Macroeconomic Measurement:
Environmental and Social Dimensions

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A GDAE Teaching Module on Social and Environmental Issues in Economics

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NOTE – terms denoted in **bold face** are defined in the **KEY TERMS AND CONCEPTS** section at the end of the module.

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1. INTRODUCTION

GDP is a good (though not perfect) summary of the annual flow of marketed goods and services through the economic system. In the 80-plus years since the introduction of national income accounting in major industrial countries, GDP has become the official barometer of living standards and business cycles. It appears in newspapers and political debates as an indicator of economic, political, and social progress and it is widely used in formulating national and international policies.

Although GDP numbers are widely used as a proxy for national success, GDP was never intended to play such a role. Economists dating back to Simon Kuznets, the originator of U.S. national accounting systems, have warned that GDP is a specialized tool for measuring market activity, which should not be confused with national well-being. National well-being is affected by social and environmental factors, such as inequality, political participation, security, quality of healthcare and education, and access to clean air and water, which are no less important than marketed economic activity. We need to account for these factors in order to develop a more complete measure of well-being.

Neglecting questions of "what, how, and for whom" can mean that growth in production per capita may not lead to increased welfare. Now we can examine in more detail the problems that arise from focusing on production alone—or from focusing only on the money value of output, with too little attention to the details of what is being produced and how it affects human well-being. In order to understand this more complete picture of the economy, national governments need to start gathering new kinds of data and creating new indicators. In addition, the use of alternative measures to GDP may have important implications for policy-making.

Before we begin to discuss specific options for adjusting, replacing, or supplementing GDP, we first need to ask ourselves three important questions:

1. *What should we measure?* GDP measures only economic production. Are there some things that GDP excludes that should be included as a component of well-being, such as health outcomes or environmental quality? Should some parts of GDP be excluded because they harm well-being, in the short or long term?

2. *What should be used as the unit of measurement?* Although GDP is measured in dollars, what units should be used to measure other variables affecting wellbeing, such as education, health, levels of crime, or environmental quality?

3. *Should we seek to combine disparate well-being indicators into a single "bottom- line" number, or should we keep the variables disaggregated (i.e., split up into component categories)?* One tempting approach is to convert all variables to dollars to allow for comparability. But what techniques can we use to measure variables such as environmental quality or social capital in dollars, and should we even try?

This module presents some alternatives to national accounting that address these questions and reflect our growing awareness of the importance of social and environmental contexts of economic

activity. We begin by listing some of the limitations of GDP as a measure of well-being and then discuss how the alternative indicators attempt to tackle these limitations.

2. WHY GDP IS NOT A MEASURE OF WELL-BEING

GDP was never intended to measure welfare or well-being. As suggested in Box 1, GDP often rises with increases in things that most people would want to have less of, while it often fails to rise with positive contributions to individual and social well-being that are not bought and sold in markets. Even if increases in GDP contributes to increasing well-being, ceteris paribus, many other factors may be equally or more important in determining well-being levels. In fact, overall social well-being may be declining if GDP growth is accompanied by increasing inequality and environmental degradation. Thus, well-being is clearly multidimensional. If we rely only on GDP to measure wellbeing, we may obtain policy prescriptions that make the country worse off, rather than better off.

BOX 1: THERE'S NO G-D-P IN "A BETTER ECONOMY"

The United States is the largest economy in the world, ranked by total GDP. In terms of GDP per capita, it ranks high but falls below some other countries such as Luxembourg, Norway, Ireland, and Switzerland. But how significant is this measure?

"Gross domestic product has become the most watched and most misinterpreted of all economic indicators. It's a measure of economic activity—of money changing hands. Despite the mundane nature of this economic indicator, politicians fiercely compete with each other to see who can promise the fastest GDP growth. Government programs and investments in technology get the green light only when they are predicted to spur GDP growth. Economists, bankers, and businesspeople pop the champagne corks when they hear 'good news' about quarterly GDP numbers.

And while the United States leads in GDP, it also leads in military spending, the number of people in prison, and the percentage of people who are obese. These other first-place finishes seem at odds with America's position atop the GDP standings—that is, until you realize that spending on war, incarceration, and disease, as well as other "defensive expenditures," all count toward GDP. The arithmetic of GDP doesn't consider what the money is actually being spent on, and over time, we've been spending more and more money on remedial activities and calling this 'progress'."

Alternative GDP indicators can be constructed that correct for these negative aspects of production, as well as taking into account positive factors such as a clean environment, household production, or volunteer work that contribute to well-being but are not included in GDP. Such indicators have drawn increasing interest from economists and policymakers in recent years.

Sources: Dietz and O'Neill, 2013; IMF, 2017.

Many important issues are not included adequately, if at all in GDP. In addition, some things that are included in GDP can be misleading or represent actively harmful activities.

- A critical issue is *household production*, which is examined at more length later in this module. While standard accounting measures include the paid labor from such household activities as child care and gardening, these services are not counted when they are unpaid.
- Standard measures do not count the benefits of *volunteer work*, even though such work can contribute to social well-being as much as economic production does. Also, the free services provided by many non-profit organizations (e.g., a homeless shelter funded by donations) go unaccounted, even if the workers in the organization are paid.
- Some significant services *provided for free* are not counted, even though they might increase well-being. This includes some free internet services such as Wikipedia, Gmail or YouTube. While Wikipedia relies on unpaid volunteer work, Gmail and YouTube depend on income from advertising, which is counted as part of GDP, but this does not capture the full value of the services provided to users.
- *Leisure* is another important neglected factor. A rise in output might come about because people spend more time and effort on paid work. The resulting increase in measured output does not take into account the fact that overwork makes people more tired and stressed and takes away from time that they could use for enjoying other activities. But if people spend more time as leisure, increasing their well-being, this will not be reflected in GDP (except insofar as they spend money on leisure-related activities).
- Also inadequately reflected are issues around loss (or gain) of *human and social capital formation*. Social and political factors that may significantly affect well-being include the health and education levels of a country's citizens, as well as political participation, government effectiveness (or lack thereof), and issues of trust, corruption, or other aspects of the economic and social culture.
- Another significant criticism of GDP, when used as a general measure of economic progress or success, is that *interactions between the economy and the natural world are often ignored*. GDP generally does not account for environmental degradation and resource depletion, while treating natural resources that do not go through the market (such as the water purification services provided by natural systems such as forests and wetlands) as having no monetary value.
- Some outputs merely compensate for, or defend against, harmful events that result, directly or indirectly, from the economic activity represented in GDP. Referred to as **defensive expenditures**, these show up as positive contributions to GDP but we do not account for the associated negative impacts. Consider, for example, an oil spill that results in massive clean-up efforts: The billions of dollars spent cleaning up after the 2011 Deepwater Horizon oil spill in the Gulf of Mexico turned up as positive additions to GDP, even while the environmental and human losses are mostly not reflected. When environmental issues are mostly invisible, there can be an appearance of economic growth even as the ecological basis for future economic health is being seriously undermined.
- *Products or production methods that reduce, rather than increase, well-being* may show up as additions to GDP. Unhealthy foods and drugs and dangerous equipment, for example, may lower, not raise, overall well-being. Even if people are willing to pay for such goods and services, either individually (perhaps influenced by advertising) or through their governments (perhaps influenced by interest group lobbyists), such decisions might reflect

poor information or bad judgment when looked at from the point of view of well-being. In terms of production methods, if people are miserable at their jobs, suffering boring, degrading, unpleasant, or harmful working conditions, their well-being is compromised. The divergence between output and well-being is especially obvious in cases where workers' lives or health are threatened by their working conditions, even while their work results in a high volume of marketed goods and services.

- Another gap between GDP and well-being is *financial debt*. GDP counts consumption levels as rising even if the rise is financed by unsustainably large debt burdens, whether the debt is held by consumers or by governments. When debts are high enough to require painful changes in future consumption, not accounting for financial debt is similar to not accounting for unsustainable tolls exacted on the natural environment.

- Finally, increased economic activity in a given country is counted as an addition to GDP even if it *increases inequality*. Two countries with the same per-capita GDP may have a significantly different income distribution and, closely related, different levels of overall well-being. At an individual level, if someone making just $20,000 per year receives a raise of $1,000, this is counted as the same societal gain as it would be if that raise went to someone with an income of $100,000. Obviously, the additional income means much more for the individual well-being of the person with the lower salary. Although economists generally accept this concept (called the diminishing marginal utility of income), GDP counts income gains the same regardless of whether the person receiving the increase desperately needs the income or is already rich.

The foregoing examples all indicate the dangers of pursuing policies geared only to raising GDP. A narrow national focus solely on increasing output may result in decreased leisure and less time for parenting, friendships, and community relations; it can increase levels of stress and mental illness, or raise economic inequality to a socially destructive level. For all these reasons, improvements are needed in the design of measures of national success and in defining and gathering the data needed for such measures. The next section describes some leading alternative measures.

3. A BROADER VIEW OF NATIONAL INCOME ACCOUNTING

A number of national and international initiatives have been taken to modify national accounts by additional official data on well-being. In the United States, efforts to improve social and environmental dimensions of macroeconomic measurement in the national accounts has slowed considerably due to funding cutbacks. Nevertheless, many private groups, subnational entities (such as states in the U.S.), and official statistical agencies in a number of other countries are making progress in developing better measures to address the social and environmental issues of the twenty-first century.

One of the approaches to creating alternative indicators focuses on refining measures of national assets and production, supplementing the National Income and Products Account (NIPA) framework with information on resources and environmental impacts. Another approach involves developing separate indicators for the different aspects of well-being and using these additional measures in combination with GDP to get a better assessment of well-being. Other measures rely

on creating wholly new indicators based on a composite index including a set of variables measuring different aspects of well-being. Examples of some of these indicators, along with their estimation and application, are presented in this section.

