

8. Suppose a newspaper report indicates that the price of wheat has fallen. Which of the following could be possible explanations? (There may be more than one.) Illustrate *one* case you choose on a supply and demand graph.
 - a. A drought has hit wheat-growing areas
 - b. An increase in the price of rice
 - c. Due to increasing health concerns, tobacco farmers have begun growing other crops
 - d. A new science report suggests that wheat is bad for one's health
9. Prices of many financial assets such as stocks and foreign exchange are now readily available on the Internet. Search for a chart such as Figure 4.11 for a stock index or foreign currency of your choosing, and print it out. During the time period covered by the graph you found, does it seem like this market is fairly calm, or is it characterized by periods of volatility? (Caution: because price swings can be made to look relatively large or small simply by changing the scale of the graph, you may want to choose a fairly long time series, or compare the behavior of the asset you've chosen with a similar asset, in answering this question.) Is there any evidence of a speculative bubble?



Part Two

Macroeconomic Basics

5

Macroeconomic Measurement: The Current Approach

As we pointed out in Chapter 3, being able to make wise economic choices depends on having a good sense about the size of the relevant economic stocks and flows. Whether you are deciding how much money to spend in the bookstore, or groups such as households, community organizations, businesses, nonprofits, or governments are deciding how to use their resources, good decision making requires good information.

In macroeconomics, we consider how good economic choices could be made at a *national* level, usually by governments interested in maintaining high employment levels, stable prices, and/or achieving other national goals such as sustainable growth or national security. The amount of information required for such large tasks is daunting! While learning about how data are gathered and organized in order to create measures of macroeconomic performance may seem dry and dull at times, it is crucial for you to understand how common measures of economic performance are put together. What do they include? What do they leave out? Why might they be biased? To what extent might they be useful as measures of human well-being, and to what extent might they be misleading?

1. MEASURING A COUNTRY'S AGGREGATE BEHAVIOR

The idea of creating a system of national accounts to guide U.S. decision makers first took hold during the Great Depression in the 1930s. Presidents Hoover and Roosevelt knew that national production was down, but other than a few numbers representing the volumes of railroad shipments and steel production, they had no information on by *how much* it was down. Likewise, they had little way of knowing whether the policy actions they were trying were actually helping the economy rebound.

The Department of Commerce commissioned economist Simon Kuznets to begin to develop national accounts. The first set of accounts was presented to Congress in 1937. Interest in keeping national accounts increased in the 1940s because of the need for national economic mobilization during World War II.

The national accounts have evolved over the decades for several reasons. The economy itself has evolved, for example moving from being strongly oriented toward agriculture and manufacturing toward a structure in which service and information activities are increasingly important. Improved data collection techniques and new statistical methods have been developed in the decades since the 1930s. Perhaps most importantly, the purposes for which the accounts are intended and the most pressing topics of concern also change over time. Keeping track of environmental degradation, for example, was not a purpose for which the accounts were originally developed, although it is a pressing problem today.

In this chapter we explain how U.S. government agencies construct the major economic indicators used by contemporary macroeconomists. Even though GDP is often referred to as if it measures economic well-being, it is in fact not very well suited for that purpose—although it does a good job of addressing some of the questions for which it was specifically designed. This chapter will demonstrate how GDP, economic growth, measures of price changes, and national saving are commonly measured. In the next chapter, we discuss extensions of the national accounts that are currently being developed in order to update them to reflect better the concerns of the twenty-first century.

Discussion Questions

1. How might the purpose for which accounts are intended affect their design? For example, what sorts of economic activities do you think it would be most important to track if the purpose were to plan for fighting a war? To look at the level of overall well-being? To help ensure the present and future well-being of people who are children today?
2. What statistics about national economic performance have you seen mentioned in the news? Do you know what these statistics mean?

2. THE NATIONAL ACCOUNTS AND THEIR CONVENTIONS

In the United States, the **Bureau of Economic Analysis (BEA)** publishes statistics concerning production, income, spending, prices and employment in the **National Income and Product Accounts (NIPA)**.

Bureau of Economic Analysis (BEA): the agency in the United States in charge of compiling and publishing the national accounts

National Income and Product Accounts (NIPA): a set of statistics compiled by the BEA concerning production, income, spending, prices, and employment

All systems of accounting make considerable use of “conventions” or assumptions. Accounting conventions are simply habits or agreements, adopted by people in order to try to make accounts as standardized and comparable across different time periods as possible. It is important for you to realize that the conventions do not simply reflect the “world as it is.” There are many different ways of describing the world, and each convention chosen reflects just one of many possibilities.

A personal example might help you understand this problem. Perhaps you keep track of your own expenditures. Suppose you buy soft drinks at a grocery store, even though you don’t like them yourself, because you want to have a stock of them around to serve your friends when they visit. Suppose you then want to summarize your expenses by grouping them into larger categories such as “groceries” and “entertainment.” In which of these categories should you classify your soft-drink purchases? They arguably could be classified as either. To keep your accounts meaningful, you will need to decide on—and consistently apply—a convention that assigns your soft-drink expenditures to one category or the other, or in fixed proportions to each. But, in national accounts, as in this personal case, there is often an element of arbitrariness about conventions. And conventions can change over time, as old ways of doing things become outdated in the face of new developments.

Internationally, the **United Nations System of National Accounts (SNA)** provides guidelines to countries about how to construct systems of accounts, with a view to making national

statistics more comparable *across countries* as well as across time periods. In 2003, the United States NIPA underwent a comprehensive revision, one of the objectives of which was greater harmonization with the SNA.

United Nations System of National Accounts (SNA): a set of guidelines for countries about how to construct systems of national accounts

2.1 CONVENTIONS ABOUT SECTORS

The official system of U.S. national accounts uses the following four-way classification of sectors.

Households and institutions sector. The first sector includes both households and nonprofit institutions that serve households. These include organizations such as nonprofit hospitals, universities, museums, trade unions, and charities. The BEA also refers to the **households and institutions sector** as the “personal” sector.

households and institutions sector (BEA definition): the sector consisting of households and nonprofit institutions serving households

Business sector. The BEA **business sector** is somewhat broader than just for-profit businesses. Certain business-serving nonprofit organizations, such as trade associations and chambers of commerce, are included in this category. In addition, government agencies that are like business enterprises in that they produce goods and services for sale—such as the U.S. Postal Service, municipal gas and electric companies, and airports—are also classified as being in the business sector.

business sector (BEA definition): the sector including all entities concerned with producing goods and services for profitable sale. It also includes business-serving nonprofit organizations and government enterprises.

Government sector. The **government sector** includes all federal, state, and local government entities, except for the “business-like” government enterprises mentioned above.

government sector (BEA definition): the sector that includes all federal, state, and local government entities (except for government enterprises).

Foreign sector. The entities in the first three sectors include, for the national accounts, only those that are located within the physical borders of the United States. The **foreign sector** (or “rest of the world”) includes all entities—household, nonprofit, business, or government—located outside the borders of the United States. An individual in another country who buys imported U.S. products, for example, or a company located abroad that sells goods or services to the United States, figure into U.S. accounts as part of the foreign sector.

foreign sector (BEA definition): the sector consisting of entities located outside the borders of the United States.

2.2 CONVENTIONS ABOUT CAPITAL STOCKS

While natural, manufactured, human, and social capital are all crucial resources for economic activity, it is largely only *manufactured* capital that is currently included in the accounting of national non-financial assets. This might be due to the national accounts having originally been devised at a time when the relatively recent rise of manufacturing made the accumulation of

machinery and factory buildings appear to be the main road to prosperity. In the twenty-first century, the rise in importance of knowledge and ecological concerns suggests that additional accounts should be added—a topic we will take up in the next chapter.

For the most part, the national accounts currently include only manufactured capital in the accounting of national assets.

The first category of manufactured capital in the national accounts is called **fixed assets**. Fixed assets include equipment owned by businesses and governments, structures such as factories and office buildings, and residences (that is, houses and apartment buildings). In 1999, in partial recognition of the increasingly important role of knowledge and technology in production, computer software was added as an additional type of fixed asset.

fixed assets (BEA definition): equipment owned by businesses and governments; structures; residences; and software

A second—and much smaller—component of the manufactured capital stock is **inventories**. Inventories are stocks of raw materials, such as crude oil awaiting refining, or manufactured goods, such as the shoe inventory of a retail shoe store, that are being held until they can be used or sold. The BEA only counts inventories held by the business sector.

inventories: stocks of raw materials or manufactured goods being held until they can be used or sold

Equipment used by governments and businesses is included in “fixed assets.” But what about equipment owned by households, such as cars and stoves, that are used in household production of goods and services? The BEA calls all goods bought by households that are expected to last longer than three years **consumer durable goods**. In 2003, the BEA began including consumer durables in its accounts of assets.

consumer durable goods: consumer purchases that are expected to last longer than three years. These are generally items of equipment, such as vehicles and appliances, used by households to produce goods and services for their own use.

The BEA estimates of the dollar value of the nation’s stock of manufactured assets at the end of 2006 are given in Table 5.1. (Numbers may not add up exactly due to rounding.)

2.3 CONVENTIONS ABOUT INVESTMENT

The way the national accounts measure investment spending may seem confusing if one does not keep in mind some basic facts. First, recall from Chapter 3 that economists use the term “investment” to mean additions to stocks of *non*-financial assets. This contrasts with the common on-the-street use of the term “investment” to refer to financial investment, such as the purchase of stocks and bonds. Second, it is important to remember that investment represents a *flow*. A machine added to a factory in 2005, for example, is considered to be part of the national *stock* of nonresidential assets for every year from the time it is installed until the time it is junked. However, the machine was only an *addition* to assets in 2005, and hence its value would only be counted as an *investment* in that one year. Lastly, as was discussed in Chapter 3, *gross* investment includes all measured flows into the capital stock over a period of time while *net* investment adjusts this measure for the fact that some portion of the capital stock wears out, becomes obsolete, or is destroyed—that is, depreciates—over the period.

Table 5.1 The Estimated Size of U.S. Manufactured Capital Stock, 2006

Type of Capital	Value in Trillions of Dollars at the End of the Year
Equipment and software	5.9
Structures	17.2
Residences	17.4
Inventories	1.9
Consumer durable goods	3.9
Total Value of Manufactured Capital	46.4

Source: BEA, Standard Fixed Assets Table 1.1 and NIPA Table 5.7.5B, and authors' calculations.

For example, suppose an office complex built in 1965 is torn down this year and replaced by a new, larger office complex. Measured *gross* investment for this year would include the full value of the new office complex. *Net* investment for this year would be calculated as the value of the new office complex *minus* the value of the (thoroughly depreciated) building that was torn down. If the new building has 100,000 square feet of space, while the old one had 60,000 square feet, for example, the economy has a net gain of only 40,000 square feet of office space. Net investment, which measures only the value of the *new* space and any improvements in quality, gives a better idea of the actual addition to productive capacity.

Gross investment in fixed assets is always zero or positive. However, if, over a period of time, the capital stock depreciates faster than it is being replaced, net investment can be negative. This can sometimes happen to manufactured capital stocks when a country is hit by major disasters such as wars or floods.

Inventory investment is a bit different from investment in fixed assets, since the primary reason the volume of inventories may decline is not depreciation, but rather that goods or materials may be taken out of inventory to be used or sold faster than they are being replaced. Measured inventory investment will be negative if the outflows from inventories exceed inflows.

You may have noted that the numbers given for fixed assets in Table 5.1 are quoted as dollar values. Determining a money value for assets is not an easy thing—even when, as in the national accounts, we limit attention only to manufactured capital. If you have ever taken an accounting class, you know that numerous conventions have been invented reflecting different ways of thinking about how to measure such things as depreciation and the value of inventories.

Ideally, productive investments by all sectors would be recognized in the national accounts. But it was not until 1996 that government investment in fixed assets was recognized, and household investment in consumer durables is still, by convention, not considered to be part of investment in the national accounts.

Discussion Questions

1. The BEA definitions of sectors use some conventions that are not obvious. To which sector might the BEA assign each of the following entities? Why?
 - a. A local city-government-owned golf course that charges fees similar to local private courses
 - b. A large nonprofit hospital

- c. A U.S.-owned movie company whose offices and studio are in Japan
 - d. A nonprofit trade association, such as the Chocolate Manufacturers Association
2. Under the BEA definitions, would spending on education be counted as investment? Would buying shares in a company be considered investment? Why?

3. GROSS DOMESTIC PRODUCT: WHAT IT REPRESENTS

Certainly the most talked-about single number that comes out of the national accounts is GDP. A wide range of policymakers and media outlets have traditionally awaited the announcement of newly published figures on GDP with great anticipation. The figures on the growth rate of GDP are often taken to signal the success or failure of macroeconomic policymaking.

3.1 THE DEFINITION OF GROSS DOMESTIC PRODUCT

According to the BEA, **gross domestic product (GDP)** is supposed to measure the total value of final goods and services newly produced in a country over a period of time (usually one year).

gross domestic product (GDP) (BEA definition): a measure of the total value of final goods and services newly produced in a country over a period of time (usually one year)

This definition contains several key phrases. Some of them are easy to understand, while others rely on complicated conventions.

“Final goods and services.” A **final good** is one that is ready for use. That is, no further productive activity needs to be applied before the good can be consumed (if it is a good that is used up as it is put to use) or put to work producing other goods and services (for example, if it is a piece of equipment). The reason for limiting measurement to *final* goods and services is to avoid double counting. For example, suppose that during a year, paper is produced by one company and sold to another company that uses it to make books. The books are then sold to their final buyers. Books in this case are the final goods, while the paper used in them is an **intermediate good**. By limiting the accounting to final goods, production is only counted once—the paper is only counted as part of the books.

final good: a good that is ready for use, needing no further processing

intermediate good: a good that will undergo further processing

“Over a period of time.” Since GDP measures a flow, it of course must be measured over some time period. Macroeconomists usually work with GDP measured on a yearly basis. Estimates of GDP are released more often than once a year—generally on a quarterly basis (the first quarter covering January through March, the second April through June, and so on). However, even when only a part of the year is being covered, GDP and its growth rates are usually expressed in annual terms.

“Newly produced.” Only new goods and services are counted. For example, if you buy a book published in 2005 at a used book shop, the value of the book itself is not included in this year’s GDP. Only the retail services provided by the used book shop are “newly produced,” and are part of this year’s GDP.

“In a country.” This means that the goods and services are produced within the physical borders of the country. If a U.S. citizen goes abroad to work, for example, what he or she pro-

duces while away is *not* part of U.S. GDP. On the other hand, the work of a Japanese citizen at a Japanese-owned factory *is* part of U.S. GDP if that factory is located inside the borders of the United States.

How is the “*total value*” measured? This is a complicated topic, coming up next. It is also a controversial one, as we will see in the next chapter.

