in this appendix</td>
</tr>
<tr>
<td>Depletion of metals and minerals (MID)</td>
<td>Calculated as the ratio of the value of the stock of mineral resources to the remaining reserve lifetime. It covers bauxite, copper, gold, iron ore, lead, nickel, phosphate rock, silver, tin, and zinc.</td>
<td>See “Fossil Fuel Energy and Mineral Resources” section earlier in this appendix</td>
</tr>
<tr>
<td>Carbon dioxide damage ($CO_2$)</td>
<td>Cost of damage due to $CO_2$ emissions from fossil fuel use and the manufacture of cement, estimated to be US$40 per ton of $CO_2$ (the unit damage in 2017 US dollars for $CO_2$ emitted in 2020) times the number of tons of $CO_2$ emitted.</td>
<td>World Bank, World Development Indicators</td>
</tr>
<tr>
<td>Air pollution damage (POL)</td>
<td>Cost of damage due to exposure of a country’s population to ambient concentrations of particulates measuring less than 2.5 microns in diameter ($PM_{2.5}$), indoor concentrations of $PM_{2.5}$, and ambient ozone pollution. Damages are calculated as foregone labor income due to premature death from pollution exposure.</td>
<td>Data on health impacts from pollution exposure from the Institute for Health Metrics and Evaluation’s Global Burden of Disease Study</td>
</tr>
</tbody>
</table>


and Milesi-Ferretti (2007). The Lane and Milesi-Ferretti database, last updated in early 2020, provides estimates of NFA for 1970–2019 for 214 economies. Where estimates of NFA and its components are not available in the Lane and Milesi-Ferretti database, additional data are obtained from various sources to extend the country coverage.

### Adjusted Net Saving

Table A.8 provides a brief overview of the underlying components of the adjusted net saving (ANS) indicator and their primary data sources.

### Notes

1. The 4 percent discount rate is the long-term (100 years or more) real return on financial assets globally, derived from Credit Suisse data.
2. Mangroves also provide protection from coastal erosion, but that value is not yet included.
3. *Ex-vessel* pertains to activities that occur when a commercial fishing boat lands or unloads a catch.


References


BGR (German Federal Institute for Geosciences and Natural Resources). 2015. *Reserves, Resources, and Availability of Energy Resources*. Hanover, Germany: BGR.