3.1 Satellite Accounts

One approach to measuring well-being has been the development of **satellite accounts**, which are intended to supplement standard national income accounts by tracking data on well-being indicators, such as health, education, and other aspects of social and environmental well-being.[1] For example, the United Kingdom maintains environmental accounts that track data on forested area, oil and gas reserves, waste generation, greenhouse gas emissions, and expenditures on environmental protection. Satellite accounts can be viewed as a "dashboard" approach to national accounting. The dashboard on a car provides not only a speedometer but also a gas gauge, as well as indicators of temperature, battery level, and miles driven per gallon of fuel. The dashboard on an airplane contains even more indicators, and an economy is considerably more complex than an airplane. Proponents of this approach agree that GDP is a useful measure of national output for historical and international comparisons, but believe that GDP tells us only one of the things that we want to know about the economy. Some of the things that it does not tell us are important, and they deserve to have their own indicators.

The U.S. Bureau of Economic Analysis (BEA) uses dollar-denominated satellite accounts to highlight certain existing components of GDP.[2] Beginning in 1994 the BEA operated a satellite account that was designed to see how GDP would be different if research and development were counted as investment rather than spending. This change was incorporated into the core GDP account beginning in 2013.

In 1998, BEA introduced two other satellite accounts—Transportation, and Travel and Tourism—to estimate the contribution of each of these sectors to the GDP. And in 2013, the Health Care account was added to highlight health-care spending classified by the diseases being treated (instead of the types of goods and services purchased such as doctor visits or drugs). More recently satellite accounts for Arts and Cultural Production and Outdoor Recreation have been added to the BEA accounts. These satellite accounts eliminate some of the obscurity in the aggregate GDP measure, by estimating the contributions of particular sectors to the national income. Future uses of satellite accounts in the BEA may start experimenting with changes such as valuing household labor or counting environmental damages as losses.

In general, the BEA's satellite accounts rely on monetary valuation and are readily comparable to GDP. Other countries use satellite accounts in which the unit of measurement is physical units such as tons of carbon dioxide emitted or numbers of children in poverty. Even where resources can be easily valued in dollars, data in physical units may be more meaningful. Consider that we

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[1] The United Nations differentiates between "internal" satellite accounts (those that are linked to standard accounts and typically measured in monetary units) and "external" satellite accounts (not necessarily linked and measured in either physical or monetary units).
See: http://unstats.un.org/unsd/nationalaccount/AEG/papers/m4SatelliteAccounts.pdf.
[2] Information on BEA Satellite Account is available at: https://www.bea.gov/industry/#satellite

could measure the economic value of mineral reserves by multiplying the quantity of reserves in physical units by the market price. But suppose that the market price increases considerably at the same time that reserves are drawn down. Although the economic value of reserves could increase, that information would fail to tell us that our physical reserves have declined.

Moreover, it is often very difficult to convert variables to monetary units. How can we express changes in crime levels or health status in terms of dollar values? Such questions raise important methodological issues, such as whether the economic value of higher asthma rates includes only medical expenditures and lost productivity, or whether other quality of life factors need to be considered. Some people may raise ethical objections to attaching dollar values to variables such as traffic deaths or biodiversity.

As we delve into additional categories that we might wish to have reported in national accounts, we may find ourselves straying into areas where measurement becomes more difficult. Thus, we can add a fourth question to our list above: Should we include only variables that can be measured objectively (whether in money or other units), or should we also consider subjective data? In particular, should one or more of our "dashboard" indicators present the results from surveys that ask people about their well-being? We consider this possibility next.

3.2 Measuring Well-Being

Recognizing the limitations of GDP and the need to develop indicators that incorporate social and environmental factors, in 2008 French president Nicolas Sarkozy created the Commission on the Measurement of Economic Performance and Social Progress. The commission, which included many distinguished social scientists, was headed by Nobel laureates Joseph Stiglitz and Amartya Sen, and coordinated by prominent French economist Jean-Paul Fitoussi.

In September 2009, the commission produced its nearly 300-page report. It concluded that it is necessary to shift from an emphasis on measuring economic production to measuring well-being. It also distinguished between current well-being and sustainability, recognizing that whether current well-being can be sustained depends upon the levels of capital (natural, physical, human, and social) passed on to future generations.

The Stiglitz-Sen-Fitoussi Commission defined eight dimensions of well-being, including material living standards, health, education, work and personal activities, political voice, social connections, economic and physical security or insecurity, and the environment.

Objective data can be collected that provide information on many of these dimensions, such as average life expectancy, literacy rates, and air pollution levels. But such data still do not tell us exactly how these factors relate to well-being. If the goal of economics is to promote well-being, you may wonder why economists do not try to measure it directly. Until recently, most economists believed that it was not possible to obtain quantitative data on something that is inherently subjective; we cannot hook up individuals to a machine and measure their well-being in unambiguous quantitative terms. But we can take a much more intuitive approach—we can simply ask people about their well-being. Although this approach may seem unscientific, a large body of

scientific research has emerged in recent decades that suggests that data on **subjective well-being** (SWB) provides meaningful information regarding social welfare levels and the factors that influence well-being. Collecting data on SWB involves surveying individuals and asking them a question such as: "All things considered, how satisfied are you with your life as a whole these days?" Respondents then answer based on a scale from 1 (dissatisfied) to 10 (satisfied). How much credence can we give to the answers to such questions?

A wide variety of efforts, such as the World Happiness Report from Columbia University's Earth Institute,[3] the Gallup World Poll, and the European Quality of Life Survey, have come up with remarkably consistent measures of "happiness" or "life satisfaction." The Stiglitz-Sen-Fitoussi Commission concludes:

> Research has shown that it is possible to collect meaningful and reliable data on subjective as well as objective well-being. Quantitative measures of [SWB] hold the promise of delivering not just a good measure of quality of life per se, but also a better understanding of its determinants, reaching beyond people's income and material conditions. Despite the persistence of many unresolved issues, these subjective measures provide important information about quality of life.[4]

The Stiglitz-Sen-Fitoussi Commission recommends using SWB data in conjunction with objective data on various well-being dimensions such as income levels and health outcomes to obtain a more comprehensive picture of welfare.

Most relevant for our study of macroeconomics is how SWB results correlate with standard economic measures of national welfare such as GDP. We can ask two relevant questions about this relationship:

1. Are average SWB levels higher in countries with higher GDP per capita?
2. As GDP per capita increases in a particular country over time, do SWB levels rise?

SWB data have been collected for many developed and developing countries. Figure 1 plots average SWB against per-capita GDP, adjusted for differences in purchasing power, for 60 countries. In general, SWB is positively correlated with higher levels of GDP per capita, but note that the benefits of income gains decline at higher income levels, as shown by the curved trendline.* However, SWB can be high in both rich and poor countries. In fact, the countries with the highest SWB levels are Mexico and Colombia, both middle-income countries.

Figure 1 also shows that while SWB varies among richer countries, all developed countries have relatively high SWB. There are no countries above a per capita GDP of US$20,000 per year that have an average SWB below 6.0, and many poorer countries have an average SWB below 6.0. Thus, it appears from this graph that for at least some developing countries, increasing GDP could lead to higher SWB levels. But income gains in richer countries are associated with much smaller increases in SWB.

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[3] World Happiness Report 2017.
[4] Stiglitz, Sen and Fitoussi, 2009, p. 16.
* A trendline represents the statistical "best fit" showing the relationship between the two variables on the graph.

Figure 1. *The Average Subjective Well-Being and GDP per Capita, 2016 PPP*
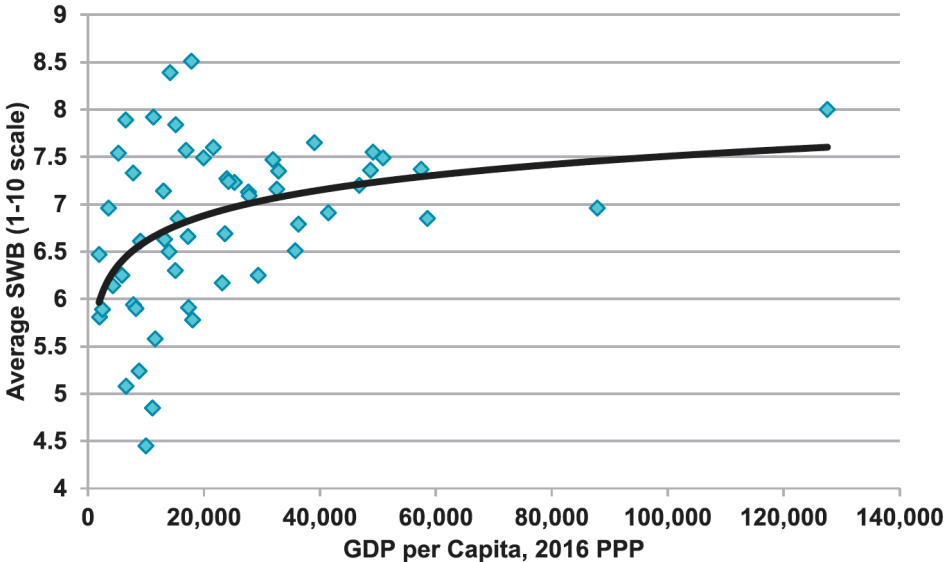
Sources: SWB from World Values Survey online data analysis, 2005–2008 survey wave; GDP from World Development Indicators online database.

Note: The trendline is a statistically fitted line showing a "best fit" estimate of the relationship between the two variables on the graph, GDP per capita and SWB.

The other way to analyze country-level SWB data is to consider how SWB changes as a country develops economically over time. The longest time series of SWB data comes from the United States, dating back to 1946. While real GDP per capita has increased by about a factor of three since 1946, average SWB levels have essentially remained constant. An analysis of country trends in SWB over the period 1981–2007 found that average SWB rose in 45 of 52 countries, with economic growth associated with greater SWB gains for low-income countries. India is an example of a country that has experienced significant gains in SWB levels as its economy has grown in recent decades.[5]

Based on both approaches to evaluating SWB, the results imply that as people are able to meet their basic needs, such as adequate nutrition and basic health care, their happiness generally increases. Beyond that, further income gains are associated with smaller increases in SWB or no increase at all (as shown by the flattening out of the trend line in Figure 1). One explanation for this might be that at higher income levels, people are more likely to judge their happiness relative to others. So even if everyone's income increases by the same percentage, average happiness levels may be unchanged. Another possibility might be that consuming more goods and services is simply not making people any happier, or that the benefits of increased consumption are offset by negative factors such as increased congestion and stress.