3.2 THE THREE APPROACHES TO MEASURING GDP: AN INTRODUCTION

The BEA publishes tables showing the components of GDP, as well as many other tables dealing with assets, employment, prices, and other topics in the National Income and Product Accounts. (These are easily accessed at www.bea.gov.) To understand these tabulations, however, you need to understand how aggregate *production*, *spending*, and *income* are related in an economic system.

Imagine a simple economy with no foreign sector, no depreciation, no inventories, no transfers, no non-market production, and in which all the profits that companies earn end up in the wallets of households. In this case, three quite different measures of counting GDP would in theory all add up to the same number:

$$\text{Value of Production} = \text{Value of Spending} = \text{Value of Income}$$

Using a *production approach*, which might seem to be the most natural and direct method, we could sum up the dollar value of all final goods and services produced in each sector—by the household and institutions sector, the business sector, and the government sector.

However, using the *spending approach*, we could look at who *buys* the final goods and services that have been produced. Since we assumed that no goods are carried as inventory in this very simple economy, everything produced must be bought. Totaling up the dollar value of spending on all various kinds of goods and services by all sectors in this imaginary simple economy will give a second way of arriving at the figure for a country’s aggregate production.

Lastly, since in this simple economy everyone who is involved in production also receives a monetary payment for their contribution to it, we could, alternatively, take an *income approach*. In this approach, we total up the compensation received by everyone involved in production, including workers, investors, creditors, and owners of land or equipment rented for productive use.

In this very simple economy if, say, \$10 million worth of goods and services is produced, then the amount spent on goods and services must also be \$10 million and the amount of payment received as income must also be \$10 million. Sometimes in dealing with national accounts economists hence use the terms “production,” “income,” and “expenditure” interchangeably.

Discussion Questions

1. Which of the following would be included in U.S. GDP?
 - a. The value of Los Angeles hotel rooms rented to Italian tourists
 - b. The value of a Renaissance-era painting sold at an auction in New York
 - c. The value of steel production, that is used in making cars during the same year
 - d. The value of new military aircraft
2. Can you explain why economists often use the terms “production,” “income,” and “spending” interchangeably?

4. GROSS DOMESTIC PRODUCT: CALCULATING ITS VALUE

While there is a rough equivalence in theory among the product, spending, and income approaches to calculating GDP, making estimates for an actual economy requires a number of conventions and adjustments.

4.1 THE PRODUCT APPROACH

The BEA measures the “value” of final goods and services primarily—at least in concept—by their *dollar market value*. For example, if the business sector produces 1,000 automobiles of a certain type this year, which are then sold to final users for \$20,000 each, this adds \$20 million to GDP.

Rather than looking at the final sale, however, it is sometimes useful for accounting and analytical purposes to follow an alternative approach. This is to think about how much each *industry* contributes to the value of the final good or service. In the **value-added** approach to GDP accounting, you start with the raw materials—say, iron ore—used in producing a good or service—say, an automobile—and then see how much market value is added at each stage in the production process.

value-added: the value of what a producer sells, less the value of the intermediate inputs it uses. This is equal to the incomes paid out by the producer.

For example:

1. You find the value of iron ore as it is sold from the mining company to the steel manufacturer. Minus the value of any intermediate goods used, this is counted as being the value added to the ore in the ground by the mining company. Conveniently, this value added in production can also be measured as the sum of the incomes paid out by the mining company.

2. Then, the value added by the steel manufacturer is calculated as the value of the steel sold to the auto manufacturer, *minus* the amount the steel maker paid for the iron ore, other material, and energy inputs. (We subtract the value of the intermediate good, iron ore, so we don’t count it twice.) This value added by the steel manufacturer can also be measured by looking at the incomes it pays out.

3. The value added by the auto manufacturer is calculated as the value of the automobile it sells, less the value of the intermediate inputs (steel, rubber, etc.) it purchased. This is equivalent to the incomes paid out in the process of auto production.

4. Summing up the value added at each stage of production should lead to the same number we would get by directly assessing the final value of the car—the amount it sells for on the market.

The BEA maintains an extensive set of Input-Output Accounts to keep track of the contributions to GDP by various industries. These tables show outputs of each industrial sector (for example, agriculture, manufacturing, or services) can become inputs (intermediate goods) to production in other sectors. (What about the contribution of natural resources, such as the deposits of iron ore, to the production of the car? The production of the car depletes these resources. The national accounts, as currently structured, however, do not seek to keep track of changes in natural capital.)

The fact that the calculated total value of final goods should add up to be the same number, whichever of the two methods is used—looking only at the markets for final goods, or, alterna-

tively, going through a value-added accounting—serves to provide “checks” on the validity of data the BEA collects from different sources.

While finding the market value of production may seem fairly straightforward for manufacturing industries, in practice the idea of “market value” is often much harder to determine. In practice, the BEA uses **imputation** to estimate the value of many components of GDP. An imputation is a sort of educated guess, usually based on the value of similar outputs or on the value of inputs used in production.

imputation: a procedure in which values are assigned for some category of products, usually using values of related products or inputs

For example, the housing stock of a country produces a flow of services—the services of shelter. For housing units that are rented, the rent paid is the market value of the housing services. But how can we find out the value of the services generated by houses occupied by their owners? For these, the BEA must *impute* a value. They use data from the rental housing market to impute what owner-occupiers might be said to be “paying in rent” to themselves.

In cases where no similar marketed product exists, the BEA often falls back on using a value-added approach, looking exclusively at the value of inputs. We know, for example, that governments purchase many intermediate goods, and then produce their outputs of goods and services using the services of workers they employ and the services of structures and equipment. But rarely are government outputs—new highways, the services of parks, the services of public education, national defense, etc.—actually sold on markets. How, then, is the production of the government to be valued?

In the actual GDP accounts, the value of government production is *imputed* by adding up the amount that governments pay their workers, the amount they pay for intermediate goods and services, and an allowance for depreciation of fixed assets. Likewise, the production of nonprofit institutions is measured in large part by looking at their inputs. For example, data on payroll expenses forms an important part of the information used in estimating the value of the services produced by nonprofit agencies.

The value of *non-marketed production* by governments and nonprofit institutions is usually imputed by measuring the value of *inputs* used.

Imputations are also used when data are difficult or impossible to obtain. Although it might be tempting to imagine the BEA as an all-knowing agency that can directly observe all market transactions, gathering data is a laborious (and often expensive) process. The BEA relies on a variety of censuses and surveys to obtain information, as well as on regulatory and administrative data such as government budgets and tax records. Market transactions that people take pains *not* to have observed by the government—such as illegal drug deals or work performed “off the books” to avoid taxes—hence are usually not represented in the national statistics. The BEA updates all its estimates periodically, as it receives better data or improves its statistical techniques—hence you may see many slightly varying numbers quoted for, say “U.S. GDP, 2006” depending on when the data were published.

In one significant case, however, the designers of the national accounts decided not even to attempt to impute a value for production. This is the case of the production of goods and services within households for their own use. The official measure of production by households includes the value of services produced by the *house* (that is, the rent or imputed rent) and production within the households to the extent that work is *paid* (that is, done by hired housekeepers, nannies, private gardeners, and so on). But activities such as unpaid child care, cooking, or the cleaning or landscaping of a home done without pay by household members—traditionally, mostly by women—are

not counted in GDP. This creates an anomaly in the accounts. For many years, textbooks noted that “if a man marries his housekeeper, GDP falls.” That is, marriage would convert the woman’s housekeeping work from being paid and counted, to being unpaid and uncounted.

How much of GDP is *produced* by entities within each of the BEA-defined sectors? Not surprisingly, given the conventions and accounting procedures, the BEA attributes a very large share of productive activity to the business sector, as shown in Table 5.2. For the period from January through December of 2006, the business sector was estimated to have produced goods and services worth about \$10 trillion, or slightly more than 77 percent of the total GDP of \$13 trillion. The household and institutions sector, and the government sector, were each estimated to have contributed about 11 percent. (In Table 5.2, as in later tables, the numbers in the column to the far right, showing contribution by sector, are added up to reach the total at the bottom of the table. The other numerical column gives values for subcategories. Numbers may not add exactly due to rounding.)

We can also summarize the product approach by the equation:

$$\begin{aligned} \text{GDP} &= \text{Business production} \\ &+ \text{Household and institutions production} \\ &+ \text{Government production} \end{aligned}$$

This sort of equation is called an **identity** or an **accounting identity**. It holds simply because of the way that the various terms have been defined. If we once agree on the definitions of terms, then there remains nothing controversial about an identity. (When we begin to deal with macroeconomic modeling in Chapter 9, we will introduce another kind of equation, called a behavioral equation. A behavioral equation represents an economist’s supposition about how some economic actor behaves—and since it may or may not hold well in practice, it can be more controversial.)

identity (accounting identity): an equation where the two sides are equal by definition

The foreign sector does not contribute to the production of GDP. Can you explain why? (Hint: Look back at the definition of GDP.)

4.2 THE SPENDING APPROACH

The spending approach adds up the value of newly produced goods and services bought by the household and institution, business, foreign, and government sectors. The estimated values for these expenditures for 2006 are listed in Table 5.3.

Purchases of goods and services by households and nonprofit institutions serving households are called “personal consumption expenditures” by the BEA. By convention, these are all considered “final” goods and services (even though, as discussed earlier, many of these are used in household and nonprofit production processes).

Business spending on final goods and services is called “gross private domestic investment” by the BEA. This includes business spending on fixed assets including structures, equipment, and software, as well as the value of changes in inventories within that sector.*

* Why isn’t business spending on wages or on materials such as energy and raw goods counted here? Recall that GDP only accounts for *final* goods and services. The value of such inputs will be reflected in GDP as the products of the businesses are bought by households, institutions, or governments. Including the value of such inputs with business spending as well would result in double counting. Investment goods and inventories, however, stay within the business sector.

Table 5.2 **Gross Domestic Product, Product Approach, 2006**

Sector and Subsector	Production by Subsector (trillions of dollars)	Production by Sector (trillions of dollars)
Households and institutions production		1.50
Private households	.83	
Nonprofit institutions	.67	
Business production		10.19
Government production		1.50
Federal government	.46	
State and local governments	1.04	
Total: Gross domestic product		13.20

Source: BEA, NIPA Table 1.3.5, published 10/31/2007.

Table 5.3 **Gross Domestic Product, Spending Approach, 2006**

Sector and Type of Spending	Spending by Type (trillions of dollars)	Spending by Sector (trillions of dollars)
Household and institutions spending (<i>personal consumption expenditures</i>)		9.22
Durable goods	1.05	
Nondurable goods	2.69	
Services	5.49	
Business spending (<i>gross private domestic investment</i>)		2.21
Fixed investment	2.16	
Change in private inventories	.05	
Net foreign sector spending (<i>net exports of goods and services</i>)		-.76
Exports	1.47	
Less: Imports	2.23	
Government spending (<i>government consumption expenditures and gross investment</i>)		2.52
Federal	.93	
State and local	1.59	
Total: Gross domestic product		13.20

Source: BEA, NIPA Table 1.1.5, published 10/31/2007.

The simple economy we discussed when noting how, in concept, “production = spending = income” was a **closed economy**, with no foreign sector. While sometimes countries isolate themselves from world trade (China during 1960s being a prime example), for the most part global economic relations have become increasingly important as advances in transportation and communication have accelerated. Since the United States is an **open economy**, we need to take into account interactions with the foreign sector.

closed economy: an economy with no foreign sector

open economy: an economy with a foreign sector

Some of the goods and services produced inside the United States are bought by entities in the foreign sector. The value of these exported goods must be added to the value of domestic spending in calculating GDP. On the other hand, some of the spending by U.S. residents is for goods and services produced abroad. Such spending is, in fact, already included in the calculation of spending by the various other sectors in Table 5.4. So the value of imported goods and services must be subtracted to arrive at a measure of *domestic* production.

Net exports measures the overall impact of international trade on GDP. It is the difference between exports and imports.

$$\text{Net exports} = \text{Exports} - \text{Imports}$$

Net exports may be either positive (if we sell more abroad than we buy) or negative (if we buy more than we sell). In 2006, for example, we can see in Table 5.3 that the United States imported goods and services worth \$0.76 trillion (that is, \$760 billion) more than the value of the goods and services exported. (In the table, the fact that the value of imports is subtracted rather than added is denoted by putting the number in italic type.) Net exports were hence negative in that year.

net exports: the value of exports less the value of imports

Lastly, we come to the expenditures made by the government sector. The BEA calls these “government consumption expenditures and gross investment” and breaks these down by whether they are made at the federal level or at the state and local level. These figures represent only spending for final goods and services, so they exclude the parts of government budgets that go for transfers (such as Social Security). In 2006, about 67 percent (that is, two-thirds) of federal government spending went for national defense. About 17 percent of total government spending was considered to be investment spending, while the rest was considered consumption.

If we want to highlight the various sectors involved, we can summarize the spending approach with the identity:

$$\begin{aligned} \text{GDP} &= \text{Household and institution spending} \\ &+ \text{Business spending} \\ &+ \text{Government spending} \\ &+ \text{Net foreign sector spending} \end{aligned}$$

Or, if we want to highlight the portions that are (by convention) considered to be consumption versus those considered to be investment, we can summarize this approach with the identity:

$$\begin{aligned} \text{GDP} &= \text{Personal consumption} \\ &+ \text{Private investment} \\ &+ \text{Government consumption} + \text{Government investment} \\ &+ \text{Net exports} \end{aligned}$$

4.3 THE INCOME APPROACH

The production-related incomes (such as from wages, rents, and profits) earned by all people and organizations located inside the United States are summed up in a measure called **national income (NI)**.

national income (NI): a measure of all domestic incomes earned in production

Table 5.4 **Gross Domestic Product, Income Approach, 2006**

Types of Income and Adjustments	Income and Adjustments (trillions of dollars)
National income	11.66
Less: Net income payments from the rest of the world	.06
Plus: Depreciation (<i>consumption of fixed capital</i>)	1.62
Less: Statistical discrepancy	.02
Total: Gross domestic product	13.20

Source: BEA, NIPA, Table 1.7.5, published 10/31/2007, and authors' calculations.

If this were a simple economy with no foreign sector and no depreciation, the sum of the incomes from production, NI, would exactly equal GDP. But in our more complex economy, three adjustments are needed to reconcile figures on domestic income and domestic production.

First, we need to note that some domestic incomes reflect *foreign* production. For example, as mentioned above, the profits of a U.S. company may include earnings from overseas plants. Such incomes must be subtracted from NI order to reconcile this measure with the figure for *gross domestic product*. Conversely, the income from some domestic production is received by foreign residents, and so not counted in NI. A German factory located in the United States may send its profits back to its Berlin headquarters, for example. The value of these incomes must be added to NI in order to approximate GDP.* In 2006, income receipts from the rest of the world exceeded income paid out by nearly \$60 billion. These “net income payments from the rest of the world” must be subtracted off NI to get a measure closer to GDP, as shown in Table 5.4.