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[5] Ingelhart et al., 2008.

As the Stiglitz-Sen-Fitoussi Commission mentions, further work is needed to understand the relationship between SWB and other well-being measures. But the results so far suggest that SWB should be one of the indicators on our "dashboard" of well-being measures.

3.3 The Genuine Progress Indicator (GPI)

In 1989, economist Herman Daly and theologian John Cobb Jr. suggested an alternative measure to GDP that they called the Index of Sustainable Economic Welfare (ISEW). This measure was later transformed into the Genuine Progress Indicator (GPI), one of the most ambitious attempts to date to design a replacement to GDP.[6] The GPI is a monetary measure of economic well-being for a given population in a given year that adds many benefits and subtracts many costs that are not included in GDP. It is designed to differentiate

> between economic activity that diminishes both natural and social capital and activity that enhances such capital.... In particular, if GPI is stable or increasing in a given year the implication is that stocks of natural and social capital on which all goods and services flows depend will be at least as great for the next generation, while if GPI is falling it implies that the economic system is eroding those stocks and limiting the next generation's prospects.[7]

Over time, the GPI measure has been modified to respond to theoretical critiques and to integrate new data sources and valuation methods. The most recent version of GPI (termed GPI 2.0) aims to provide a consistent and precise framework for measuring GPI.[8] GPI 2.0 has three main components: market-based welfare, services from essential capital, and environmental and social costs.

Market-Based Welfare
The starting point of market-based welfare is personal consumption expenditures (PCE). Economic welfare is primarily based on household's consumption levels; hence, business investments, government consumption and net exports are subtracted from GDP to get PCE. In the United States, about 70 percent of GDP consists of personal consumption. In calculating the GPI 2.0, PCE is relabeled as household budget expenditure (HBE) to broaden the term so as to encourage the use of alternatives to NIPA PCE data that may have more detailed data on consumption, and to recognize that a significant amount of PCE may not be welfare increasing consumption.

Components of HBE that have zero or negative contribution to the household's current well-being are then subtracted from HBE. This includes defensive and "regrettable" expenditures including medical care, legal services, insurance, food and energy waste, household pollution abatement, security expenses, and other expenditures that may be necessary but do not add to overall well-being. Also, to keep the focus on current welfare, expenditures on household investments that may

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[6] Another predecessor to the GPI and the ISEW was the Measure of Economic Welfare, by William Nordhaus and James Tobin. This 1973 effort was the first serious attempt to create an alternative to GDP.
[7] Talberth et al., 2007.
[8] Talberth and Weisdorf, 2017, p. 142.

contribute to long-term sustainability are subtracted from HBE. Hence, spending on consumer durables, household maintenance, higher education, savings, retirement, and charitable giving are deducted (although current services from these investments are included).

Next, an adjustment is made for income inequality to reflect the negative impact of inequality on well-being. And, finally, benefits from provision of public goods and services are added since the exclusion of government spending from PCE underestimates the actual value of household consumption. The resulting value after making these adjustments gives the total market-based welfare.

Services from Essential Capital

Unlike GDP, which mostly focuses on manufactured capital, GPI accounts for welfare benefits from services of human, social and natural capital. Services from human capital include benefits from higher education, knowledge and skills. Value of household and volunteer work, leisure time, and benefits from internet services fall under social capital. Services from manufactured capital include gains from consumer durables, home improvement and infrastructure. All economically valuable functions of nature such as provision of food and medicine, pollination of crops, and benefits from lakes, rivers, forests, wetlands, deserts and other ecosystems constitute the services from natural capital. The gains from services provided by these capital resources are added to the total market-based welfare.

Social and Environmental Costs

Social and environmental costs include aspects of economic activity that have a negative effect on well-being. For instance, homelessness, underemployment, increasing crime rate, more time spent in traffic, and vehicle accidents all have an adverse impact on human well-being and are counted as social costs. Environmental costs include the depletion of natural capital such as the loss of wetlands, groundwater depletion, productivity losses due to soil erosion, as well as the increase in air pollutants, greenhouse gas emissions, and noise and water pollution. Social and environmental costs are subtracted from the total of market-based welfare and services from essential capital to get the final GPI measure.

The adjustments made to household budget expenditure in order to arrive at the GPI for a recent year (2014) are shown in Table 1.

As we might expect, with all the adjustments outlined above, the GPI differs significantly from GDP in magnitude and trends. The largest positive adjustments to GPI come from the benefits of social capital, which include unpaid work and the value of leisure time and internet services. The largest deductions come from the depletion of natural capital.

Over the long term, not only is per-capita GPI much lower than per-capita GDP, but its growth trajectory is different from that of GDP. As shown in Figure 2, while GDP per capita and GPI per capita both increased with economic growth from 1950 to about 1978, in recent decades GPI has flat-lined while GDP continued to grow, indicating that environmental and social costs omitted from GDP have been increasing faster than the value of the omitted benefits. This trend appears to continue using GPI 2.0 for the years 2012–2014 (Figure 3). Relying on the GPI instead of GDP might suggest significantly different policy recommendations, focusing more on reducing

environmental damage, preserving natural renewable energy resources, and redressing rising inequality.

GPI estimates have been developed for countries other than the United States, including Australia, China, Germany, India, Japan, Italy and Brazil. The GPI has also been applied at the subnational level, not only in the United States but also in other countries such as China (Liaoning Province), Italy (Tuscany) and Belgium (Flanders). For example, a 2009 analysis of the Auckland region in New Zealand showed that between 1990 and 2006 the GPI grew at nearly the same rate as the region's GDP. Even in this case, environmental losses grew at a more rapid rate than the GPI—rising 27 percent during this period, while the GPI rose 18 percent. But the positive contributions to the GPI, in particular growth in personal consumption, were enough to more than offset the environmental losses.[9]

Table 1. *Genuine Progress Indicator ($2012 per Capita), United States 2014*

Indicator	Value
Market-based welfare	
Household budget expenditures (HBE)	$25,529.42
Defensive and regrettable expenditures	- $3,966.90
Household investments	- $7,278.06
Costs of income inequality	- $3,121.57
Public provision of goods and services	+ $7,025.23
Total market-based welfare	$18,188.12
Services from essential capital	
Services from human capital	+ $5,223.68
Services from social capital	+ $12,856.93
Services from built capital	+ $6,041.57
Services from protected natural capital	+ $1,554.65
Total services from essential capital	$25,676.65
Environmental and social costs	
Depletion of natural capital	- $6,495.60
Costs of pollution	- $3,714.65
Social costs of economic activity	- $5,195.44
Total environmental and social costs	$15,405.69
GPI per capita total	$28,459.09

Source: Talberth and Weisdorf, 2017.

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[9] Note that this study is based on an earlier variation of GPI, but the underlying method of estimation of GPI—taking the total personal consumption expenditure, adding the positive contributions to well-being and subtracting the negative ones—is the same.

Figure 2. *GPI vs. GDP per Capita, 1950-2004*
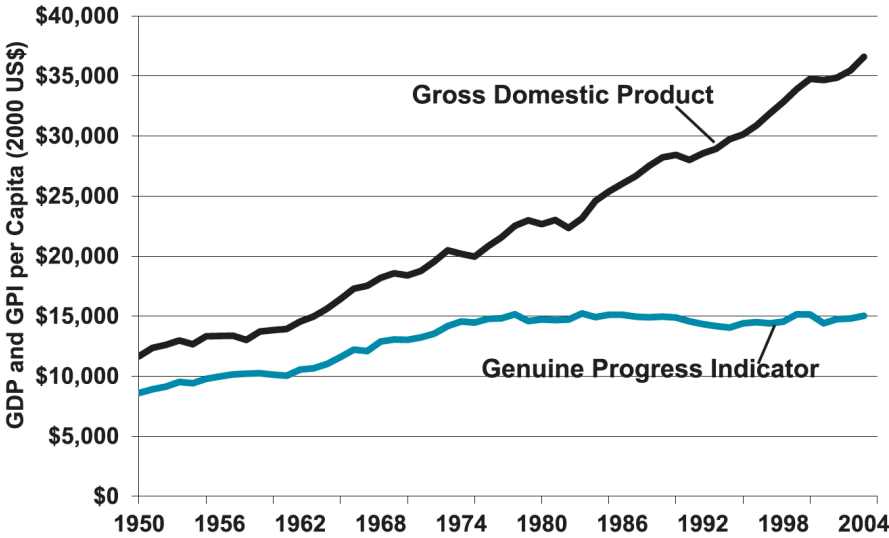
Source: Talberth et al., 2007.

Figure 3. *GPI vs. GDP per Capita, 2012-2014*
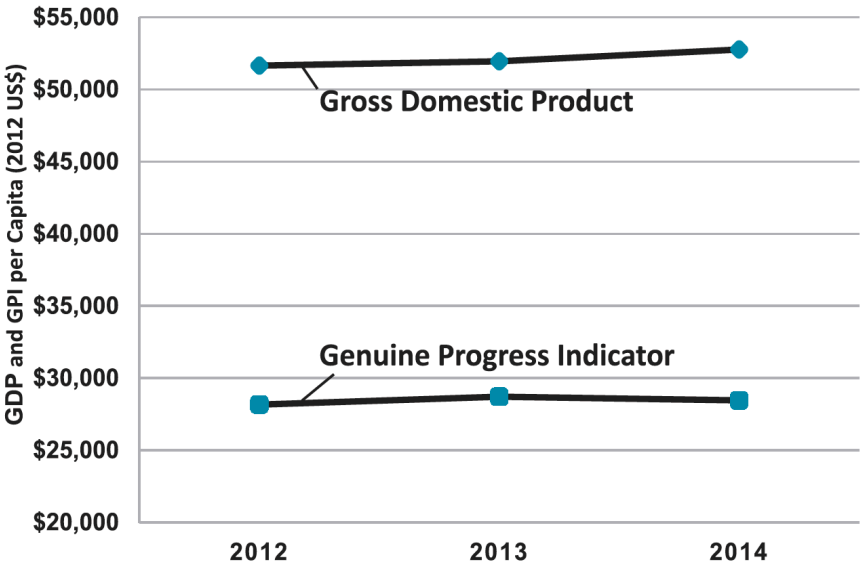
Source: Talberth and Weisdorf, 2017.