Second, we need to account for the fact that not all of GDP creates income, since some domestic production simply goes into replacing structures, equipment, and software that have worn out or become obsolete. So we must add in depreciation (what the BEA calls “consumption of fixed capital”) to get a number closer to GDP. The third adjustment in Table 5.4 is what is called the “statistical discrepancy.” It reflects the fact that, no matter how diligently the BEA compiles the accounts, it cannot exactly reconcile the results from the income approach with the results from the product and spending approaches.

We can summarize the meaningful parts of the income approach by the identity:

$$\begin{aligned} \text{GDP} &= \text{National income} \\ &\quad - \text{Net income payments from the foreign sector} \\ &\quad + \text{Depreciation} \end{aligned}$$

Discussion Questions

1. The previous section explained why a nation’s “production” and “income” can be thought of as roughly equal in a conceptual sense. Why, in practice, does the value of domestic production actually differ from the total of domestic incomes?

* When net income payments from the rest of the world are added to GDP, the result is a measure called gross national product (GNP). For many years, GNP was used as the primary measure of U.S. production. It measures a country’s production in terms of the output produced *by its workers and companies*, no matter where in the world they were located. The BEA switched its emphasis from GNP to GDP in 1991, believing that it is more important, for the purposes for which the accounts are used, to track economic activity *within the borders* of a country.

2. Sometimes you may see GDP defined as “The total *market* value of *all* final goods and services newly produced in a country over a period of time.” Given the above discussion, how true is this definition, really? Does GDP really count only goods and services exchanged *in markets*? Does it really account for *all* production?

5. GROWTH, PRICE CHANGES, AND REAL GDP

Economic growth, traditionally defined as a state in which GDP is on the rise, is historically a topic of wide concern to policymakers and the media. Likewise, inflation, or the growth rate of prices, is also closely followed.

5.1 CALCULATING GDP GROWTH RATES

So far, we have concentrated on calculating GDP in only one year. To calculate rates of economic growth, economists must look at how GDP changes over time. The percentage change in GDP from year to year can be calculated using the standard percentage change formula. The standard formula, for something that takes one value in year 1 and another in year 2, is:

$$\text{percentage change} = \frac{\text{Value}_2 - \text{Value}_1}{\text{Value}_1} \times 100$$

So to compute the growth rate of GDP from, say, 2005 to 2006, we calculate:

$$\text{growth rate of GDP} = \frac{\text{GDP}_{2006} - \text{GDP}_{2005}}{\text{GDP}_{2005}} \times 100$$

For example, United States GDP in 2005 was estimated to be \$12.43 trillion, while in 2006 it was estimated to be \$13.20 trillion. Fitting these into the equation, we have

$$\begin{aligned} \text{growth rate of GDP} &= \frac{13.20 - 12.43}{12.43} \times 100 \\ &= .062 \times 100 \\ &= 6.2 \end{aligned}$$

indicating that GDP grew about 6.2 percent between 2005 and 2006.

The BEA and newspapers commonly report the GDP growth rates for quarters, expressed in terms of an “annual growth rate.” This measures by how much the economy would grow if it were to continue to expand for the entire year at the speed reported for the three-month period. (See News in Context.)

5.2 NOMINAL VS. REAL GDP

Does the number we just calculated mean that the level of aggregate production in 2006 was 6.2 percent larger than production in 2005? Not necessarily. The measure of GDP used in the previous section is **nominal or current-dollar GDP**, or GDP expressed in terms of the prices of goods and services that were current at the time. The figure for GDP for 2006 that we used, for example, is based on prices as they were in 2006, and the figure for GDP in 2005 is based on prices that prevailed in 2005.

NEWS IN CONTEXT:**Real GDP Grew at a 0.6 Percent Rate in the Fourth Quarter**

The U.S. BEA issues regular news releases concerning GDP growth. Here are excerpts from its release of February 28, 2008.

Real gross domestic product—the output of goods and services produced by labor and property located in the United States—increased at an annual rate of 0.6 percent in the fourth quarter of 2007, according to preliminary estimates released by the Bureau of Economic Analysis. In the third quarter, real GDP increased 4.9 percent.

The GDP estimates released today are based on more complete source data than were available for the advance estimates issued last month. . . .

The increase in real GDP in the fourth quarter primarily reflected positive contributions from personal consumption expenditures (PCE), exports, nonresidential structures, state and local government spending, and equipment and software that were largely offset by a negative contributions from private inventory investment and residential fixed investment. Imports, which are a subtraction in the calculation of GDP, decreased . . .

The deceleration in real GDP growth in the fourth quarter primarily reflected a downturn in inventory investment and decelerations in exports, in PCE, and in federal government spending that were partly offset by a downturn in imports.

nominal (current dollar) GDP: gross domestic product expressed in terms of current prices

Not only does output change between two years, but generally the *prices at which output is valued* change as well. **Real GDP** is a measure that seeks to reflect the actual value of goods and services produced, by removing the effect of changes in prices.

real GDP: a measure of gross domestic product that seeks to reflect the actual value of production goods and services produced, by removing the effect of changes in prices

For example, suppose a very simple economy produces only two goods, apples and oranges. Columns (1) through (3) of Table 5.5 describe the number of each produced in each of two years, and the market prices in each year. Nominal GDP is just the sum of the dollar values of the goods produced in a year, evaluated at the prices in that same year:

$$\text{Nominal GDP} = \text{Total production valued at current prices}$$

As we can see in Table 5.5, in Year 1 the value of nominal GDP is \$200. In Year 2, the value of nominal GDP is \$300. The percentage growth of GDP from Year 1 to Year 2 can be calculated as 50 percent, applying the percentage change formula from the previous section.

But if you look carefully, you can see that only part of the change in nominal GDP is due to an increase in production: The quantity of oranges produced rises from 50 pounds to 75 pounds from Year 1 to Year 2. The rest of the year-to-year increase is due an increase in the price of apples, from \$1.00 to \$1.50.

Table 5.5 Calculation of Nominal GDP in an “Apples-and-Oranges” Economy

(1) Description	(2) Price this Year	(3) Quantity this Year	(4) Nominal GDP = sum of [column (2) × column (3)]
Year 1			
Apples	\$1.00	100	\$100
Oranges	\$2.00	50	\$100
			<u>\$200</u>
Year 2			
Apples	\$1.50	100	\$150
Oranges	\$2.00	75	\$150
			<u>\$300</u>

5.3 CALCULATING REAL GDP

Until 1995, the BEA calculated real GDP using the “constant-dollar method.” Since the constant-dollar method is relatively easy to understand and contains most of the intuition you need as a beginning economics student, we will cover it in some detail.

The constant-dollar method uses prices from one particular year, called the **base year**, to evaluate the value of production in all years.

base year (in the constant-dollar method of estimating GDP): the year whose prices are chosen for evaluating production in all years. Real and nominal GDP are equal in the base year

Constant-dollar real GDP is calculated by doing the same sort of multiplying and summing exercise as shown in Table 5.6, but using the *same* prices for all years:

$$\text{Constant-Dollar Real GDP} = \text{Total production valued at base year prices}$$

Applying the constant-dollar method to our simple “apples-and-oranges” example, for instance, we might take Year 1 as the base year, and express GDP in both Year 1 and Year 2 in terms of Year 1’s prices. Calculations of constant-dollar real GDP for each year are shown in Table 5.6. While the quantities in column (3) are the same as in Table 5.5, the prices in column (2) are *all from Year 1*. GDP in Year 2 expressed in “constant (Year 1) dollars” is the sum of quantities in Year 2 multiplied by prices in Year 1. This comes out to be \$250. In the base year, real and nominal GDP are the same.

Using the percentage growth rate formula from the previous section, we can see that constant-dollar *real* GDP has grown by 25 percent. Note that this is less than the 50 percent growth figure for nominal GDP. Some of the growth in nominal GDP is due to price changes, not production changes.

The convention of using “constant dollars,” however, has a number of problems. One of the most bothersome is that it makes measured GDP growth calculations depend on which year is chosen as base. For example, what if we chose Year 2 to be the base instead of Year 1? Applying Year 2 prices to both years would yield a measured growth rate of 20 percent, instead of the 25 percent we calculated using Year 1 as base. (You can check this as an exercise.) The method also suffers from various biases, which become more important the more dissimilar relative prices and spending patterns are between the base year and a current year.

Beginning in 1996, the BEA switched to calculating real GDP using the “chained-dollar” method. The concept behind the new measure is still the same—real GDP still is an attempt

Table 5.6 Calculation of Constant-Dollar Real GDP

(1) Description	(2) Price in Base Year	(3) Quantity this Year	(4) Real GDP =sum of [column (2) × column (3)]
Year 1 (Base)			
Apples	\$1.00	100	\$100
Oranges	\$2.00	50	\$100
			<u>\$200</u>
Year 2			
Apples	\$1.00	100	\$100
Oranges	\$2.00	75	\$150
			<u>\$250</u>

to measure output change free of the influence of changing prices. While there is still one year for which real and nominal GDP are equal, it is now called the “reference year,” and real GDP is currently expressed in BEA publications in terms of “chained (2000) dollars.” Unlike the constant-dollar method, the chained-dollar method yields a unique estimated growth rate. Unfortunately, while this method has arguably increased the accuracy of GDP growth calculations, one drawback is a steep jump in computational complexity. Because these calculations are much harder than for the constant-dollar method, their explanation has been placed in the Appendix to this chapter.

In Figure 5.1 you can see how measures of real and nominal GDP diverge. Because prices were generally rising over the period 1990–2006, nominal GDP grew faster than real GDP, as shown by the more steeply rising line.

5.4 PRICE INDEXES AND INFLATION RATES

Price indexes are interesting both for how they relate to calculation of real GDP and on their own because of the policy interest in measuring (and controlling) inflation. An **index number** is a figure that measures the change in size of a magnitude, in this case the price level, as compared to its magnitude in some other period. Generally, the value of the index number in the reference or base year is set to 100, though sometimes other values (such as 1 or 10) are used.

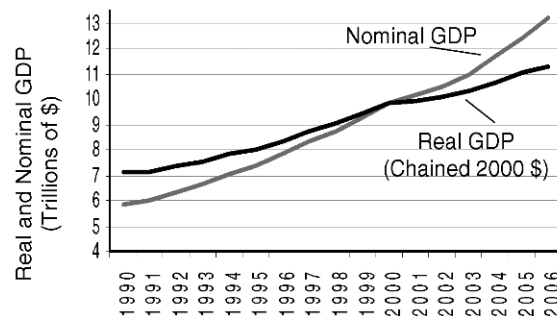
index number: a figure that measures the change in size of a magnitude, such as a quantity or price, as compared to its magnitude in some other period

The price index most often reported in the news is the **consumer price index (CPI)**, calculated by the U.S. Bureau of Labor Statistics (BLS). The CPI measures changes in the prices of goods and services bought by households.

consumer price index (CPI): an index measuring changes in prices of goods and services bought by households

The CPI is calculated using a *weighted average* of the prices of the various goods and services it tracks. The mathematics of this is worth a little explaining. A “weighted average” is an average in which the different numbers being averaged together are “weighted” to indicate their relative importance in the calculation. You are probably already familiar with this, in the calculation of your own Grade Point Average now or in high school. Each grade you receive in a course is “weighted” by the number of credits or hours the course is worth. These weighted grade points

Figure 5.1 Real versus Nominal GDP, 1990–2006



Nominal GDP grows faster than real GDP when prices are rising. (Data source: BEA NIPA Tables 1.1.5 and 1.1.6, published 10/31/2007)

are summed up and then divided by the total number of credits or hours to yield your GPA. An “A” received in a two-credit course thus properly receives less emphasis in the calculation than an “A” received in a four-credit course.

Similarly, in measuring price levels in the economy, we want to give greater emphasis to prices at which many transactions are made, and less emphasis to the prices of relatively minor goods and services. The way to do this is to weight each price by a corresponding quantity of goods produced and sold at that price.

Once again, however, we face choices about what standards to use. Should we use as weights the quantities bought in Year 1, Year 2, or some combination? Until recently, the Bureau of Labor Statistics used a *constant-weight method* to calculate the CPI. Quantities bought during one time period are chosen as “base.” These quantities are said to represent a typical “market basket” of goods bought by households. A constant-weight price index is calculated according to the following formula:

$$\text{Constant Weight Price Index} = \frac{\text{sum of current prices weighted by base quantities}}{\text{sum of base prices weighted by base quantities}} \times 100$$

The price-index problem is analogous to the calculation of “constant-dollar” GDP—only now it is a common set of *quantity weights*, rather than prices, from the base period that are applied to every calculation.

Consider, again, our “apples-and-oranges” economy, assuming that the quantities given reflect purchases by consumers. Table 5.7 shows how we would calculate the numerator and denominator for the constant-weight price index formula, considering Year 2 to be the current year and using the Year 1 “market basket” as the base. The sum of current (Year 2) prices weighted by base quantities is \$250, while the sum of base prices weighted by base quantities is \$200. The CPI for Year 2 is therefore calculated as $(250 \div 200) \times 100 = 125$. The price index for the base year (here, Year 1) is always equal to 100.

The growth rate of prices—that is, the inflation rate affecting consumers—is measured by the growth rate of this price index:

$$\text{Inflation rate} = \frac{CPI_2 - CPI_1}{CPI_1} \times 100$$

So, in this case, with the price index rising from 100 to 125, the inflation rate is 25 percent.

Table 5.7 Calculation of Parts of a Constant-Weight Price Index

(1) Description	(2) Price this Year	(3) Quantity in Base Year	(4) Sum of (Prices × Base Quantities) = <i>sum of</i> [column (2) × column (3)]
Year 1 (Base)			
Apples	\$1.00	100	\$100
Oranges	\$2.00	50	\$100
			<u>\$200</u>
Year 2			
Apples	\$1.50	100	\$150
Oranges	\$2.00	50	\$100
			<u>\$250</u>

Unfortunately, when a price index is based on constant weights, it may tend to overstate inflation for periods after the base year. When the price of a good is rising particularly fast relative to other goods, people tend to look for cheaper substitutes. But a constant-weight index assumes that people are still buying the same quantities of the expensive goods. Various innovations have recently been made in the CPI to attempt to get around this problem. Currently, the “market basket” is updated periodically using data from ongoing household expenditure surveys. The BLS now also publishes “chained” price indexes. The mathematics of these more advanced calculations will not be presented here.

The CPI is not the only price index in use. The producer price index (PPI) measures prices that domestic producers receive for their output, and so tracks many intermediate goods not included in the CPI market basket. Import and export price indexes track prices of goods traded between domestic residents and the foreign sector. Because they track different goods, these indexes—and inflation rates calculated from them—may vary from each other.