The states of Maryland and Vermont and the city of Baltimore also measure their GPI. In Maryland, while economic contributions to the GPI rose steadily over the period 1960–2010, the net social contributions increased only slightly, and the environmental costs more than doubled (based on the earlier variation of GPI). In Vermont, 2011 GPI per capita was 40 percent less than

state GDP due to rising income inequality and a strong dependence on fossil fuels.[10] According to a 2017 analysis of the Maryland GPI, "the GPI can help to show net societal benefits of policies such as investing in public transit, increasing the minimum wage and reducing greenhouse gases—giving policymakers and advocates additional ammunition for political battles over such issues," but actual influence on policy was limited.[11]

3.4 The Better Life Index (BDI)

One of the challenges of using multiple indicators to evaluate well-being, as suggested by the dashboard approach, is that it is sometimes difficult to communicate the results. How do we assess overall well-being if the poverty rate falls by two percentage points, but the emission of greenhouse gases increases by 3 percent? On the other hand, summing up production, poverty, inequality, environmental degradation and other aspects of the quality of life in one single index, as is done with the GPI measure, also poses problems: In order to be added up, monetary values need to be attached to each dimension. Yet it is extremely difficult to value health, inequality or ecological functions in dollar terms.

The Organization for Economic Cooperation and Development (OECD) has thus tried a mixed approach.† With its **Better Life Index** (BLI), it tries to combine a large number of dimensions, many of which cannot easily be valued in monetary terms, into one single indicator using different possible weights for each dimension. BLI is somewhat more ambitious than the GPI in attempting to include more variables that are not commonly used for national accounting, precisely because they are hard to measure. The 2015 BLI report argues that:

> a better understanding of people's well-being is central to developing better policies for better lives. Well-being is multidimensional, covering aspects of life ranging from civic engagement to housing, from household income to work-life balance, and from skills to health status. A thorough assessment of whether life is getting better requires a wide range of metrics, captured on a human scale, and able to reflect the diverse experiences of people.[12]

BLI considers well-being a function of the following 11 dimensions:
1. **Income, Wealth, and Inequality**: The main variables used for this dimension are disposable household income and net financial wealth.[13] The BLI also considers the degree of inequality in income and wealth.
2. **Jobs and Earnings**: The main variables comprising this dimension are the unemployment rate, the long-term unemployment rate, and average earnings per employee.

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[10] Ceroni, 2014.

[11] Hayden and Wilson, 2018, p. 462.

[12] BLI, 2015.

[13] In addition to the main variables discussed here, most of the dimensions also consider secondary variables. For example, the dimension of income and wealth also includes data on household consumption and a subjective evaluation of material well-being.

† The OECD is a group of the world's advanced industrialized countries, now including some developing countries, such as Mexico. The BLI was created, in part, as a response to the 2009 Sarkozy Commission report.

3. **Housing Conditions**: Sufficient housing is important to provide security, privacy, and stability.

4. **Health Status**: The BLI includes life expectancy and a subjective evaluation of one's overall health status.

5. **Work and Life Balance**: The BLI measures the proportion of employees who work long (50 or more) hours per week, the time available for leisure and personal care, and the employment rate for women with school-age children.

6. **Education and Skills**: This is measured as the percentage of the adult (25–64-year-old) population that has a secondary-school degree, and uses standardized testing to measure students' cognitive skills.

7. **Social Connections**: This dimension is measured by people's responses to a standardized question asking whether they have friends or relatives on whom they can count in times of need.

8. **Civic Engagement and Governance**: This dimension is based on voter turnout data and a composite index that measures citizen input into policy-making.

9. **Environmental Quality**: The main variable used to measure environmental quality is air pollution levels, specifically levels of particulate matter. Secondary environmental variables include an estimate of the degree to which diseases are caused by environmental factors, people's subjective satisfaction with their local environment, and access to green space.

10. **Personal Security**: This dimension focuses on threats to one's safety. It is measured using homicide and assault rates.

11. **Subjective Well-Being**: This dimension measures people's overall satisfaction with their lives, as well as reported negative feelings.

The BLI is designed to produce an overall well-being index. The results for each dimension are standardized across countries, resulting in a score from 0 to 10. But how do we assign a weight to the various components? One approach would be simply to weigh each of the 11 dimensions equally. The BLI report makes no specific recommendations for weighting the different dimensions, but its Web site allows users to select their own weights for each of the dimensions (see www.oecdbetterlifeindex.org). The OECD collects user input and uses this information to gain a better understanding of the factors that are most important for measuring well-being.

Based on input collected from over 100,000 users about their preferred weight for each dimension, the OECD 2015 report shows a considerable variation in the importance of the eleven well-being dimensions across regions. The highest ranked dimensions are education in Latin America, life satisfaction in North America, health, education and environment in Europe, safety in Asia-Pacific, and work-life balance in Australia.[14]

The BLI has been measured for 38 countries, including the OECD member countries, along with Brazil, South Africa, and Russia. Figure 4 shows the total BLI for eight countries. Among these countries, Norway and Australia show the greatest life satisfaction, scoring highly on employment levels, quality of jobs and health of the population (other Nordic nations along with Switzerland, New Zealand, and Canada have similar scores). Countries with low employment levels and low life expectancy have the lowest life satisfaction. The United States performs well in terms of

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[14] OECD, 2016.

household income, status of housing and sanitation, and long-term unemployment. It falls somewhere around the OECD average in terms of work-life balance, social connections, civic engagement, quality of working environment, literacy and cognitive skills, and exposure to pollution. But it ranks among the lowest in terms of inequality in income and health outcomes.[15]

Figure 4. *BLI for Selected Countries, 2015*
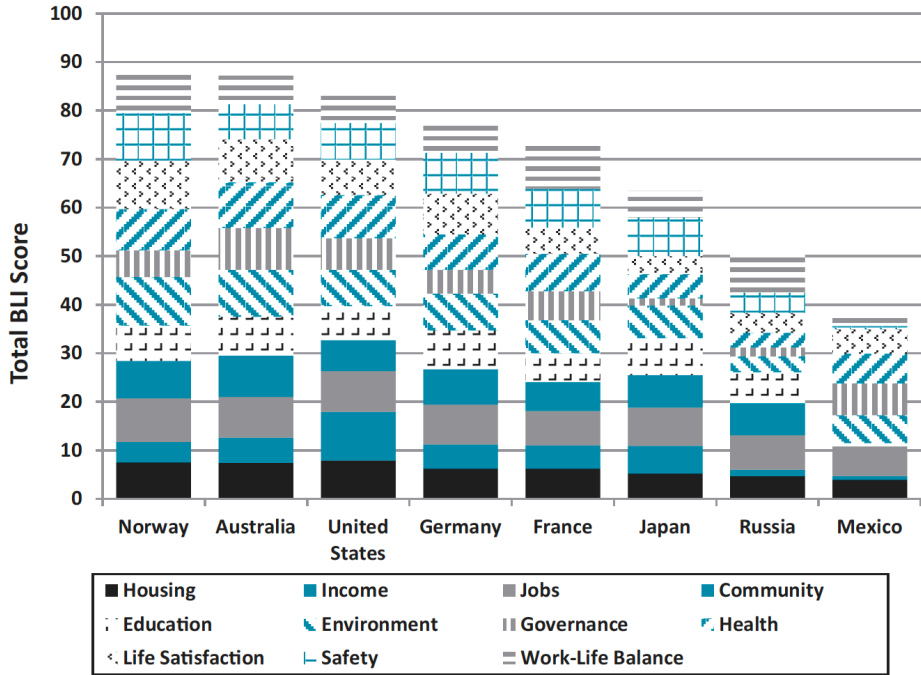
Source: OECD, 2015.

The BLI provides a comprehensive view of the many factors that influence well-being. Income is not presented as a dominant feature but as one component of many. One of the criteria used to choose the BLI variables is policy relevance. Several of the dimensions, such as education, housing, and environmental quality, can be directly improved with effective policies, although the linkage between other dimensions (such as subjective well-being) and policies needs further study.

3.5 The Human Development Index (HDI)

In contrast to the BLI, the United Nations **Human Development Index (HDI)** is calculated based on only three components of well-being: life expectancy at birth, years of formal education, and real Gross National Income (GNI) per capita.‡ Although these are denominated in different units,

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[15] OECD, 2015.

‡GNI is another name for GNP or Gross National Product. The difference between GNI/GNP and GDP is based on whether foreign earnings are included. GDP includes all earnings within a country's borders, including those earned by foreign citizens and corporations. GNI accounts for the earnings of a country's citizens and corporations, regardless of where they are located. To get from GDP to GNI, we subtract the earnings of foreign individuals and corporations and add the foreign earnings of domestic citizens and corporations.

no attempt is made to translate one into the other. Rather, relative performance is presented in a scaled index (Figure 5).