The BEA uses the CPI, PPI and other indexes created by the BLS in creating its own national income and product statistics, and also creates a price index of its own. While the other indexes reflect price levels of specific groups of goods and services of interest to consumers and producers, the index published by the BEA reflects changes in all the prices of goods and services included in GDP. Called the **implicit price deflator** (or the **GDP deflator**), it is calculated for any year as:

$$\text{Implicit Price Deflator} = (\text{Nominal GDP} / \text{Real GDP}) \times 100$$

where real GDP is calculated using the chained-dollar method. Calculations are demonstrated in the Appendix.

implicit price deflator (GDP deflator): a price index derived by dividing nominal GDP by real GDP

5.5 GROWTH AND GROWTH RATES

We have calculated year-to-year growth rates for GDP and prices. But suppose we want to ask how much GDP has grown over the last five years, or twenty years? How do we calculate those numbers? The answer is rather complicated, but fortunately you can use NIPA’s published tables to answer such questions.

Economics in the Real World: How Quantity Weights Can Lose Validity Over Time

Why do economists and statisticians make a fuss about updating the quantity weights used in calculating the Consumer Price Index? Consider how household expenditure patterns have changed over time.

In 1901, nearly half of the budget of a typical urban, working family went towards food, while 15 percent went towards shelter and an equal proportion towards clothing. The family probably spent nothing at all on cars or gasoline—since automobiles were not yet in wide use!

By 1950, the picture had changed considerably. Now only a third of the family's spending went towards food, while only 11 percent went towards shelter and 12 percent towards clothing. On average, families now spent about 12 percent of their budget on expenses related to private vehicles, since by this time automobile ownership was becoming widespread.

In recent data on consumer expenditures, the share devoted to food has dropped even further—to 14 percent. Expenditures on clothing have dropped to less than 5 percent of a household's budget, on average. Meanwhile, families are spending more on shelter (19 percent of their budget) and private vehicle expenses (18 percent of their budget), than they were at mid-century.

Using expenditure patterns from one of these periods to “weight” the CPI in another would clearly result in biased figures. Using the 1901 expenditure pattern nowadays would, for example, mean that auto and gasoline prices would not figure into the CPI at all.

The invention of new goods and services (for example, MP3 players) and quality improvements in existing goods (for example, in products for home entertainment and computing) continue to create special challenges for the economists working on measuring price changes.

Sources: Eva Jacobs and Stephanie Shipp, “How Family Spending Has Changed in the U.S.” *Monthly Labor Review* March 1990; U.S. Bureau of Labor Statistics, *Consumer Expenditures in 2002*, Feb 2004; and authors' calculations.

However, a handy way to get a grasp on the relation of annual growth rates to changes over a longer period of time is by using the **rule of 72**. Taking the number 72 and dividing by an annual growth rate will give you approximately the number of years it will take for an amount to double if it grows at that constant rate (as long as the numbers you are using are not extremely high or low). For example, if real GDP grew at a constant 4 percent rate per year, it would double in about eighteen years (since $72/4 = 18$).

rule of 72: a shorthand calculation that states that dividing an annual growth rate into the number 72 yields approximately the number of years it will take for an amount to double

Discussion Questions

1. The “constant-dollar” method of estimating real GDP uses prices for one year to calculate measures of GDP for all years. Why is it sometimes important to evaluate GDP in the current year using prices from some other year? Why can’t we just always use current prices? Explain.
2. How is the “constant-dollar” method of estimating real GDP similar to the use of “constant weights” in the computation of the price indexes? Explain.

6. SAVINGS, INVESTMENT, AND TRADE

At a personal level, you produce goods and services, earn income, consume, save, and borrow or lend. One of the reasons you keep personal accounts is to try to track your inflows and outflows, so you know whether you are running down your personal assets or building them up. If you can save money from your current income, you are bettering your financial position for the future. On the other hand, if you run down your savings or go into debt merely to finance a high level of consumption, you may find yourself in trouble later on. Running down financial savings or going into debt can be a good choice for your future only if you use the funds to gain some other valuable asset. Students often go into debt in order to finance their education, for example, with the idea that it will later pay off by enabling them to earn higher income.

There are analogous issues at the national level. Besides keeping track of economic growth and inflation, systems of national accounts serve another important purpose. They allow us to look at the savings-and-asset situation of a national economy as a whole (at least as far as *manufactured* assets and financial flows are concerned).

6.1 THE RELATIONSHIP OF SAVINGS, INVESTMENT, AND TRADE

The analogous category at the national level to your personal day-to-day consumption spending is the consumption spending done by the household and institutions and government sectors. This is spending on goods and services that are presumably “used up” right now—they are not expected to help the country over the long term. The analogous category to your income is—at least roughly—GDP.

Recall that the spending approach to GDP says that

$$\begin{aligned} \text{GDP} = & \\ & \text{Personal consumption} + \text{Private investment} \\ & + \text{Government consumption} + \text{Government investment} + \text{Net exports} \end{aligned}$$

Rearranging, we can get

$$\begin{aligned} \text{GDP} - \text{Personal consumption} - \text{Government consumption} = \\ \text{Private investment} + \text{Government investment} + \text{Net exports} \end{aligned}$$

Since saving is what is left over from income after spending on consumption,

$$\text{Saving} = \text{Investment} + \text{Net Exports}$$

Thinking about these quantities in terms of valuable goods and services, this important identity says, intuitively, that goods and services that are produced in our domestic economy in excess of what we currently use for consumption can be investment goods—additions to our stock

of manufactured assets (including replacement of depreciated assets)—or can sold to foreign countries (in excess of the value of what we import from them.)

6.2 FINANCING SPENDING

Another way to look at the relation of saving, investment, and trade is to think of how the various sectors *finance* their purchases of goods and services. In a contemporary economy, goods are rarely traded for goods, but rather money is used as a means of exchange. So corresponding to any flow of goods and services transacted in exchanges there is an equivalent flow of monetary funds.

Consider, for a moment, a closed economy. In this case the last identity would reduce to:

$$\text{Saving} = \text{Investment}$$

This says that, in a closed economy as a whole, the total amounts that the various sectors choose not to spend on consumption goods is available for spending on investment goods. How does financial saving get turned into tangible investments?

In the national accounts, it is primarily businesses and the government who are counted as investing. They finance their investment expenditures either from their own savings or by borrowing someone else's savings. Household savings, in the form of income not spent on consumption, can be made available for investment by the other sectors—as when the funds in a household's bank deposit are lent out to a business, or a household buys a government bond. The “saving = investment” identity tells us that at an aggregate national level in a closed economy, only what the country as a whole saves out of current income can be available to finance investment for the future.

When we consider an open economy, things get more complicated. Now the nation as a whole can also borrow from, or lend to, the foreign sector, and the relevant identity is:

$$\text{Saving} = \text{Investment} + \text{Net Exports}$$

If net exports are positive, we sell more goods abroad than we buy. How do people abroad pay for all our goods, if the value of what we sell to them exceeds the value of what they sell to us? They are not earning enough from their sales to pay us! The most important way they can finance their purchases of our goods is by borrowing from us. They would need to borrow the amount by which our exports to them exceed our imports from them. So the identity can be (approximately) rewritten as:*

$$\text{Saving} = \text{Investment} + \text{Net foreign lending}$$

That is, if we have extra savings, above and beyond what is being used for domestic investment, we can loan it to foreigners so they can buy our goods.

In recent years, however, the United States has tended to have net exports that are negative—we tend to buy more from foreign countries than we sell. This means that *we* need to borrow from *them*. The following identity means exactly the same thing as the last one, but is easier to use to represent the recent U.S. situation:

* Other ways foreigners can get more goods and services from us than they sell to us is by receiving our goods as gifts, paying for them out of transfer income, or selling us their assets, such as land or businesses, in return. So the equation above is only approximate.

$$\text{Saving} = \text{Investment} - \text{Net foreign borrowing}$$

When we are in a situation of borrowing (that is, when net foreign borrowing is a positive number) then the amount we are really “putting away for the future”—that is, saving—is less than what we would guess if we only looked at what we are investing. While we may be investing domestically, if “net foreign borrowing” is positive we are also putting the country’s future financially “in hock” to other countries by borrowing from them.

Should we worry if our country has to borrow from foreigners? As in the case of your personal finances, it makes a difference what the borrowing is *for*. If the borrowing finances the purchase of productive new private or government investment goods, then it may be a way of actually improving the country’s outlook for the future. As mentioned in Chapter 1, international authorities encouraged poor countries for many decades to borrow heavily for development projects, using exactly this reasoning. But if the funds borrowed largely go into investments that do not pay off financially, or if the borrowing only finances a high level of consumption, there is reason to worry. A country that borrows a lot may be in trouble when it comes time to pay back its loans. Many poor countries have, in recent years, in fact found themselves unable to pay the *interest* on—much less pay *back*—the enormous foreign debts that they have built up over the years.

6.3 NET DOMESTIC PRODUCTION AND SAVING

The investment concept used in defining *gross* domestic product (GDP) is *gross* investment. To calculate what the level of production is during a year, above and beyond the production that simply replaces worn-out manufactured capital, we need another concept, **net domestic product (NDP)**. NDP is GDP less depreciation (just as net investment, we saw earlier, is gross investment less depreciation):

$$\text{Net domestic product} = \text{GDP} - \text{Depreciation}$$

net domestic product (NDP): a measure of national production above that needed to replace worn-out manufactured capital, found by subtracting depreciation from GDP

So far we have discussed gross saving, the gross amount a country sets aside from spending. But at the same time that we are saving, some capital goods are wearing out. To really find out what we have “put aside for the future,” we need to subtract depreciation from our measures of saving, as well. For example, even if our savings were positive, if they did not finance enough investment to make up for deterioration of the capital stock, we would actually start the next year in a *worse* position. **Net saving** is gross saving minus depreciation.

$$\text{Net saving} = (\text{Gross}) \text{ Saving} - \text{Depreciation}$$

Using the equation from the “financing spending” section (above) that relates savings to investment and foreign borrowing, we can rewrite this as:

$$\text{Net saving} = (\text{Gross}) \text{ Investment} - \text{Depreciation} - \text{Net foreign borrowing}$$

Net saving is a better measure than gross saving of whether we are “putting aside for the future.”

How much has the United States been “putting aside for the future” lately? BEA estimates of gross investment, depreciation, and net foreign borrowing for 2006 are approximately \$2.6 trillion, \$1.6 trillion, and \$0.8 trillion, respectively. Allowing for the fact that some of the statistics used in these calculations may contain errors, the BEA estimates that net saving for that year was only about \$250 billion (that is, \$0.25 trillion).

Discussion Questions

1. Suppose the country of Atlantis is investing and exporting a great deal, while it imports little. What can you say about its level of national saving? Suppose the country of Olympus invests more than it saves. How can it do this?
2. For many years it was often said that the level of government debt was not much of a problem, no matter how high it was, since we “owe it to ourselves.” Taxpayers within the United States would, of course, eventually have to pay back the debt (or at least pay interest on it, as it gets refinanced time after time). But their payments would be going to owners of government bonds who were *also* primarily people within the United States. Over the years, however, many U.S. government bonds have been purchased by foreigners. Does this complicate this picture? Explain.

7. GROSS DOMESTIC PRODUCT IN THE TRADITIONAL MACROECONOMIC MODEL

During the mid-to-late twentieth century, it became popular to teach macroeconomic principles using an especially simple representation of the basic macroeconomic identities. The **traditional macroeconomic model** that will be explored at length in later chapters is based on a representation of national accounts that adds further simplifications to the conventions adopted by the BEA.

traditional macroeconomic model: a simple, mechanical model that portrays the macroeconomy as being made up of businesses that produce and invest, and households and governments that (only) consume.

As in the NIPA, three of the recognized sectors in the traditional model are the business, government, and foreign sectors. Instead of a “household and institutions” sector, however, the model posits only a “household” sector. While in actuality nearly 10 percent of measured Personal Consumption Expenditures comes from nonprofit institutions such as hospitals and universities, nonprofit institutions are ignored in the traditional model. Personal consumption expenditures—shortened to **consumption** and denoted by C —are treated as representing only *household* spending.

consumption (C) (traditional macro model): the component of GDP that represents spending by households.

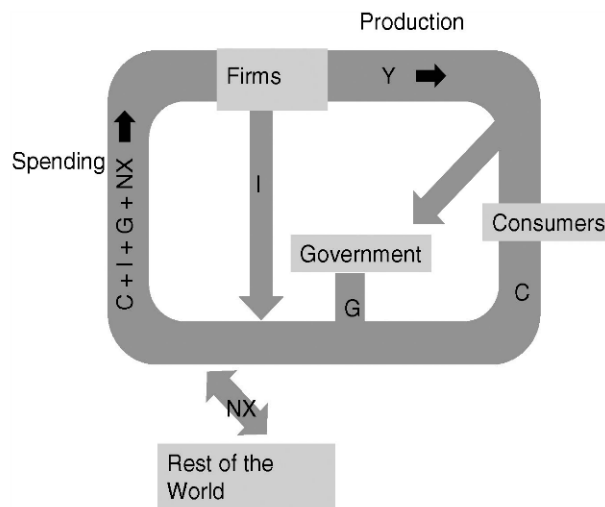
The traditional model follows the NIPA in not accounting for investments in natural, human, and social capital. **Investment (I)** is limited to spending on structures, equipment, and inventories. While current BEA practice recognizes that governments undertake investments, investment in the traditional model is assumed to be exclusively an activity of the business sector. In this model, **government spending (G)** on goods and services is not generally considered to have an investment component.

investment (I) (traditional macro model): the component of GDP that represents spending on structures, equipment and inventories by business firms

government spending (G) (traditional macro model): the component of GDP that represents spending by federal, state and local governments (and which is assumed to be consumption-oriented)

The foreign sector and **net exports (NX)** are treated similarly to the way they are in the national accounts. GDP is often represented by the notation Y , and referred to interchangeably

Figure 5.2 The Traditional Macroeconomic Model “Circular Flow” Diagram



In the traditional macroeconomic model, only business firms are portrayed as producing. Governments and households appear only as actors who buy the firms' products, and non-profit institutions and the environment do not appear at all.

as aggregate “product,” “income,” or “spending.” The basic identity of the model is taken from the spending approach to GDP accounting:

$$Y = C + I + G + NX$$

That is, aggregate spending (or income or product) in the traditional macro model is defined as the sum of consumption spending by households, investment spending by business firms, government spending, and net exports. (Compare this to Table 5.3 above.)

net exports (NX) (traditional macro model): the component of GDP that represents the value of exports less the value of imports

The basic identity of the traditional macro model is $Y = C + I + G + NX$

What might be the most startling assumption of this model, however, is that not only is it assumed that governments and households do not invest, it is *assumed that governments and households do not produce*. Production is assumed to be accomplished only by the business sector. For example, most presentations of this model include a circular flow diagram for production and spending similar to Figure 5.2. (In some cases, the diagrams include financial flows such as taxes, transfers, and savings. These are omitted here for simplicity.) In this diagram, business firms are represented as producing the whole of GDP. The government and “consumers” (households) make use of this production, by buying most of the goods and services provided. Business investment spending also contributes to total spending. The effect of the rest of the world can be to either add to, or subtract from, the flow of spending, depending on whether net exports are positive or negative.