Figure 5. *Selected Countries as Ranked in the Human Development Index, 2016*

Human Development Index (Scale 1 – 100)	
90 – 95	Norway, Australia, Germany, Denmark, Netherlands, Canada, **United States**, New Zealand, Sweden, United Kingdom, Japan
85 – 89.9	Israel, France, Finland, Austria, Italy, Spain, Greece, Qatar, Poland
80 – 84.9	Chile, Saudi Arabia, Portugal, Hungary, Argentina, Russia
75 – 79.9	Bulgaria, Malaysia, Cuba, Turkey, Mexico, Brazil
70 – 74.9	Ukraine, Peru, Thailand, China, Colombia
65 – 69.9	Egypt, Vietnam, Philippines, El Salvador, South Africa
60 – 64.9	Iraq, Guatemala, India, Bhutan
55 – 59.9	Ghana, Kenya, Pakistan
50 – 54.9	Nigeria, Zimbabwe
45 – 49.9	Rwanda, Haiti, Afghanistan
40 – 44.9	Ethiopia, South Sudan
35 – 39.9	Niger, Central African Republic

Source: UNDP, Human Development Report, 2016 data.

Like the BLI, the HDI then faces the issue of how to assign relative weights. The standard HDI approach is to give equal weight to each of the three indicators. Although the GNI measure is modified to account for the principle, discussed above, that additional income is worth more to a person with lower income than to a person with higher income, the inclusion of standard measures of income as one-third of the indicator makes it highly, although not perfectly, correlated with GDP; of the 30 countries with the highest HDI scores in 2015, all but one was also ranked in the top 40 by national income per capita.

At the same time, the results often show that countries with similar income levels measured by GNI per capita vary dramatically in overall human welfare, as measured by the HDI. For example, Jamaica, the Philippines, and Swaziland have similar levels of GNI per capita, but their HDI scores vary significantly. Jamaica has the highest score in this group with a relatively high life expectancy of about 76 years, compared to 68 years in Philippines and 49 years in Swaziland. Education levels in Jamaica are also higher than those in the Philippines and Swaziland. Swaziland's low life expectancy and lower average education levels pulls down its HDI score.

The relative simplicity of the HDI has made it much easier to apply in countries with less money to spend on data collection; hence, it has been especially valuable for developing countries. It has

been an annual feature of every UN Human Development Report since 1990. In a number of countries, the HDI is now an official government statistic; its annual publication inaugurates serious political discussion and renewed efforts, nationally and regionally, to improve lives and is followed by many development agencies interested in tracking progress. The HDI is one of the most referenced quality-of-life indices and it continues to be modified, with new versions that adjust for inequality and gender equity.

3.6 Other National Accounting Alternatives

Aside from the measures just described, many other proposals have been made either to supplement GDP, adjust it, or replace it. To give a sense of this landscape, we briefly describe a sample of them. Except for the first one, they are all indicators that have been developed for use in specific locales.

- The **Happy Planet Index** (HPI) has been proposed by the New Economics Foundation of London, UK. Like the HDI, the HPI is designed to compare the success of different countries, to see how efficiently (in environmental terms) each country is able to promote the well-being of its inhabitants. The HPI is obtained by taking the product of life expectancy, life satisfaction, and inequality of outcomes, and dividing it by ecological footprint—a measure of ecological impact (see Box 2).
- **The Measure of America** presents an HDI modified for application in the United States. For example, although the standard HDI measures access to knowledge using the average number of years that students spend in school, Measure of America uses average achievement scores at various grade levels. The results, calculated down to the level of congressional districts, are available at www.measureofamerica.org.
- **Indicators of Well-Being in Canada** are listed on the Web site of the Canadian Department of Human Resources and Skills Development. Data collected by Statistics Canada are used to develop indicators of well-being in the domains of work, education, financial security, family life, housing, social participation, leisure, health, security, and environment.
- Other national examples include Italy, which has a **Regional Quality of Development Index**, a composite index of 45 variables pertaining to environment, economy, rights, gender equality, education, culture, working conditions, health, and political participation.
- France has the **Fleurbaey/Gaulier Indicator**, which is similar to GPI but tries to include even more monetary values of non-monetary factors (job security, healthy life expectancy, environmental sustainability), using subjective valuations of these factors to create adjusted "equivalent incomes." They are aggregated and then reduced by the degree of inequality in the equivalent incomes.
- The **Gross National Happiness (GNH)** concept was proposed in Bhutan in 1972 as a guiding principle for economic development that takes a holistic approach to improving the quality of people's lives. Although the concept of GNH has been used for decades, the attempt to quantify it is recent.[16] In 2010 it was formally defined along nine different dimensions of welfare (psychological well-being, standard of living, good governance,

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[16] Ura et al., 2012.

health, education, community vitality, cultural diversity and resilience, time use, and ecological diversity and resilience), including 33 distinct indicators. In 2015 the Centre for Bhutan Studies conducted an extensive survey of over 7,000 Bhutanese households to assess the country's GNH.[17] The results indicate that 43.4 percent of Bhutanese households have sufficiency in at least six domains and are thus considered either "deeply" or "extensively" happy. This is an improvement over an earlier survey in 2010, when 40.9 percent were similarly happy.

BOX 2: THE HAPPY PLANET INDEX

The Happy Planet Index asserts that the goal of society is to create long and happy lives for its members. To do this, natural resources must be used and wastes generated. The HPI is made up of four variables that reflect these concepts:

1. *Average life expectancy*: This measures whether a society's members lead long lives. The statistic for average life expectancy is obtainable for almost all countries.
2. *Average subjective well-being*: This measures whether a society's members lead happy lives. The data are obtained from the Gallup World Poll survey, which asks people how satisfied they are with their lives overall, on a scale of 1 to 10.
3. *Inequality of outcomes*: This measures inequality based on the data on distribution of life expectancy and subjective well-being within each country.
4. *Ecological footprint*: This measures a society's overall ecological impact. It is defined as the amount of land required to provide a society with the resources that it consumes and assimilate the waste that it generates. While it has been subject to methodological critiques, by converting all ecological impacts into a single value, it provides an overall assessment of sustainability.

In order to obtain the HPI, a country's well-being, life expectancy, and inequality of outcomes are multiplied to get a single measure of "happy life years" of a society. Then the HPI is calculated as:

HPI = Happy Life Years/Ecological Footprint

In 2016, the HPI was calculated for 140 countries. The countries with the highest HPI scores are those that have rather happy and long-lived citizens, moderate levels of inequality in outcomes, and relatively modest ecological footprints. Examples of countries with high HPI include Costa Rica, Vietnam, Thailand, and Jamaica. One interesting aspect of the HPI is that a country's HPI ranking tends to be unrelated to its GDP. Most wealthy nations including the United States, Japan, Canada, Australia and developed countries in Europe all score highly on 'Happy Life Years', but their HPI rank is lower than that of some of the less developed countries in Latin America and Asia Pacific region because of their larger ecological footprint. Luxembourg, for example, ranks 8th by GNI per capita and 20th in the HDI measure, but ranks 139th by HPI measure. The United States ranks 108, just above Bulgaria, Afghanistan and Rwanda, mainly because of its relatively large ecological footprint. The low HPI rank for most Sub-Saharan countries, in contrast, is due to

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[17] Centre for Bhutan Studies, 2016.

the low life expectancy, low subjective wellbeing and high inequality despite the relatively low ecological footprint of this region.

The interpretation and policy implications of the HPI are unclear. For example, India and Haiti have a higher HPI score than Sweden or Australia. Does this imply that India and Haiti are more desirable to live in, or more ecologically sustainable, than Sweden or Australia? Probably not. Another issue is to what extent a country's policies can affect happiness levels, which may be more a result of inherent social and cultural factors rather than policy choices.

Despite its limitations, the HPI has received attention as an alternative or supplement to GDP, especially in Europe. So while the HPI is unlikely to become a widespread alternative to GDP, it does provide information that is not currently captured in any other national accounting metric.

Sources: Jeffrey et al., 2016; Goossens et al., 2007.

One lesson from all these alternatives is that there is not necessarily a positive correlation between the total value of final purchases in an economy (which GDP is designed to measure) and other measures of well-being in the present or of economic possibility (even as measured by GDP) in the future. In many instances, GDP is rising while other measures stay flat or fall.

The next two sections focus on the issues surrounding two particular elements that have been seriously underrepresented in GDP. Section 4 discusses issues of accounting for household production. Section 5 takes up environmental accounting, including subsections on the methodological problems of how to assign values to things that are not sold through markets.

4. MEASURING HOUSEHOLD PRODUCTION

The preceding section described efforts around the world to improve the statistics that are used to assess a country's economic performance. Part of this movement includes interest in gathering data on household production. Many countries, including the United States, Australia, Canada, India, Japan, Mexico, Thailand, and the UK, have conducted or are conducting national time-use surveys to aid their understanding of productive activities that do not receive monetary compensation. The United Nations Statistical Commission and Eurostat (the statistical office of the European Union) are encouraging countries to develop satellite accounts that provide the necessary information to adjust measures of GDP so that they take into account both household production and interactions between the economy and the environment, while not changing the official definition of GDP.

4.1 Measuring Household Labor

Efforts to calculate household labor actually predate standard GDP accounts. In 1921 a group of economists at the National Bureau of Economic Research calculated that the value of household

services would be about 25 to 30 percent of marketed production. Decades later, in 1988, economist Robert Eisner reviewed six major proposed redesigns of the National Income and Product Accounts (NIPA), all of which included substantial estimated values for household production.[18] Despite numerous demonstrations of its practicality dating back almost 100 years, household production has never been included in the U.S. GDP accounts.

There are strong arguments to suggest that current GDP figures are less accurate for having neglected household production. Most obviously, GDP is understated— a substantial area of valuable productive activity has been overlooked (see Box 3). This was stressed by Simon Kuznets, the architect of national income accounting, when he presented his original set of estimates to Congress in 1937. With his typical candor, he noted what was missing, pointing in particular to "services of housewives and other members of the family."

BOX 3: WHAT ARE STAY-AT-HOME MOMS REALLY WORTH?

What is the fair market value of all the work a typical stay-at-home mom does in a year? To answer this question we can multiply the hours spent at different tasks by the typical wage paid to workers who perform those tasks. For example, according to 2012 research by insure.com, the typical mom spends 14 hours per week cooking. The U.S. Bureau of Labor Statistics estimates the average wage for cooks at about $9 per hour. This implies that the annual value of a mom's cooking labor is over $6,000. Applying the same approach to other household tasks, including child care, cleaning, shopping, yard work, and driving, the annual value of a full-time stay-at-home mom is over $60,000. Similar research by salary.com comes up with an even larger market value—about $113,000 annually!

While the number of stay-at-home dads in the United States has increased in recent decades, up to 2 million in 2012 compared to 1.1 million in 1989, they are far outnumbered by the 10.4 million stay-at-home moms in 2012.[19] But the number of stay-at-home moms has been declining in recent decades as more women have entered the workforce. While this brings additional income to households, the income is partially offset by additional expenses. In many states, the cost of full-time child care exceeds the typical annual cost of college tuition. For example, Child Care Aware of America reports that the average cost of childcare in Massachusetts is $17,082 per year.[20]

While the additional household income and market expenditures are counted as increases to GDP, the median salary in the United States for a woman working full-time is only about $39,052.[21] So based on the values presented above, it isn't clear whether total social welfare increases or decreases as a result of more women entering the workforce.

Sources: Briody, 2012; Pew Research Center, 2014; BLS, 2017; and ChildCare Aware of America.

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[18] Eisner, 1988.

[19] Data based on Pew Research Center research by Livingston (June 2014) and Cohn, Livingston, and Wang (2014).

[20] See: https://usa.childcareaware.org/advocacy-public-policy/resources/research/costofcare/

[21] Based on data for 2016 from the U.S. Bureau of Labor Statistics.

Even the most conservative estimates of the total value of household production arrive at numbers equal to about 25–30 percent of standard GDP in the United States, and less conservative estimates put the value as equal to or greater than the value of marketed production. An analysis of 27 mostly high-income countries shows that the value of unpaid labor equates to an average of more than 25 percent of GDP.[22] The UK Office of National Statistics estimated that the value of unpaid labor in 2014 was equivalent to 56 percent of GDP, with the largest components of the value of unpaid work being child care and transportation.[23]

Neglecting household production not only leads to an understatement of the level of GDP, but might also give a wrong impression about growth trends. One of the major economic shifts during the twentieth century was the movement of a large proportion of women from unpaid employment as full-time homemakers to paid employment outside the home. In 1870, 40 percent of all U.S. workers were women working as full-time homemakers; by 2000, the proportion had dropped to 16 percent. Trends in many European countries were similar, but timing often differed. This increase in work outside the home, as well as the increase in purchases of substitutes for home production, such as paid child care and prepared foods, was counted as an increase in GDP. The value of lost household production, however, was not subtracted. This failure to account for reductions in some home-produced goods and services means that GDP growth during the period was overstated. For example, an article in the May 2012 Survey of Current Business found that if "home production"—the value of the time spent cooking, cleaning, watching the kids, and so forth—were counted, it would raise the level of nominal GDP nearly 26 percent for 2010. Back in 1965, when fewer women were in the formal labor force and more were working in the non-market sector, GDP would have been raised by 39 percent. Because the inclusion of "home production" would add more to the level of GDP in 1965 than in 2010, factoring in the value of these non-market activities was found to reduce the average annual growth rate of GDP over this period.[24]

Recognizing the value of unpaid work is important if we are to make a comprehensive assessment of well-being, especially as more unpaid labor is typically undertaken by women. To quote from a report published by the OECD:

> Unpaid work contributes not only to current household consumption (e.g., cooking) but also to future well-being (e.g., parental investments in raising children) and to community well-being (e.g., voluntary work). In all countries, women do more of such work than men, although to some degree balanced—by an amount varying across countries—by the fact that they do less paid work.[25]

Data on unpaid labor from the United Kingdom indicate that men do an average of 16 hours per week of unpaid labor, while women do an average of 26 hours.[26] The gender imbalance is even more significant in developing countries of the global South, where household production make up a much higher proportion of total production than they do in the developed countries of the global North. Hence, GDP is even more inadequate as an indicator of national production in

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[22] Folbre, 2015.
[23] Peachy, 2016.
[24] Bridgman et al., 2012.
[25] Vreel, 2011, p. 30.
[26] Office for National Statistics (UK), 2016.

developing countries. Globally, the United Nations estimates that women do nearly 2.5 times the amount of unpaid care and domestic work than men.[27]

We see in Figure 6 that when we add paid and unpaid labor, women almost always do more total work than men (Uganda is the only exception in the figure). The overall gender imbalance is greatest in India, where women do 35 percent more total work than men, and in the United States where women do 18 percent more total work than men.

Figure 6. *Selected Paid and Unpaid Work by Gender, Selected Countries*
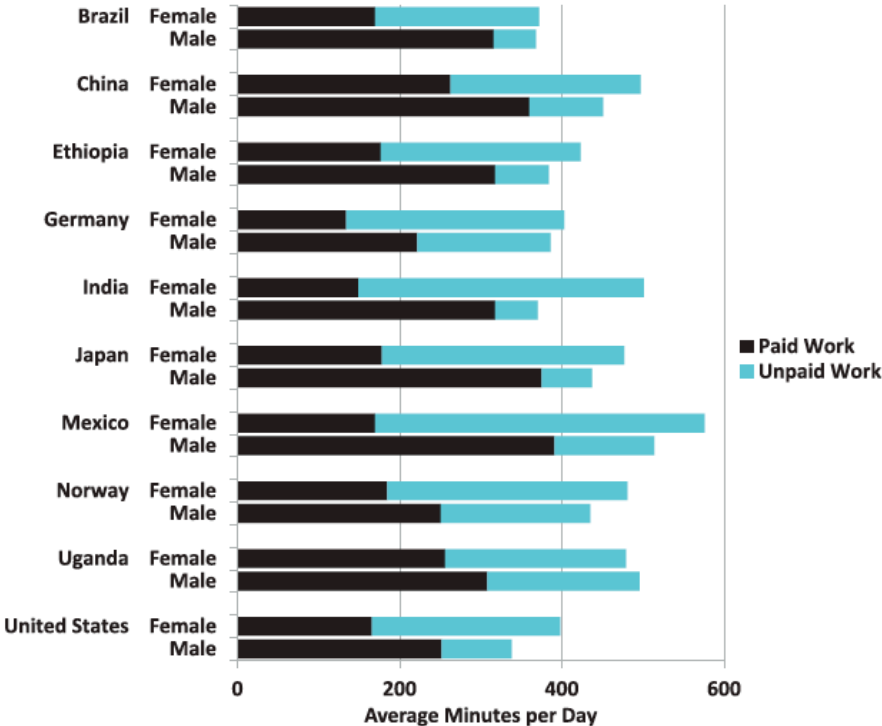
Source: UN Women, 2015, Annex 3.

Why does this matter? One important reason is that the omission of most household production from the national accounts may contribute to a subtle bias in the perceptions of policymakers who base their economic decisions on them. The U.S. Social Security retirement system, for example, makes payments to people based only on their market wages and years in paid work. Some advocates suggest that people should also get credit for time spent raising children—for example, a year of Social Security credit for time taken off with each child, in recognition of the contribution that such unpaid work makes to social and economic life. Having home production counted in GDP might help make policymakers more aware of its productive contributions.[28] Interestingly, critiques of GDP for its failure to count household labor arise out of both conservative principles, which emphasize family values, and progressive ones, which seek to recognize the value of labor that has been historically and disproportionately performed by women.

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[27] UN Women, 2015.
[28] A prominent advocate of this view is Marilyn Waring, author of If Women Counted (San Francisco: Harper and Row, 1988).

4.2 Time-Use Surveys

A first step in determining a value for household production is to find out how much time people spend in unpaid productive activities. In the past, estimates of time use in the United States came from small and sporadic surveys. However, in 2003, following the lead of many other industrialized countries, the U.S. Bureau of Labor Statistics (BLS) began to collect data for the first national ongoing survey of time use. The American Time Use Study (ATUS), conducted by the BLS, asks people age sixteen or over in a nationally representative sample to report in detail how they used their time on one particular day.[29]

The results of the survey for 2016 indicate that, on average on any given day, 85.4 percent of women and 68.8 percent of men spend some time engaging in household activities, including housework, food preparation and cleanup, lawn and garden care, or household management (such as paying bills). When averaged over all responses (including those who had not spent any time on household activities), women spent an average of 2.24 hours per day on these activities, while men spent 1.38 hours. On an average day, 21 percent of men reported doing housework, such as cleaning or doing laundry, compared with 50 percent of women.

4.3 Methods of Valuing Household Production

After time use has been measured in terms of hours spent on various activities, standard national accounting procedures require that these hours be assigned a monetary value using market or quasi-market prices. Economists have developed two main methods of assigning a monetary value to household time use: the replacement-cost method and the opportunity-cost method.

In the **replacement-cost method**, hours spent on household labor are valued at what it would cost to pay someone else to do the same job. In the most popular approach—and the one used to generate the most conservative estimates—economists use the wages paid in a general category such as "domestic worker" or "housekeeper" to impute a wage. A variant of this method, which usually results in higher estimates, is to value each type of task separately: child-care time is valued according to the wage of a professional child-care worker, housecleaning by the wages of professional housecleaners, plumbing repair by the wages of a plumber, and so forth.

The **opportunity-cost method** starts from a different view, based on microeconomic "marginal" thinking. Presumably, if someone reduces his or her hours at paid work in order to engage in household production, he or she is assumed to value the time spent in household production (at the margin) at least at the wage rate that he or she could have been earned by doing paid work for another hour. That is, if you choose to give up $30 that you could have earned working an extra hour in order to spend an hour with your child, you must presumably think that the value of spending that hour with your child is at least $30. This leads to using the wage rate that the household producer would have earned in the market to value the time spent doing household work. In this case, estimates of the value of non-market production can be quite a bit higher than

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[29] https://www.bls.gov/tus/datafiles_2010.htm

using the replacement-cost method, since some hours would be valued at the wage rates earned by doctors, lawyers, and other more highly paid workers.