While this simplified model can be useful in some applications, users also need to be aware of how this very simple image of an economy, which leaves out important aspects of real economies, can create distortions in our way of thinking about economic life.

Discussion Questions

1. What is the basic identity of the traditional macro model? Why is the left-hand side of the equation referred to interchangeably as “product,” “income,” or “spending”? Which approach to counting GDP does the identity reflect?
2. Do you think the National Income and Product Accounts focus attention on the most important characteristics of an economy in the twenty-first century? What about the traditional macro model? Give examples of some important contemporary economic problems for which the national accounts and the traditional model might give useful frameworks for study and analysis, and some examples of some problems where they would not.

REVIEW QUESTIONS

1. For what purpose was national accounting in the United States originally begun?
2. Who compiles the National Income and Product Accounts?
3. What are the four sectors of the economy, according to the BEA? What sorts of entities are included in each?
4. What forms of capital assets are tracked by the BEA?
5. Explain the difference between gross and net investment.
6. Explain four key phrases that appear in the definition of GDP.
7. What are the three approaches to GDP measurement?
8. Explain why, in a simple economy, the three approaches would yield the same figure for the value of total production.
9. Explain why the following two approaches arrive at the same number for the value of a final good: (a) looking at the market price of the good and (b) counting up the value-added at each stage of its production.
10. How are “market values” determined for goods and services that are not exchanged in markets, or when data is not available?
11. Describe the components of GDP according to the product approach.
12. Describe the components of GDP according to the spending approach.
13. What are the major differences between GDP and national income?
14. Describe the reasoning behind the “constant-dollar” approach to calculating real GDP.
15. What are some problems with the “constant-dollar” approach to calculating real GDP? Identify a problem with the “chained-dollar” approach.
16. Describe the reasoning behind the “constant-weight” method traditionally used in estimating the price indexes.
17. Is there only one kind of price index? Explain.
18. Explain how savings, investment, and trade are related in the national accounts.
19. Explain how a country can finance an excess of imports over exports.
20. What additional simplifying assumptions does the traditional macro model impose, beyond those made in the NIPA?

EXERCISES

1. If you look at the government-supplied statistical tables regarding the national accounts, you might find that they often go into considerable detail about “farm” vs.

“non-farm” activities, while it is much harder to dig out good information on, for example, the activities of the finance industry. Can you conjecture how this might relate to the history of the national accounts?

2. In which line (or lines) of Table 5.2 (the product approach) would the value of each of the following be counted? “Not counted in any category” is also an option.
 - a. Production of fresh apples, domestically grown for profitable sale
 - b. State health inspection services
 - c. Education services provided by a private, nonprofit domestic college
 - d. Childcare services provided by a child’s parents and relatives
 - e. Production by a U.S.-owned company at its factory in Singapore
3. In which line (or lines) of Table 5.4 (the income approach) would the value of each of the following be counted? If it is part of “net income flows from the rest of the world” explain whether it reflects domestic (or foreign) production, and whether it reflects domestic (or foreign) income. “Not counted in any category” is also an option.
 - a. Wages paid by your local supermarket to its employees
 - b. Profits received by a U.S. electronics firm from its factory in Mexico
 - c. Business spending to replace worn-out equipment
 - d. Wages paid by a U.S. electronics firm to the employees of its factory in Mexico
 - e. Profits received by a Japanese automaker from its factory in the United States
4. In which line (or lines) of Table 5.3 (the spending approach) would the value of each of the following be counted? “Not counted in any category” is also an option.
 - a. A new refrigerator bought by a family
 - b. A book newly produced in Indiana and bought by a store in Mexico
 - c. New computers, manufactured in Asia, bought by a U.S. accounting company
 - d. Meals produced and served in Virginia to military personnel
 - e. New computers, produced in the United States, bought by a U.S. computer retail chain, and not yet sold by the end of the year
 - f. A three-year-old couch bought by a used furniture store in Arizona
 - g. Cleaning services bought by a nonprofit hospital in New York
 - h. The services of volunteers in an environmental action campaign
5. Using the relations among accounting categories demonstrated in the tables and identities in the text, use the following information on values (measured in Neverlandian pesos) from the country of Neverland in 2010

Household and institutions spending = 650
 Household and institutions production = 150
 Net income payments from the rest of the world = 5
 Nonprofit institutions production = 50
 State and local government spending = 30
 Change in private inventories = 2
 Depreciation = 60

Business spending = 50
 Exports = 225
 Imports = 125
 Government production = 200
 Statistical discrepancy = 0
 GDP = 850

to find values for the following categories:

- a. Private household production
- b. Business production

Table 5.8 Deriving Real GDP in Chained (Year 1) Dollars

Type of Measure	Year 1	Year 2
Nominal GDP	\$200	\$300
Fisher quantity index (current to previous year)	—	1.225
Chain-type quantity index	100	100×1.225 = 122.5
Real GDP (chained Year 1 dollars)	= \$200	$(122.5 \times \$200)/100$ = \$245

Notice that this growth rate is *between* the two growth rates (20 percent and 25 percent) we obtained by using the constant-dollar method with various base years. The Fisher quantity index method gives us a unique *average* number for estimated growth.

A quantity index for the current year in terms of a reference year that may be several years in the past is created by “chaining together” year-to-year Fisher quantity indexes to make a **chain-type quantity index** comparing real production relative to the reference year. The chain-type quantity index has a value of 100 in the reference year. In any subsequent year, it is set equal to the chain-type quantity index from the previous year multiplied by the Fisher quantity index calculated for the current year.

chain-type quantity index: an index comparing real production in the current year to the reference year, calculated using a series of year-to-year Fisher quantity indexes

Finally, estimation of real GDP in (chained) dollar terms is made by multiplying the chain-type quantity index for a year times the level of nominal GDP in the reference year, and dividing by 100.

For example, suppose we take our “apples-and-oranges” economy, making Year 1 the reference year. Year 1’s chain-type quantity index is thus set equal to 100, and its nominal and real GDP are equal. These are shown in Table 5.8. The chain-type quantity index for Year 2 is the previous year’s value (100) times the Fisher quantity index we just calculated (1.225). We multiply this result, the new index number 122.5, times nominal GDP in the base year (\$200) and divide by 100 to get real GDP, \$245. Whew!

This can be continued for many years into the future—or into the past. (For example, if the Fisher quantity index calculated for Year 3 were to come out to be 1.152, then the chain-type quantity index for Year 3 would be 122.5×1.152 .) If you want to check to see that this method actually makes some sense, calculate the percentage change in real GDP from Year 1 to Year 2 using the values in the table above. You will find it does, in fact, equal 22.5 percent!

The implicit price deflator can be calculated for Year 2 (using Year 1 as the reference year) as $(300/245) \times 100 = 122.5$, showing a 22.5 percent price increase over Year 1.

The new method has some other drawbacks, as well. The sum of real components of GDP in chained-dollar terms do not generally exactly add up to real GDP. Users of the data are also warned not to make comparisons of chained-dollar amounts for years far away from the reference year. The BEA tries to make the data more usable by providing tables in which, for example, year-to-year growth rates in components of GDP are already calculated for the user.

6

Macroeconomic Measurement: Environmental and Social Dimensions

With the increasing need to recognize issues of ecological and social sustainability, many economists have in recent decades examined the question of how national accounting—and macroeconomic analysis based on such accounts—can be improved. As economist William D. Nordhaus, chair of a blue-ribbon National Research Council panel, put it in a 1999 report to the U.S. Bureau of Economic Analysis:

Over the last quarter century, we have become increasingly aware of the interactions between human societies and the natural environment in which they thrive and upon which they depend . . . The idea of including environmental assets and services in the national economic accounts is part of a larger movement to develop broader social and environmental indicators. This movement reflects the reality that economic and social welfare does not stop at the market's border, but extends to many nonmarket activities.¹

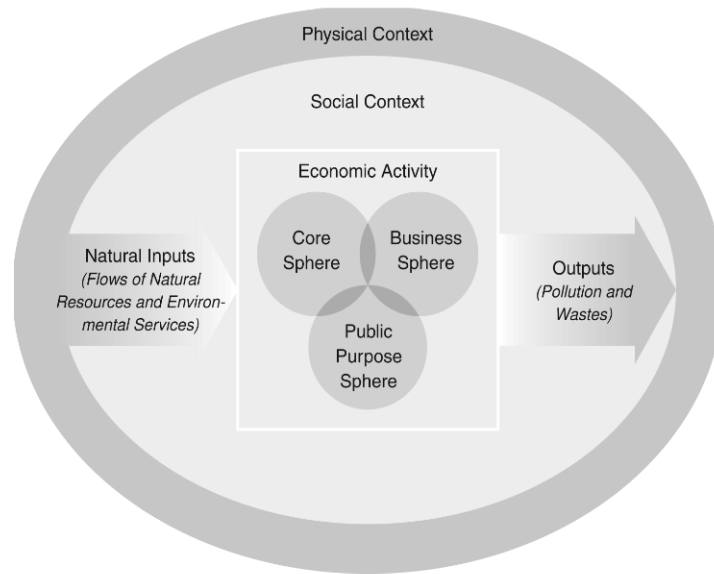
1. NEW UNDERSTANDINGS FOR THE TWENTY-FIRST CENTURY

The traditional macroeconomic model introduced at the end of the last chapter portrays a hypothetical economy in which only businesses engage in production, and in which the natural environment plays no role. This was illustrated in the flow diagram, Figure 5.2. Increasingly, however, people have raised questions about whether this gives an adequate picture of the macroeconomy.

People have come to realize that economic activity actually takes place within the context of human social institutions that in turn are inextricably embedded in the natural environment. This embeddedness is illustrated by the outer rings labeled “Social Context” and “Physical Context” in Figure 6.1. In addition, the contributions to production of households and community groups (within the core sphere), and of nonprofit as well as government institutions (within the public-purpose sphere) have recently received more attention, as illustrated in the center of Figure 6.1. Of course, the role of businesses, both foreign and domestic, is recognized in both the traditional and newer approaches.

Many researchers argue that national governments need to start gathering new kinds of data in order to face the challenges of twenty-first-century concerns. Building on these new kinds of information, some researchers are concentrating on developing refined measures of national assets and production, keeping as close as possible to the framework of the National Income and Product Accounts. In this chapter, we discuss the two major areas in which improvements in data gathering and possibly in the design of national accounts seem to be most badly needed: accounting for the environment and accounting for unpaid work in households.

Figure 6.1 Macroeconomics in Context



An emerging understanding of macroeconomic performance notes that businesses (both foreign and domestic), households and communities (the core sphere) and public-purpose institutions (governments and nonprofit organizations) are all involved in the productive activities. Economies are, in turn, embedded in a context of larger social institutions and the natural (physical) environment.

Other researchers aim to design indicators that more directly measure social and economic well-being. Rather than seeking to measure the volume of *production*, these researchers seek to develop indicators of the *quality of life* (see last section of this chapter).

Discussion Questions

1. GDP can be characterized as a (rough) measure of the amount of “throughput” going on in an economy—as measuring the level of activity whose purpose it is to turn renewable and non-renewable resources into new products. How does “throughput” relate to sustainable well-being? Is more “throughput” always a good thing?
2. In Chapter 3 we discussed how 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?

2. ACCOUNTING FOR THE ENVIRONMENT

The natural environment plays roles that are indispensable to economic life. Environmental economists describe these under the headings of three functions:

1. Resource functions: The natural environment provides natural resources that are inputs into human production processes. These include such things as mineral ores, crude petroleum, fish, 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 enjoy the services of the natural environment directly when they enjoy pleasant scenery or outdoor recreation.

3. Sink functions: The natural environment serves as a “sink” which absorbs (up to a point) the pollution and wastes generated by economic activity. Car exhaust dissipates into the atmosphere, for example, while used packaging goes into landfills and fluid industrial wastes end up in rivers and oceans. Some wastes break down relatively quickly into harmless substances. Others are toxic and/or accumulate over time, eventually compromising the quality of the environment.

The way in which the natural environment provides the resources and environmental services that sustain economic activity is illustrated by the arrow on the left in Figure 6.1, showing inflows into economic activity. The way in which economic activity puts waste products into environmental sinks is illustrated by the arrow on the right in Figure 6.1, showing the economy generating flows back into the environment.

The three main ways in which the environment interacts with the economy are through resource functions, environmental service functions, and sink functions.

resource functions: the provision by the natural environment of inputs into human production processes

environmental service functions: the provision by the natural environment of the ecosystem services that support and enhance life

sink functions: the provision by the natural environment of places to put waste materials

Although these three environmental functions were treated for centuries 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. (See News in Context.)

2.1 PHYSICAL ACCOUNTS

A first step toward accounting for the environment is simply to attempt to quantify some of the major environmental effects of economic activity in physical terms, such as in terms of proportions of fish stocks lost or tons of coal burned.

Many governments have already committed in principle to creating such accounts for their own nation, at least on one issue of major concern. The burning of fossil fuels and the resulting release of carbon dioxide into the atmosphere has been scientifically linked to global changes in climate that may, if not halted, have catastrophic results within the next few decades. In 1997 the Kyoto Protocol on Greenhouse Gas Emissions was drafted. It aims to reduce climate-change-causing greenhouse gas emissions (such as emissions of carbon dioxide) to 5 to 7 percent below 1990 levels by 2012. Individual goals were set for different countries. By mid-2007, 175 parties, including most industrialized countries such as Canada, the United Kingdom, France, Germany, Italy, Spain, Switzerland, Sweden, Norway, Japan, the Republic of Korea, and New Zealand (as well as many less industrialized countries including China and Mexico) had ratified the agreement.

Of course, for a country to monitor its own efforts in this area, it needs to know how many tons of greenhouse gasses it released into the atmosphere in 1990 and how many tons it is releasing

NEWS IN CONTEXT:**Commercial Fleets Reduced Big Fish by 90 Percent, Study Says**

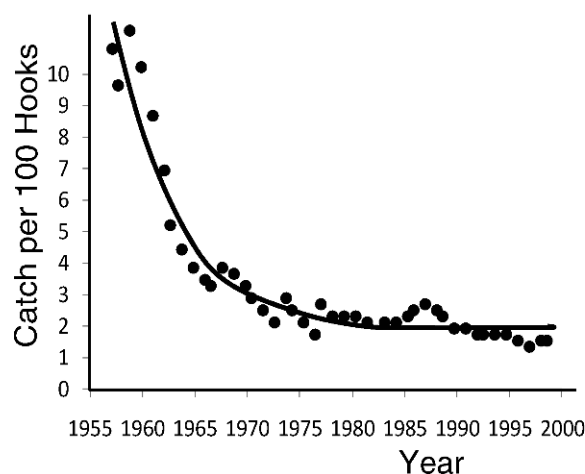
In just 50 years, the global spread of industrial-scale commercial fishing has cut by 90 percent the oceans' population of large predatory fishes, from majestic giants like blue marlin to staples like cod, a new study has found.