Neither approach to imputing a wage rate is perfect. However, it would be hard to argue that perfection has been achieved in any of the other measurements and imputations involved in creating the national accounts, and many argue that imputing any value for household labor time, even using minimal replacement costs, is more accurate than imputing a value of zero.

Similar arguments have been made concerning unpaid volunteer work in communities and non-profit organizations—the time that people spend coaching children's sports teams, visiting nursing homes, serving on church and school committees, and so on. In the American Time Use Survey, 14.3 percent of the people surveyed reported participating in organizational, civic, and religious activities on their surveyed day, a figure that includes organized volunteer activities. If volunteer work as well as household work were both counted in national accounts, the proportion of production attributed to the core sphere of the economy would rise considerably.

5. ACCOUNTING FOR THE ENVIRONMENT

The natural environment underpins all economic activities. The natural environment provides resources and environmental services as inflows to economic activity and that economic activity also releases waste products into the environment. Environmental economists describe economic functions of the natural world under three headings:[30]

1. *Resource functions*: The natural environment provides natural resources that are inputs into human production processes. They include mineral ores, crude petroleum, fish, soil, and forests. Some of these resources, such as fish and forests, are renewable while others, such as minerals and petroleum, are not.

2. *Environmental service functions*: The natural environment provides the basic habitat of clean air, drinkable water, and suitable climate that directly support all forms of life on the planet. Water filtration provided by wetlands and erosion control provided by tree-covered hillsides are other examples of services provided by ecosystems. People receive the services of the natural environment directly when they enjoy pleasant scenery or outdoor recreation.

3. *Sink functions*: The natural environment also serves as a "sink" that absorbs (up to a point) the pollution and waste generated by economic activity. Car exhaust dissipates into the atmosphere, for example, while used packaging goes into landfill, and fluid industrial waste ends up in rivers and oceans. Some waste breaks down relatively quickly into harmless substances. Others are toxic or accumulate over time, eventually compromising the quality of the environment.

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[30] A fourth category of environmental value stems not from use but from mere appreciation of the existence of species and environmental amenities; this is felt by some people even if they do not expect to see, for example, a blue whale or Victoria Falls. The "existence value" of a given species or resource is difficult to quantify, but it is recognized as a legitimate economic value by economists.

Although for centuries these environmental functions were treated as though they were provided "free" and in unlimited amounts, more recently the problems of depletion of resources, degradation of environmental services, and overuse of environmental sink functions have become increasingly apparent. Consider the example of a country that depends heavily on natural resources. If its forests are cut down, its soil fertility depleted, and its water supplies polluted, surely the country has become poorer. But national income accounting will merely record the market value of the timber, agricultural produce, and industrial output as positive contributions to GDP.

In the United States, soil and water depletion has not yet raised the cost of land-based food but is likely to do so in the future without significant changes in farming practices. The market price of fish has increased with depletion of many species. The United States shares with all other countries a reliance on weather patterns that support existing lives and lifestyles; as human activities have increased the level of greenhouse gases emissions that lead to serious disruptions in climate, more severe storms, and rising sea levels, more and more money must be spent in what we have described as "defensive expenditures." Omitting such important environmental considerations from our measures of success could seriously undermine our goals for sustainability. We therefore need to account for the environmental costs of economic activity.

5.1 Methods of Valuing the Environment

System of Environmental-Economic Accounting

In 1993 the United Nations put forth a comprehensive framework, called the **System of Environmental-Economic Accounting (SEEA)**, to add statistics on environmental accounting to the existing methods of national accounting, using supplementary tables. This framework was revised most recently in 2014.[31] The 2014 SEEA lists three basic approaches to environmental accounting:

1. *Measuring the physical flows of materials and energy*. This approach measures the physical flows of natural capital from the environment to the economy as inputs to production, such as extracting metal, drilling for oil and cutting trees. It also looks at flows from the economy to the environment, such as disposal of solid waste and emission of air and water pollutants. Flows into, or out of, different sectors of the economy are quantified into tables. A table for water pollution, for example, would include quantities of chemical waste, insecticides, fertilizers and industrial discharges into the water from various sectors of the economy.

2. *Measuring the stocks of environmental assets*. The SEEA lists seven categories of environmental assets: mineral and energy resources, land, soil, timber, water, aquatic resources, and other biological resources. These assets are either measured in physical units such as tons of soil, or acres of wetlands, or in monetary units by multiplying a physical quantity of an environmental asset by its per-unit market price or through some nonmarket valuation process discussed in Section 5.2 below.

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[31] United Nations, 2003; United Nations, 2014.

3. ***Measuring economic activity related to the environment***. This approach lists monetary transactions related to the environment, such as the amount of spending on environmental protection and resource management, and environmental taxes and subsidies. The measure also includes production of environmental goods and services, "environmentally friendly" products and technologies, and pollution-control equipment.

These approaches are not necessarily mutually exclusive—we could theoretically implement all of them simultaneously. While many countries have adopted one or more of these accounts to some extent, no country has fully implemented the SEEA recommendations. Also, there is no universally accepted approach to environmental accounting.

Green GDP

The most basic approach to "green" accounting is to start with traditional measures and make adjustments that reflect environmental concerns. In current national income accounting, it is commonly recognized that some of each year's economic production is offset by the depreciation of manufactured, or fixed, capital such as buildings and machinery.[32] In other words, while economic activity provides society with the benefits of new goods and services, each year the value of previously produced assets declines, and this loss of benefits should be accounted for. Thus, national accounting methods produce estimates of net domestic product (NDP), which starts with GDP and then deducts the annual depreciation value of existing fixed capital. For example, in 2016 the GDP of the United States was \$18.6 trillion. But the depreciation of fixed capital that year totaled \$2.9 trillion.[33] Thus, the NDP of the United States in 2016 was \$15.7 trillion.

Extending this logic, we can see that each year the value of natural capital may also depreciate as a result of resource extraction or environmental degradation. In some cases, the value of natural capital could also increase if environmental quality improves; that, after all, is the point of restorative development. The net annual change in the value of natural capital in a country can simply be added or subtracted from NDP to obtain what has been called an environmentally adjusted measure of national product, or **Green GDP**. Thus:

$$\text{Green GDP} = \text{GDP} - D_m - D_n$$

where D_m is the depreciation of manufactured capital and D_n is the depreciation of natural capital.

This measure requires estimating natural capital depreciation in monetary terms, rather than physical units such as biomass volume or habitat area. However, estimating all types of natural capital depreciation in monetary terms is a daunting task that would require many assumptions. Thus, the estimates of Green GDP that have been produced generally focus on only a few categories of natural capital depreciation.

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[32] Depreciation is simply a measure of the loss of capital value through wear and tear. For accounting purposes, it can be calculated using a "straight-line" formula according to which, for example, a new machine is estimated to lose 10 percent of its original value each year over ten-year period or using more complex valuation methods.

[33] Estimates of fixed capital depreciation are obtained from tax records. Businesses are not taxed on the value of their fixed capital depreciation—thus they have a strong incentive to claim this deduction.

Attempts to estimate Green GDP date back to the 1980s. A pioneering 1989 analysis estimated the value of depreciation in Indonesia for three categories of natural capital: oil, forests, and soil.[34] The analysis found that accounting for natural capital depreciation could reduce GDP by 25 percent or more. A 2001 analysis in Sweden looked at a broader set of natural resource categories, including soil erosion, recreation values, metal ores, and water quality.[35] The results found that accounting for these factors would reduce GDP in Sweden by about 1–2 percent for 1993 and 1997, with some sectors being particularly affected, such as agriculture, forestry, and fisheries.

Another study estimated the value of changes in forest resources in India in 2003.[36] Based on timber and firewood market prices, the results indicated that while the overall physical stock of timber decreased, the value of timber resources actually increased due to higher prices. This illustrates the potential distortionary effect of looking at natural capital in monetary, rather than physical, terms. If we measure the value of natural capital at market prices, we can lose important information regarding the actual physical stock of those resources.

A significant effort to estimate Green GDP occurred in China in the early 2000s. The initial findings by China's State Environmental Protection Agency (SEPA) in 2006 indicated that environmental costs equaled about 3 percent of China's gross domestic product (GDP). The report was widely criticized because it failed to include numerous categories of environmental damage, such as groundwater contamination. Shortly afterward, a separate report concluded that environmental damage was closer to 10 percent of China's GDP—a value similar to what many observers were expecting. And in a 2007 report jointly produced by the World Bank and SEPA, the health and non-health costs of air and water pollution alone were estimated at 5.8 percent of China's GDP.[37] Green GDP efforts in China were subsequently cancelled in response to opposition from provincial officials who wanted to promote high growth rates and viewed Green GDP as a threat to their efforts. But in 2015 China announced it was restarting its efforts with the implementation of "Green GDP 2.0," with pilot projects in certain regions.

Adjusted Net Savings
The World Bank has developed an indicator of Adjusted Net Saving that seeks to measure what a society is truly saving for its future, starting with net savings (gross savings minus manufactured capital depreciation) and making adjustments for education, pollution, and the depreciation of natural capital.[38] Expenditures on education are added to national savings to reflect investment in human capital. Adjustment for pollution damages accounts for the negative impacts of carbon dioxide emissions on the country's future and local air pollution damages from particulate matter that affect the productivity of workers. Accounting for depreciation of natural capital involves deducting the depletion of non-renewable fossil fuels (oil, coal and natural gas), extraction of non-renewable minerals and adding the net change in forest area.

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[34] Repetto et al., 1989.
[35] Skanberg, 2001.
[36] Gundimeda et al., 2007.
[37] World Bank and SEPA, 2007.
[38] See World Bank data on environmental accounting.

Table 2. *Adjusted Net Savings (ANS) Rates, Selected Countries, Percent of Gross National Income, 2015*

Country	Net national saving	Education expenditure	Energy depletion	Mineral depletion	Net forest depletion	Pollution damage	ANS
Botswana	17.77	9.48	-0.16	-1.10	0	-0.35	24.5
Brazil	6.18	5.54	-0.71	-0.53	-0.10	-0.18	9.36
China	25.29	1.79	-0.43	-0.26	0	-0.41	22.87
Congo, Dem. Rep.	4.78	2.06	-0.16	-3.63	-16.54	-2.48	-16.36
Germany	9.80	4.67	-0.03	0	0	-0.08	13.71
Ghana	-1.69	5.84	-1.33	-4.01	-8.79	-1.12	-12.38
India	21.08	3.08	-0.43	-0.12	-0.36	-1.18	18.65
Kuwait	21.57	3.19	-9.48	0	0	-0.09	12.73
Mexico	10.72	5.04	-1.21	-0.36	-0.08	-0.13	12.62
Philippines	28.04	1.84	-0.05	-0.68	-0.19	-0.44	27.60
Russian Federation	14.76	3.90	-4.88	-0.52	0	-0.38	8.96
United States	3.42	5.05	-0.05	-0.05	0	-0.11	7.41

Source: World Bank, World Development Indicators database.
Note: The final value of ANS is slightly different from the sum total of its components due to adjustments made by World Bank to account for particulate emissions damages.

The World Bank has calculated ANS rates for most countries of the world. For most countries, the environmental adjustments are relatively minor. The deduction for energy depletion is particularly high in Kuwait, and also significant in Russia, Ghana, and Mexico. High rates of both mineral and forest depletion lead to a negative ANS for the Democratic Republic of the Congo and Ghana. The pollution adjustment tends to be a smaller share of national income, but is still high in such countries as India, Ghana, and the Democratic Republic of Congo.

5.2 Monetary Valuation of Environmental Factors

If assigning a monetary value to manufactured assets that are used for only a few years is difficult, think about how much more difficult it is to determine a dollar measure for natural assets!

Consider, for example, the value of uranium reserves still in the ground. Perhaps uranium will become more valuable a hundred years in the future because countries turn increasingly to nuclear power. Or the price of uranium may fall in the future as countries, concerned about safety and the disposal of nuclear wastes, explore other energy sources instead. The discovery of previously unknown mineral deposits, changes in policies, shifts in consumer demand, and new technologies are among the factors that make predicting the future over the long term very difficult and thus make it very hard to determine the value of many assets.

Other assets are difficult to value because, although we have a sense that overall ecological balance is important to human as well as other life on the planet, some forms of natural capital have no apparent market value. Biologists tell us, for example, that in recent decades there has been a worldwide decline in populations of amphibians (frogs, toads, and salamanders), along with a large increase in deformities in these animals. Clearly, degradation of the natural environment is occurring. But since the market value of most frog species is zero, there are wide disagreements about how—or even whether—a monetary value can be put on these losses.

As an example, suppose that a hillside is stripped of its forest covering, and the wood is sold as pulp for papermaking. The lack of vegetation now means that runoff from rain increases, and "Streamside," a town at the bottom of the hill, suffers flooding and has to repair many buildings. In the national accounts as currently constructed, the logging activity contributes to GDP in this year (in the form of valuable wood products) and the activity of repairing buildings is counted as an economic activity that also adds to GDP in this year.

Or consider an alternative scenario, in which the town realizes that flooding is likely and fills sandbags to line its riverbank. It thereby avoids costly repairs. But, again, both the logging and the sandbag making are counted as adding to GDP.

What is wrong with this, of course, is that the initial environmental services of the forest in terms of water retention were not counted as part of GDP. If they had been, we would have noticed that the efforts of the town did not reflect new production so much as a shift in production from the "nature sector" to the human sector. Had we included the "nature sector" from the beginning, our national accounts would have shown a decrease in the production of that sector (decreased water retention) offsetting the increase in production of the human sector (that is, repairing buildings or constructing sandbag barriers).

But how should we go about evaluating the environmental services received from the trees on the hillside? Normally, economists would try to value the production of water retention services of an existing forest by looking at some places in which this value has been translated into dollar terms. Let's imagine that near Streamside there is another town, "Sandybank," which has an identical situation, with identical logging, but it has avoided damage by spending $100,000 on sandbagging. Our goal is to figure out the dollar value of a year's worth of water retention services provided by the forest near Streamside.

Suppose that the cost of repairs in Streamside, after the flooding, was $5 million. If you estimate the value of the water retention services of the hillside forest using the **damage-cost approach**, you would say that the services are worth $5 million.

However, we could also use the experience of Sandybank as the basis for our value estimate. Using the equally plausible **maintenance-cost approach**, we could say that the value of the forest's services is $100,000. (This is similar to the "replacement- cost" approach discussed earlier in the module.) As often happens, the two approaches do not agree—in this case the value of the forest's services could be estimated at either $5 million or $100,000.

Economists and environmental scientists face a similar choice in many other areas; for example, whether to measure the value of unpolluted air in terms of effects of pollution on human health (damage) or in terms of the cost of pollution-control devices (maintenance). So far, some national and international agencies have adopted one convention and some the other in their experimental environmental accounts.

If the withdrawal of environmental services makes people suffer or die, then we enter the even more controversial area of trying to assign dollar values to human suffering and human lives. And many environmental effects cross national lines. What is the monetary value of a global "public good" such as a stable climate? On whose account should we tally the loss of deep-sea fisheries located in international waters?

One approach to the problem of valuation is simply to use satellite accounts, as described above, which can be recorded in physical terms, without monetary valuation. So, for example, we might note that the forest cover in a country has declined by 10 percent without attempting to value all the ecological functions of forests. Many governments have already committed in principle to creating such accounts for their own country, and some, such as Norway, maintain extensive satellite accounts for many resource and environmental categories.

6. CONCLUSION: MEASURING ECONOMIC WELL-BEING

No one—and especially not their creators—would argue that alternative macroeconomic indicators have been perfected. Nor has any single approach emerged as the "best" way to adjust, replace, or supplement GDP. As we have seen, any macroeconomic indicator involves numerous assumptions. One of the strengths of some of the new measures is that they allow users to see how the results change under different assumptions. For example, the BLI allows users to adjust the weights on each of the 11 well-being dimensions according to their personal preferences. Some have suggested that the best approach is to use multiple indicators, along the lines of the "dashboard" analogy mentioned earlier. One thing is clear—reliance on a single traditional GDP measure omits or distorts many crucial variables. Thus, all the alternative approaches discussed in this module have some value in providing broader perspectives on the measurement of well-being.

KEY TERMS AND CONCEPTS

Better Life Index (BLI): an index developed by the OECD to measure national welfare using 11 well-being dimensions

Damage-cost approach: assigning a monetary value to an environmental service that is equal to the actual damage done when the service is withdrawn

Defensive expenditures: money spent to counteract economic activities that have caused harm to human or environmental health

Green GDP: GDP less depreciation of both manufactured and natural capital

Human Development Index (HDI): a national accounting measure developed by the United Nations, based on three factors: GNI per capita level, education, and life expectancy

Maintenance-cost approach: assigning a monetary value to an environmental service that is equal to what it would cost to maintain the same standard of services using an alternative method

Opportunity-cost method (for estimating the value of household production): valuing hours at the amount that the unpaid worker could have earned at a paid job

Replacement-cost method (for estimating the value of household production): valuing hours at the amount it would be necessary to pay someone to do the work

Satellite accounts: additional or parallel accounting systems that provide measures of social and environmental factors in physical terms, without necessarily including monetary valuation

Subjective well-being: a measure of welfare based on survey questions asking people about their own degree of life satisfaction

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DISCUSSION QUESTIONS

1. GDP can be characterized as a (rough) measure of the amount of "throughput" taking place in an economy—as measuring the level of activity whose purpose it is to turn renewable and non-renewable resources (inputs) into new products (outputs). How does "throughput" relate to sustainable well-being? Is more "throughput" always a good thing?

2. Economies are based on natural, manufactured, social, and human capital. Only the value of manufactured capital (structures and equipment)—and recently, software—is estimated in the current national accounts. Can you think of ways that the stocks of natural, social, and human capital might be measured? What kind of information would be needed?

3. Does the Genuine Progress Indicator include anything that you think should be left out or fail to account for something that you think should be included? Think hard about what you really think human well-being is about.

4. Give examples of each of the following:
   - Efforts to supplement GDP
   - Efforts to adjust GDP
   - Efforts to replace GDP

Are there some alternatives discussed above that would fit into more than one of these categories? Are there some that are difficult to fit into any of them? Would you suggest any other ways of categorizing efforts that are being made to improve how we measure the success of an economy in achieving well-being for present and future people?

5. Do you think that national governments should incorporate a monetary estimate of the value of household production in national accounting statistics? How do you think the inclusion of household production would affect the measurement of economic activity in developed versus developing countries?

6. Think back on at least one household activity in which you have engaged in the past couple of days that in principle could be replaced by market or third-person services. How would that activity be valued by the replacement-cost method? By the opportunity-cost method? What sorts of manufactured capital goods were important, along with your labor, in the activity?

7. In Burgess County, current irrigation methods are leading to rising salt levels in agricultural fields. As a result, the number of bushels of corn that can be harvested per acre is declining. If you are a county agricultural economist, what two approaches might you consider using to estimate the value of the lost fertility of the soil during the current year? What sorts of economic and technological information would you need to come up with your estimates?

8. Some people have argued that the monetary valuation of environmental costs and benefits is important because "any number is better than no number"— without valuation, these factors are omitted from GDP accounts. Others say that it is impossible to express environmental factors adequately in dollar terms. What are some valid points on each side of this debate? How do you

think this debate should be resolved?

9. Of the various alternative indicators presented in this module, which one would you advocate as the best approach for measuring economic well-being? What do you think are the strengths and weaknesses of this indicator? ‡

10. Suppose that your national government officially adopted your preferred indicator from the previous question. How do you think this would change specific policy debates in your country? What new policies do you think could be enacted?