Oceanographers not connected with the study say it provides the best evidence yet that recent fish harvests have been sustained at high levels only because fleets have sought and heavily exploited ever more distant fish populations . . . The study, drawing on decades of data from fishing fleets and research boats, paints a 50-year portrait of fish populations under siege as advances like sonar and satellite positioning systems allowed fleets to home in on pockets of abundance . . . In almost all exploited areas, it generally took just 10 or 15 years for populations to crash. One measure was fish caught per 100 hooks on the Japanese lines. The study said the rate went from 10 fish per 100 hooks to 1 or less in that period.

"This shows that the reason we've had so much tuna and swordfish, the only reason this has been sustained, is because boats kept going farther and farther away," said Dr. Jeremy B. C. Jackson, a professor at the Scripps Institution of Oceanography. Dr. Jackson has conducted other studies showing declines and ecological effects in coastal waters but was not involved in the new work. "The problem now is there's no place left to go," he said. "There are a lot of people out there willing to fish the last fish. But that's just not going to work."

Source: Andrew C. Revkin, *The New York Times*, May 15, 2003

Figure 6.2 **The Decline of Large Predatory Fishes in the Tropical Atlantic Ecosystem**



The spread of industrial-scale commercial fishing has seriously depleted the oceans' populations of large fish.
(Source: Data taken from "Rapid worldwide depletion of predatory fish communities" by Ransom A. Myers & Boris Worm. *Nature* 423, May 15, 2003, Figure 1)

Which sort of environmental function is discussed in this news article? Why did fish appear to be in "limitless" supply for so long, in spite of the depletion of specific fisheries?

currently. The gathering of scientific and economic information necessary to measure such environmental variables, aggregated to a national level, is thus a new and expanding field.

2.2 NATURAL ASSETS AND THE NATIONAL ACCOUNTS

As we saw in the last chapter, the Bureau of Economic Analysis currently counts only manufactured assets in its tables of national assets, and only investment in manufactured assets in its calculation of investment (and savings). The 1999 National Research Council report pointed out that:

Natural resources such as petroleum, minerals, clean water, and fertile soils are assets of the economy in much the same way as are computers, homes, and trucks. An important part of the economic picture is therefore missing if natural assets are omitted in creating the national balance sheet. Likewise, consuming stocks of valuable subsoil assets such as fossil fuels or water, or cutting first-growth forests, is just as much a drawdown on the national wealth as is consuming aboveground stocks of wheat, cutting commercially managed forests, or driving a truck.²

In principle, then, this panel concluded, the value of a nation's natural resources should be added to the value of its manufactured capital stock in accounting for national assets.

Measures of the natural capital stock of a country should also include the value of assets related to environmental service and sink functions. An old-growth forest, for example, not only provides timber resources, but also environmental services such as water retention, habitat provision, and carbon sequestering, as well as recreational and aesthetic value. Ideally, then, tables in the national accounts that look at a country's assets, such as the one we examined in Table 5.1, should be much expanded.

Asset tables measure *stock* values, as discussed in Chapter 3—the value of assets is measured at a point in time. But more importantly, perhaps, for immediate policy purposes, is the issue of taking into account *changes* in the level of national environmental assets. When, over the course of a year, nonrenewable resources are depleted, or the environment's capacities to provide service flows or function as an effective sink are degraded, the nation's ability to produce in the future is reduced. The natural capital stock has depreciated. This is a *flow* variable, as discussed in Chapter 3—the amount of “disinvestment” that occurs is measured over the course of a year.

In concept, then, whenever the depreciation of manufactured capital is subtracted in the national accounts, *depreciation of natural capital* should be subtracted as well. For example, the 2003 version of the United Nations System of Integrated Environmental and Economic Accounts discusses a measure called **environmentally adjusted net domestic product (eaNDP)**, or GDP less both these kinds of depreciation.

$$\begin{aligned} \text{eaNDP} &= \text{GDP} \\ &\quad - \text{Depreciation of manufactured capital} \\ &\quad - \text{Depreciation of natural capital} \end{aligned}$$

This measure should more accurately reflect the full picture of production and depreciation in a given year.

environmentally adjusted net domestic product (eaNDP): suggested by the United Nations, this is equal to GDP less depreciation of both manufactured and natural capital

Similarly, the World Bank in 1995 proposed that saving less both kinds of depreciation be called **genuine saving**:

$$\begin{aligned}
 \text{Genuine saving} &= (\text{Gross}) \text{ Saving} \\
 &\quad - \text{Depreciation of manufactured capital} \\
 &\quad - \text{Depreciation of natural capital}
 \end{aligned}$$

Under standard measures of net saving, a country only needs to save a little more than the amount it needs to replace its worn-out manufactured capital in order to appear to be saving for the future. The genuine saving measure points out that countries that run down their natural capital may be making things worse for the future, even if their manufactured investment seems to be keeping a healthy pace.

genuine saving: proposed by the World Bank, this is equal to gross saving less depreciation of both manufactured and natural capital

2.3 NATIONAL ACCOUNTS AND WHAT NATURE PRODUCES

The adjustments we just discussed relate to the asset or *stock* value of natural assets, and how the value of these assets can depreciate over time. But, you might have noticed, in calculating *eaNDP* we started with the traditional measure of the *flow of production* over a year, GDP. Should we also adjust the measures of the flow of national production to account for environmental factors? Should GDP itself be “environmentally adjusted”?

In an ideal accounting system, we might think of the natural environment as yet another productive sphere or sector. The ecosystem, unless severely disturbed, generates over the course of any year such goods and services as new plants in forests and fields, new livestock and fish, clean air and water, spectacular scenery, an amazing diversity of plant and animal species, and services such as protection from solar radiation—often without any effort on the part of humans. Many of these natural processes add to human well-being, and humans could not survive and flourish without them. In theory, then, accounts of production relevant to human well-being should include all the flows of new goods and services that nature generates.

Most economists agree, however, that compiling comprehensive accounts for *all* that nature does for us over the course of a year would be an over-ambitious task. In fact, for productive flows, as for stocks of assets, what we really want to know about for policy purposes are the ways that the *economy and environment interact*, particularly when this interaction leads to undesirable outcomes.

For example, suppose a hillside is stripped of its forest covering, and the wood is sold as pulp for papermaking. The lack of vegetation now means that run-off from rain increases and a town downstream from the hillside suffers flooding and has to repair many buildings. Even if the vegetation should grow back by the end of the year (which is unlikely), something has happened. 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. It would seem that the more damage we do to the environment, the more “productive” the economy is!

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), netting out in something closer to a wash.

Expenditures that are made simply to compensate for or defend against harmful events are called **defensive expenditures**. The town's expenditures on repairs or floodwalls in our example were simply necessary to maintain the status quo.

defensive expenditures: expenditures necessary just to maintain a status quo (that is, necessary to keep well-being from going down in the face of negative developments)

Clearly, including defensive expenditures as positive additions to GDP, while not taking into account the loss of environmental service production that made them necessary, can result in misleading numbers. We will similarly be misled if our GDP accounts include the rising cost of hospital services to treat asthma attacks made worse by pollution, or the cost of additional fuel required by the fishing industry as boats must travel farther and farther from port to find ever-scarcer fish.

Reductions in "natural-sector production" also often have direct impacts on human well-being without being reflected in measurable defensive expenditures. For example, a person who suffers pain or dies from pollution-aggravated asthma or from contamination of their water by toxic chemicals is harmed by the fall-off in the quality of environmental services, whether or not they "add to GDP" through expenditures on medical treatment.

2.4 THE PROBLEM OF VALUATION

Even if we were able to compile very good information on environmental assets and production in physical terms, there is a very big problem currently standing in the way of directly incorporating environmental accounting into the National Income and Product Accounts. This is the problem of monetary valuation. As you recall from the previous chapter, all assets and flows are counted in *dollar* terms, based on market prices or some imputation that approximates market prices. We cannot add tons of lumber directly to grams of mercury and come up with a meaningful number. Only if all quantities can be converted to a common measure—in the case of NIPA accounts, dollars—can they be added and subtracted to come up with numbers such as "depreciation" or "production."

Putting a dollar value on an asset is tricky even in the simplest case. As discussed in Chapter 5, many conventions have been adopted to try to standardize the accounts, but they are only conventions, not truths. For example, to *really* know the value of a piece of machinery, one would need to know exactly how long it will last and what the availability and prices of all inputs and outputs related to it will be for as long into the future as the piece of machinery is used. Since we never know the future, we can only make educated guesses. The current NIPA accounts rely on many conventions about, for example, how long various types of machinery are expected to be in use and how fast they will depreciate. The resulting estimates may, of course, often be proved wrong as the future unfolds. A computer, for example, may be expected to hold most of its value for two years, but instead, due to the unexpected invention of a new technology, it could be obsolete within two months.

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 get 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 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 haul 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 shocking decline in populations of frogs, toads, and salamanders worldwide, and 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 dollar value could be put on these losses.

Another factor making valuation difficult is the issue of “discounting.” A society with a “high time discount rate” tends to put relatively little value on the future, while a society with a “low time discount rate” is willing to set aside some present enjoyment for future rewards. In an environmental context, the future that is relevant includes all generations to come! Yet coming up with a numerical dollar value for assets requires that a decision be made about how much future generations should count in present decision making.

Nevertheless, some agencies have attempted to make at least rough calculations of the value of natural capital or its depreciation. World Bank estimates of genuine saving, for example, yielded negative numbers for some less developed countries, particularly in the Middle East and North Africa. Rather than saving for the future, such countries seem to be financing some of current consumption by running down their natural assets—particularly their petroleum.

Turning from the topic of environmental assets (stocks) and their depreciation to the topic of production (flows) of environmental goods and services, the prospect for accounting is mixed. For some environmental production, a valuation in market prices could be determined relatively straightforwardly. For example, the firewood collected free in forests or the fish caught non-commercially during a year, currently not counted in GDP, could be valued at the price of their market equivalents. But for other cases the problem is more difficult.

Take, for example, the logging and flooding story from the last section. Normally, economists would try to value the production of water retention services by an existing forest by looking at some places in which this value has been translated into dollar terms. Let’s imagine towns A, B, and C that are all identical, and identically situated relative to forested hillsides. Near town A, the hillside is logged and the town sustains flood damage. The hillside near town B is also logged, but town B spends on sandbagging and avoids damage. The hillside near town C has not been logged. What, then, is the dollar value of a year’s worth of water retention services provided by the forest near town C?

Suppose the cost of repairs in Town A, which did nothing to prevent flooding, was \$5 million. If you estimate the value of the water retention services of the hillside forest near town C using the **damage cost approach**, you would say that the services are worth \$5 million—the standing forest prevents town C from suffering an estimated \$5 million in damage.

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

What if we use town B as the comparison instead? Suppose it spent \$100,000 averting damage by building sandbag barriers. Estimating the value of the forest’s services using the equally plausible **maintenance cost approach** you would say that the value of the forest’s services is \$100,000. (This is sometimes also referred to as the “avoidance cost” or “replacement cost” approach.) Having the forest standing on the hillside near town C provides equivalent services as having a sandbag barrier costing \$100,000 (abstracting, of course, from animal habitat damage

and other concerns). As you can see, the two approaches may not agree—the value of the forest’s services to town C could be estimated at either \$5 million or \$100,000.

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

Another example would be 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 you 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?

The idea of an environmentally adjusted or “greened” GDP appeals to many who are concerned about the problems of a GDP measure that omits important environmental issues. It has proved difficult, however, to arrive at a single estimate of “Green GDP.” What may be more useful, at least for the time being, are studies that give ranges of well-reasoned monetary estimates, while making their assumptions and methods clear.

2.5 MAKING CHANGES: SATELLITE ACCOUNTS

As an alternative to defining a “greened” GDP, many nations have chosen to create supplementary or **satellite accounts** that record changes in important environmental and resource sectors in physical rather than monetary terms. Satellite accounts can give a detailed picture of areas such as forest cover, water resources, mineral assets, land quality, pollution emissions, and pollution control measures, without assigning specific money values.

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

Countries whose national incomes are derived in large part from exports of mineral or forestry resources, for example, can assess their stocks of ore and count up their remaining timber acreage. Others, with different concerns, can create input-output accounts to get a better idea of where resources are used, where pollution comes from, and which domestic economic sectors are most reliant on imported resources. The sectors most responsible for carbon dioxide emissions can be identified. These accounts are linked to the existing national accounts: For example, economic production of oil is associated with depletion of petroleum reserves, and physical flows of pollutants are related to the output of pollution-generating industries.

The advantage of using satellite accounts is that an extensive database of environmental information can be created, and related to existing GDP sectors, without having to determine a precise monetary value for each category. Transforming physical into monetary measures is not ruled out, however, and can be done whenever reliable and generally accepted techniques for environmental valuation exist. The United Nations has published a systematic guide to integrated economic and environmental accounting using the satellite approach, and many countries have established such accounts.

Unfortunately for the progress of environmental accounting in the United States, funding for the Commerce Department’s Integrated Environmental and Economic Accounts (IEESA) was terminated by Congress in 1994, and was not restored despite the encouragement given by the

National Research Council panel in 1999. The United States has also been the only major industrialized country that has *not* ratified the Kyoto Protocol. In June 2001, President Bush withdrew U.S. support for the Kyoto Protocol, citing doubt about the scientific evidence on climate change and unfairness in the application of prescribed cutbacks. He also claimed that compliance with the prescribed reductions in greenhouse gas emissions would have a “negative impact” on the U.S. economy. While environmental accounting is moving ahead in many other nations, attention to environmental issues seems to be lagging behind in the United States.

Discussion Questions

1. 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?
2. Some people have argued that the monetary valuation of environmental costs and benefits is important because “some number is better than no number”—without valuation, these factors are omitted entirely 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?

3. MEASURING HOUSEHOLD PRODUCTION

Another significant omission in the national accounts, as currently constituted, is the value of much household production. As noted in the previous chapter, only two aspects of household production are currently counted in GDP: one, the services of the house itself and, two, the services provided by paid household workers such as housekeepers and gardeners. The household production of goods and services such as childcare, housecleaning, laundry services, meal preparation, landscaping, and transportation using unpaid labor and household capital goods (such as automobiles and appliances) is not counted.

Even the most conservative estimates of the total value of household production come up with numbers equal to about 25–35 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. How did this substantial area of productive activity come to be overlooked, and what is being done to remedy this omission?

3.1 THE HISTORY OF EXCLUSION

Various reasons have been advanced over the decades for why household activities should not count in GDP.

“Households are nonproductive”

One reason given was that households were not part of the economy because they did not produce economic goods. This depends on a definition of “economic” in which factories, farms and office buildings, and the people in them, were taken as defining “the economy.” Dating

from Victorian times, households and families were often thought of, conversely, as “non-economic,” running along more primitive lines of social development, and as somehow “closer to nature” and naturally self-renewing. There was also a gender aspect to this split: For much of the nineteenth and twentieth centuries, “the economy” was a man’s world, while “the home” was assigned to women.

This omission of much household production from the national accounts may contribute to a subtle bias in the perceptions of policymakers who make economic decisions based on them. Since household work is not measured, it may be easy to think that it’s not important, or not even an “economic” matter at all. The U.S. Social Security retirement system, for example, gives stipends 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 in child raising—for example, up to 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 keep policymakers more aware of its productive contributions. The foremost advocate of this view is Marilyn Waring, author of the book *If Women Counted*.³

“It’s too hard to distinguish household production from consumption”

Sometimes an argument has been made on the basis of convenience: it is simply too hard, some commentators have argued, to distinguish production activities from consumption activities within the household. If diapering your baby is considered work, should cuddling be considered work, too? If you enjoy cooking as a hobby, is not that activity more like a form of entertainment than like the work of a paid cook? Should the time you spend playing tennis be considered “productive” and counted in GDP? It’s just easier, such commentators argue, to draw the line at the household door than to try to sort out the question of “What parts of the activities are productive?”

Yet the matter of distinguishing production from consumption has been discussed intelligently for decades. A frequently applied rule is what is called the **third-person criterion**: An activity should only be classified as household production if it is in principle replaceable by market or third-person services. Cooking a meal is in this sense “production,” since you might alternatively pay someone to cook for you. Playing a game of tennis clearly is not, since paying someone to play on your behalf would be absurd.

third-person criterion: the convention that says that an activity should be considered to be production (rather than leisure) if a person could buy a market replacement or pay someone to do the activity in his or her place

The fact that some household productive activities—like some parts of cooking and child-care—may sometimes be sources of intrinsic pleasure to some of the people doing the work is, arguably, not particularly relevant. If we insisted that only work that is perceived as neutral or unpleasant should count as “work,” then substantial portions of time at *paid* jobs should obviously be excluded as well. There is an increasing realization that the definition of “work” should be centered around the idea that it is an activity that produces something valuable—a needed report, an emotionally healthy child—and not around whether the activity is unpleasant (or not) or paid (or not).

“GDP measures market production”

Sometimes it is granted that people do engage in productive activities in their roles as household members. But then you will often hear it said that that GDP aims to only measure production *for*

the market. Since household outputs are not sold, this argument goes, it is consistent to exclude them from GDP.

The problem with this argument is that a substantial portion of GDP *already* reflects nonmarket production. Most government production of goods and services is never sold on a market (11 percent of GDP in 2006). Nor do owner-occupiers really pay rent on their houses to themselves (over 6 percent of GDP in 2006). As more market substitutes have developed for formerly home-produced goods and services (day care for home childcare, prepared foods for home cooked, etc.) it has become less and less tenable to draw the line for defining “the economy” at the household door, imputing “market values” for the services of governments and houses, but not for the unpaid work done within homes.

“Including household production would make too big of a change in the accounts.”

One might grant that households do, in fact, produce many goods and services, and that estimated monetary values of these flows would be very large. Some statisticians then argue against measuring household production on other grounds: “The inclusion of large non-monetary flows of this kind in the accounts together with monetary flows can obscure what is happening on markets and reduce the analytic usefulness of the data” for addressing topics such as inflation and economic fluctuations.⁴

In reply, some economists argue 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. Perhaps more importantly, changes in an economy over time, such as the true growth rate of production, may be misstated. One of the major economic shifts that occurred during the twentieth century was the movement of a large proportion of women from unpaid employment as full-time homemakers into paid employment in market work. In 1870, 40 percent of all U.S. workers (paid and unpaid, male and female) were full-time homemakers; by 2000, the proportion had dropped to 16 percent.⁵ This increase in market work, simultaneous with the increase in purchases of substitutes for home production such as paid childcare and prepared foods, were counted as increases 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 would tend to mean that GDP growth during the period was *overstated*.

The picture is a bit more complex, however, if you also take into account the changes in the *productivity* of household labor time during this period. Homemakers in 1870 had very little in the way of “capital stock” to work with—probably a coal stove that needed daily cleaning (instead of a range), a washtub and clothesline (instead of a washer/dryer), and an icebox (instead of a refrigerator). Productive investments in household technology have, the evidence suggests, led to people now enjoying cleaner clothes and more interesting and varied diets than previously. While the household sector was shrinking relative to other sectors in terms of labor hours devoted to it, the value of its real product, at least in some areas such as cooking and cleaning, was not necessarily falling. This growth in true national product due to changes in household productivity has been entirely missed in standard accounting.

Accounting for household production might also change how we see the cyclical behavior of the economy, since there is reason to believe that the level of household production probably moves **countercyclically**. That is, when the economy is *down*—in recession—people’s “do-it-yourself” work probably goes *up*. While the financial and emotional consequences of lack of needed paid employment should not be trivialized, it is likely that many of the unemployed use some of their extra time doing additional childcare and household tasks. When people are in

financial straits, they also tend to economize by replacing market purchases with home-produced goods and services.

countercyclical movement: when an indicator moves in the opposite direction from the business cycle. It moves up as the economy goes down (into recession), and down as the economy goes up (into recovery).

Comparisons between countries are also made more difficult by the lack of accounting for household production in GDP. In countries of the global South, where such activities make up a much higher proportion of total production, GDP is even more inadequate as an indicator of national production.

3.2 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 for 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 began collecting data for the first national ongoing survey of time use. The American Time Use Study (ATUS), conducted by the U.S. Bureau of Labor Statistics, asks people age sixteen or over in a nationally representative sample to report in detail how they used their time on one particular day.

The results of the survey for 2005 indicate that on average on any given day, 84 percent of women and 65 percent of men spend some time doing 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 2.3 hours per day on these activities, while men spent 1.4 hours. On an average day, 19 percent of men reported doing housework, such as cleaning or doing laundry, compared with 53 percent of women.

Some other highlights are summarized in Table 6.1. These figures are averages for people in all employment categories, and include both weekdays and weekend days.

The largest blocks of time reported were for personal care (including sleeping), leisure and sports (including an average 2.6 hours per day of watching television), and working (for pay) and work-related activities (including commuting time).

Unpaid household production is spread over several categories in Table 6.1. Time spent caring for children or the elderly or ill is included in the category of “caring for and helping people,” though these data require closer examination. These tasks may be done as a primary activity, as reported in Table 6.1. Or they may be done as a secondary activity—that is, done while the person is primarily doing something else, such as shopping or watching television. Other tables released by the BLS reveal that in households with children under thirteen, women spend an average of 6.4 hours caring for children as a secondary activity, while men spend an average of 4.2 hours.

The most conservative approach to measuring household production would be to count only primary “household” and “caring and helping” activities as productive, yielding an average figure for household production of 2.59 hours per day, compared to 3.69 for paid work and related activities. Even taking this most conservative approach, household production would then account for 41 percent of total productive time. Less conservative approaches would also include as “productive” at least some of the time spent purchasing (analogous to how working as a “purchaser” in a business is considered productive), in education activities (that is, investing in human capital), and in caring done as a secondary activity. With such approaches, household production could easily be found to account for well over half of total productive time.

Table 6.1 **Average Hours per Day Spent in Primary Activities**

Activity	Total	Men	Women
Personal care	9.34	9.22	9.62
Eating and drinking	1.24	1.30	1.19
Household	1.82	1.35	2.27
Housework	.61	.24	.96
Food preparation and cleanup	.51	.26	.75
Lawn and garden care	.20	.27	.14
Household management	.15	.12	.17
Purchasing goods and services	.80	.63	.96
Caring for and helping people	.77	.55	.97
Working and work-related activities	3.69	4.44	3.00
Educational activities	.45	.47	.43
Organizational, civic, and religious activities	.31	.27	.35
Leisure and sports	5.14	5.50	4.80
Other activities	.35	.28	.41
TOTAL	24.00	24.00	24.00

Source: "American Time Use Survey—2005 Results Announced by BLS" BLS NEWS, July 27, 2006, Table 1.

3.3 METHODS OF VALUING HOUSEHOLD PRODUCTION

Unlike the attempt to incorporate environmental assets and services into the national accounts, which requires considerable development of new techniques of measurement and valuation, the imputation of a value for household production can generally follow a similar procedure to that currently used to impute a value for government production.

Both government production and household production result in goods and services that are generally not sold on markets. Both government production and household production use manufactured capital goods and labor. Hence, as with government production, a quasi-market value for household production could be imputed by summing the values of the labor and capital services devoted to the productive activities.

The major difference is that in the case of household work the labor is *unpaid*. Once time use has been measured in terms of hours spent on various activities, by surveys such as the one just discussed, standard national accounting procedures demand that these hours be assigned a monetary value using some 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.

Replacement 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: childcare time is valued according to the wage of a professional childcare worker, housecleaning by the wages of professional housecleaners, plumbing repair by the wages of a plumber, etc.

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

Opportunity cost method. 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 must (if acting rationally) 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 you could have earned working overtime 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 *the household producer would have earned in the market* to value household work time. In this case, estimates of the value of nonmarket production can go quite a bit higher, since some hours would be valued at the wage rates earned by doctors, lawyers, managers, etc.

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

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 *some* value for household labor time, even using minimal replacement costs, is more accurate than imputing a value of zero.

In addition to valuing the time used in household production, a value must be assigned to the capital services provided by appliances, vehicles, and the like. “Consumer durables” spending by households would need to be renamed “household investment” spending, and included as a subcategory of investment rather than consumption. Adding the flow of services that are yielded by these capital goods to the measurement of GDP would require that new calculations be made. But the techniques for estimating such service flows have already been designed for the case where cars, washing machines, etc., are owned by *businesses*. These same techniques could be extended to household capital goods.

While this section focuses on unpaid household work, similar arguments have also been made concerning unpaid volunteer work in communities and nonprofit organizations—the time people spend coaching children’s sports teams, visiting nursing homes, serving on church and school committees, etc. In the ATUS, 13 percent of the people surveyed reported participating in organizational, civic, and religious activities on their surveyed day, a figure that includes organized volunteer activities. Were both these forms of work counted, the proportion of production attributed to the “households and institutions” sector would rise considerably.

3.4 MAKING CHANGES

Perhaps surprisingly, initial estimates of the value of household services for the United States *predate* the design of the NIPA. 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 market national income. Decades later, in 1988, economist Robert Eisner reviewed six major proposed redesigns of the NIPA, all of which included substantial estimated values for household production.⁶ Despite numerous demonstrations of its practicality dating back more than 85 years, however, actual inclusion of household production in the U.S. NIPA remains a project for the twenty-first century.

Internationally, there is interest in at least gathering data on household production. Many countries, including Australia, Canada, India, Japan, Mexico, Thailand, and the United Kingdom, have conducted or are conducting national time use surveys to aid their understanding of unpaid productive activities. The United Nations Statistical Commission and Eurostat (the

statistical office of the European Union) are encouraging countries to develop satellite accounts that, similar to the satellite accounts for the environment, provide the necessary information to adjust measures of GDP to take household production into account while not changing the definition of official GDP.

Discussion Questions

1. Discuss the reasons why household production has been excluded from national accounting. Do any of the reasons seem convincing to you? What do you think has been the most important reason why household production has been excluded for so long?
2. Think back on at least one household activity you've done in the last couple of days that would be replaceable in principle 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?

4. MEASURING ECONOMIC WELL-BEING

Instead of trying to estimate a dollar value for domestic production, some economists insist that instead of—or in addition to—standardized national accounts, more direct indicators of economic well-being are needed. Since the goal of macroeconomics is human well-being, we need to be sure the indicators we pay most attention to are ones that relate to the goal we want to achieve!

4.1 DOES OUTPUT MEASURE WELL-BEING?

Measures of the value of national output (or income) per capita—even improved measures that incorporate environmental concerns and household production—can often be poor indicators of sustainable human well-being. In Chapter 1 we mentioned that neglect of the questions of *what*, *how* and for *whom* can mean that growth in production per capita may not lead to increased welfare. Now we can go into more detail about the problems that arise from focusing on production alone. These include:

Well-being-reducing products. Some outputs decrease rather than increase human well-being. The production of unhealthy foods and drugs, dangerous equipment, and community-destroying urban developments, for example, may lower, not raise, well-being. Even if it is the case that people are apparently willing to pay for such goods and services, either individually (perhaps influenced by media advertising) or through their governments (perhaps influenced by interest group lobbyists), it may be that such decisions reflect poor information or bad judgment when looked at from a well-being point of view.

Defensive expenditures. As discussed earlier, some outputs merely compensate for, or defend against, harmful events. Environmental defensive expenditures are only one example. Others include armaments necessitated by an increase in international tensions, increased spending on police forces to combat increased crime, increased gun ownership due to fear or societal breakdown, or increased medical spending due to a rise in automotive accidents. These increased expenditures do not reflect an increase in welfare, but only an attempt to maintain a status quo situation.

Loss of leisure. A rise in output might come about because people expend more time and effort at paid—and, in expanded accounts, also in unpaid—work. Only looking at the increase in

measured output does not take into account the fact that overwork makes people more tired and stressed, and takes away from time they could use for enjoying other activities.

Loss of human and social capital formation. Measured output is *lower* to the extent that people eliminate or reduce immediately productive activities in order to invest in schooling or training, or participate in community-building activities. Yet if we consider these as investments in the creation of valuable human and social capital, such activities should be seen as *increasing* sustainable well-being.

Well-being-reducing production methods. If people are miserable at their jobs, suffering alienation and unpleasant working conditions, their well-being is compromised. This is even more obvious in cases where their health or survival is threatened by unhealthy or dangerous working conditions, even if their work results in a high volume of marketed goods and services.

Unequal distribution. National income may be very unevenly distributed, making some people very rich but leaving others in extreme poverty (as was discussed in Chapter 3).

For such reasons, and others, some economists argue that other indicators, including direct measures of well-being outcomes, are necessary either instead of—or more often, in addition to—improved official national production accounts.

Some of these base their work on an NIPA-like framework, but they include more qualitative judgments about whether specific kinds of “production” actually add to sustainable well-being or perhaps detract from it instead. Some of the redesigns of national accounting suggested by academic economists have included adjustments for well-being-enhancing, or well-being-damaging, production. In 1989, economist Herman Daly and theologian John Cobb, Jr. suggested an alternative measure to GDP which they called the Index of Sustainable Economic Welfare (ISEW), in a popular book entitled *For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future*. That initiative helped to spawn the design of more such measures, nationally and internationally, generally implemented by nonprofit groups. We will examine one such measure, the Genuine Progress Indicator.

Other academic and nonprofit researchers have moved more directly to the issue of whether the economy is getting better or worse for people by developing indicators of social and economic outcomes enjoyed by the population. We will discuss one such measure, the Human Development Index, developed by a United Nations agency.

4.2 EXAMPLE: THE GENUINE PROGRESS INDICATOR

One measure of well-being expressed in monetary terms is the **Genuine Progress Indicator (GPI)**, calculated for the United States by the nonprofit group Redefining Progress.

Genuine Progress Indicator (GPI): a measure of economic well-being that adds many benefits, and subtracts many costs, that are not included in GDP. This measure is calculated by the nonprofit group Redefining Progress.

The GPI takes as its starting point the Personal Consumption Expenditures (PCE) component of GDP for each year, as calculated by the BLS, on the reasoning that this number approximates the welfare associated with consumption. The adjustments made to Personal Consumption Expenditures in order to arrive at the GPI for a recent year (2004) are described in Table 6.2.

First, the level of PCE is adjusted for increasing income inequality by dividing by a factor that reflects the growth in the Gini ratio since 1968. (Recall from Chapter 3 that a higher Gini ratio indicates greater inequality, and that the ratio was at a low point in the United States in 1968.) Next, some items that increase well-being but are not measured in PCE are added in. Estimates of the value of time spent on household and volunteer work and the value of higher

Table 6.2 **Calculating the 2004 Genuine Progress Indicator**

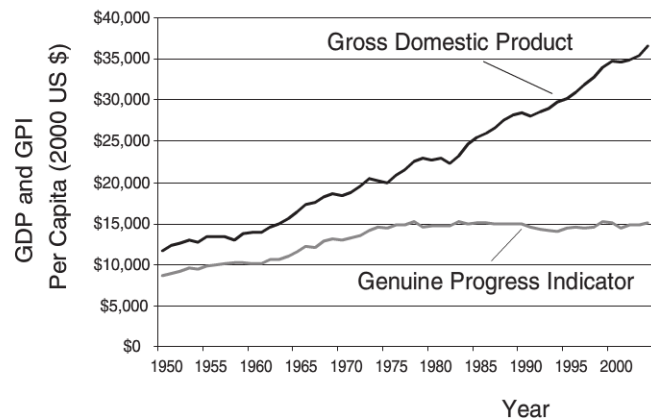
Category	Value in Billions of 2000 Dollars
The GPI's starting point	
Personal consumption in 2004	7,589
Personal consumption adjusted for income distribution	6,318
Additions of Benefits	
Value of housework and parenting	2,542
Value of higher education	828
Value of volunteer work	131
Services of consumer durables	743
Services of highways and streets	112
Subtractions of Costs	
Social costs	
Cost of crime	-34
Loss of leisure time	-402
Cost of underemployment	-177
Cost of commuting	-523
Costs of automobile accidents	-175
Environmental costs	
Cost of household pollution abatement	-21
Cost of water pollution	-120
Cost of air pollution	-40
Cost of noise pollution	-18
Loss of wetlands	-53
Loss of farmland	-264
Loss of primary forests	-51
Resource depletion	-1,761
Carbon dioxide emissions damage	-1,183
Cost of ozone depletion	-479
Other	
Net capital investment	389
Net foreign borrowing	-254
Cost of consumer durables	-1,090
The Total: The Genuine Progress Indicator	4,419

Source: John Talberth, Clifford Cobb, and Noah Slattery, "The Genuine Progress Indicator 2006: A Tool for Sustainable Development." Oakland: Redefining Progress, 2006.

education are added. A measure of the services of consumer durables is added, reflecting the well-being gained from items such as appliances and cars. While most government spending is excluded from the GPI because it is argued that such spending is defensive, services that come from government spending on highways and streets is added.

Then a number of cost items are subtracted. These include estimates of social costs, such as the costs of crime and lost leisure time, and environmental costs, including water pollution, the loss of wetlands, and carbon dioxide emission damage. A few other adjustments are made. An addition is made for the amount by which the net (manufactured) capital stock grows, on a per-worker basis, on the reasoning that constant or increasing stocks are necessary for sustainability. A measure of net foreign borrowing is subtracted, since consumption financed from foreign borrowing is not economically sustainable. Lastly, the cost of consumer-durable asset purchases is subtracted, to avoid double counting given that a measure of the *services* of consumer durables has already been included.

Figure 6.3 Real GDP Per Capita and GPI per Capita Compared



While real GDP per capita has risen substantially since 1950, well-being as measured by per capita GPI has shown less growth. (Source: “The Genuine Progress Indicator 2006: A Tool for Sustainable Development”)

Real GPI for the year 2004 was calculated at \$4.4 trillion, as can be seen in Table 6.2. This is substantially less than the personal consumption expenditures figure—\$7.6 trillion—from which the calculations started. Hence, on net, the subtracted costs—especially environmental costs—are more sizeable than the added benefits. Dividing by the population size, per capita GPI was calculated as \$15,035.

Trends in real GDP per capita and real GPI per capita are tracked from 1950 to 2002 in Figure 6.3. Not only is per capita GPI lower than per capita GDP, it has also grown more slowly. That is, environmental and social costs have been increasing faster than the value of the benefits omitted from standard accounting. Looking at the GPI over time, you get a sense of a steady or even falling level of sustainable well-being, which contradicts the trend you see when looking only at measured GDP.

4.3 EXAMPLE: THE HUMAN DEVELOPMENT INDEX

Beginning in 1990, the United Nations Development Program (UNDP), under the direction of Mahbub ul Haq and in consultation with Nobel laureate economist Amartya Sen, began publication of a **Human Development Index (HDI)** designed to compete with GDP as a crude index of human welfare.

Human Development Index (HDI): an index of well-being made by combining measures of health, education, and income. This index is calculated by the United Nations Development Program (UNDP).

The HDI aggregates three indicators of human well-being:

- Life expectancy at birth
- An index reflecting a combination of the adult literacy rate and statistics on enrollments in education
- GDP per capita

That is, not only does the HDI take into account output per capita, but it also takes into account whether national production has been effective in raising well-being outcomes in terms of human longevity and knowledge.

Table 6.3 Human Development Index

HDI Rank	Country	Life Expectancy at Birth (years)	Education Index	GDP per Capita ^a	HDI
1	Iceland	81.5	0.98	36,510	0.968
12	United States	77.9	0.97	41,890	0.951
26	Korea, Rep. of	77.9	0.98	22,029	0.921
39	United Arab Emirates	78.3	0.79	25,514	0.868
52	Mexico	75.6	0.86	10,751	0.829
99	Sri Lanka	71.6	0.81	4,595	0.743
125	Namibia	51.6	0.78	7,586	0.650
140	Bangladesh	63.1	0.50	2,053	0.547
162	Angola	44.6	0.54	2,335	0.446
177	Sierra Leone	41.8	0.38	806	0.336

Source: UNDP Human Development Report 2007/2008.

^a Expressed in purchasing power parity U.S. dollars.

The resulting index is a number between zero and one, and is computed by the UNDP for many countries every year. Examples taken from the *Human Development Report 2007/2008* are shown in Table 6.3.

Taking the 177 countries as a whole, there is a rough correspondence between rankings by HDI and rankings you would get by looking at GDP alone. At the top of the rankings by HDI is Iceland, with a life expectancy of 81.5 years, an education index of 0.98, and GDP per capita of \$36,510. At the bottom of the rankings is Sierra Leone, with both extremely low GDP per capita and abysmally low indicators for health (life expectancy of only 41.8 years) and education.

Comparisons between HDI and GDP can be revealing about the shortfalls of GDP as an indicator of welfare. For example, the United States ranks forty-second globally in life expectancy, below many lower-income countries as Malta, Chile, and Costa Rica. (See News in Context.) Looking at Table 6.3, you can see that GDP per capita is higher in the United Arab Emirates than the Republic of Korea, but Korea has been more successful in educating its populace (an education index of 0.98 compared to 0.79). Sri Lanka makes a relatively strong showing on the HDI index, in spite of its low levels of GDP per capita (\$4,595), compared to, for example, Namibia, which has a substantially higher measured GDP per capita (\$7,586). Among even poorer countries, Bangladesh makes a similarly relatively strong showing compared to Angola, which has a higher income per capita but lower health achievements.

HDI and GDP rankings differ for a number of reasons. Countries that score lower on HDI than countries with similar levels of GDP per capita may be plagued by war or by diseases such as AIDS. They often have very unequal income distributions and/or have governments that put a low priority on spending for health and education. Table 6.3 makes it clear that what is important in determining human welfare is not only *how much* is produced, but also *what* is produced (such as armaments vs. clinics) and *how it is distributed*. Countries with good social infrastructure and a lack of extreme gaps between rich and poor tend to score relatively well on HDI, compared to their achievements measured by GDP alone.

The UNDP also gathers a wealth of other statistics that can be used to measure human development in greater detail. These include measures of disparities between males and females in health, literacy, and political and economic participation; measures of poverty and deprivation

NEWS IN CONTEXT:**US Slipping in Life Expectancy Rankings**

WASHINGTON—Americans are living longer than ever, but not as long as people in 41 other countries. For decades, the United States has been slipping in international rankings of life expectancy, as other countries improve health care, nutrition and lifestyles. Countries that surpass the U.S. include Japan and most of Europe, as well as Jordan, Guam and the Cayman Islands.

“Something’s wrong here when one of the richest countries in the world, the one that spends the most on health care, is not able to keep up with other countries,” said Dr. Christopher Murray, head of the Institute for Health Metrics and Evaluation at the University of Washington . . .

The shortest life expectancies were clustered in Sub-Saharan Africa, a region that has been hit hard by an epidemic of HIV and AIDS, as well as famine and civil strife. . . Forty countries, including Cuba, Taiwan and most of Europe had lower infant mortality rates than the U.S. in 2004. The U.S. rate was 6.8 deaths for every 1,000 live births. It was 13.7 for Black Americans, the same as Saudi Arabia.

Source: Stephen Ohlemacher, Washingtonpost.com (The Associated Press), August 12, 2007.

What do you think are some of the reasons for the relatively poor performance of the United States on this indicator? Where might you go to learn more?

(for example, the percent of the population without access to safe water); and statistics on crime and environmental degradation. All of these are important to getting a full picture of human development. They also gather data on topics such as military expenditures, amounts of external debt, and public expenditures on health and education that can help to explain differences in economic and social outcomes.

4.4 THE FUTURE OF MACROECONOMIC INDICATORS

Due to funding cutbacks, progress on improving macroeconomic measurement within the official accounts is currently largely at a standstill within the United States. Many private groups within the United States, however, as well as official statistical agencies in a number of other countries, are making progress in developing better measures to deal with the social and environmental issues of the twenty-first century.

No one—and especially not their creators—would argue that alternative macroeconomic indicators have been perfected. It is quite possible to argue about whether damage cost or replacement cost should be used in evaluating environmental services, for example, or whether more direct measures of poverty should be included in the HDI. Much is still open for discussion. Many of the new measures being developed allow users to see how the results change under different assumptions. Some express their results in terms of well-justified ranges of values, rather than in terms of seemingly precise, but possibly misleading, specific values.

But all indicators have their flaws, whether due to their definitions and classifications, the data they rely on, or the statistical techniques applied. No one intimately involved in the creation of the official NIPA would argue that they are perfect, either! The creation of official statistics has often been compared to sausage making: The closer you are to observing the process, the less attractive the final product appears. Only from a distance—when you can remain naively unaware of all the conventions that their creators have had to impose on messy real-world data and all the imputations they have had to make—do “official” statistics look clean and elegant, just as only from a distance from its processing does sausage look appetizing.

The important contribution of alternative indicators is the way they bring to our attention significant aspects of the economy, such as environmental and social sustainability, that were not taken into account in the design of traditional twentieth-century macroeconomic indicators.

Discussion Questions

1. Does the Genuine Progress Indicator include anything 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.
2. Which do you think is more useful for judging the progress of an economy—GDP, expanded measures of production, measures of production adjusted for well-being effects, or measures of well-being itself?

REVIEW QUESTIONS

1. What are the three functions through which the natural environment interacts with the human economy?
2. Ideally, how would consideration of the stock of natural assets be included in the national accounts?
3. Ideally, how would consideration of flows of goods and services from the environment be included in the national accounts?
4. List four reasons why it is difficult to put dollar values on environmental assets and the environment’s production of goods and services.
5. What is the function of environmental satellite accounts?
6. What reasons have been given for excluding household production from measures of GDP?
7. What difference does it make, to the study of macroeconomic trends and design of policy, that household production has been excluded from the national accounts?
8. What information is gathered in a time-use survey?
9. Describe the two major methods of estimating the value of labor inputs into household production.
10. Is inclusion of household production in the national accounts a new idea?
11. What are some reasons why measuring *output* may be misleading as a guide to *well-being*?
12. What is the Genuine Progress Indicator? What are some of the adjustments it makes relative to GDP?
13. What is the Human Development Indicator? Why do some countries appear to perform more poorly when ranked by HDI than when ranked by GDP per capita?

EXERCISES

1. Which of the following describe a resource function of the natural environment? An environmental service function? A sink function?
 - a. A landfill
 - b. A copper mine
 - c. Carbon dioxide (a byproduct of combustion) entering the atmosphere
 - d. Wild blueberries growing in a meadow
 - e. A suitable temperature for growing corn
 - f. A view of the Grand Canyon
2. In 2003, a massive oil spill caused heavy damage to the fishing and tourist industries on the north coast of Spain. In addition, there were long-term ecological impacts on fish and wildlife. Describe how this might be accounted for in Spain's 2003 national income accounts, if they were environmentally adjusted:
 - a. In terms of depreciation of assets
 - b. In terms of flows of produced goods and services. (Describe in detail how two approaches to assigning dollar values might be applied.)
3. Consumption of oil, gas, and coal currently fuels the United States economy, but also has other effects. How might the following be accounted for in the United States national accounts, if they were environmentally adjusted?
 - a. Depletion of domestic oil, natural gas, and coal reserves
 - b. Release of greenhouse gases into the atmosphere
 - c. Smoggy air that hides scenery and makes outdoor activity unpleasant
4. How would each of the following activities be classified in the American Time Use Survey? Which ones are productive activities, judged by the third person criterion?
 - a. Having lunch
 - b. Working as a hospital nurse
 - c. Watching TV
 - d. Volunteering for a political campaign
 - e. Cooking dinner
 - f. Grocery shopping with your young child
5. Suppose you buy a bread-making machine, some flour, and other foodstuffs, take them home, and bake bread with a group of young children who are in your care (unpaid). How would these activities be accounted for in current GDP accounting? How might they be accounted for in an expanded account that includes household production?
6. Describe in a short paragraph why measures of *output* do not always measure *well-being*. Include some specific examples beyond those given in the text.
7. In calculating the Genuine Progress Indicator,
 - a. Which factors are subtracted off, compared to personal consumption expenditures, because they represent *bad* things?
 - b. Which factors are *not* included in GPI, even though they are included in GDP, because they are defensive expenditures or because of differences in accounting methods?