2

A Tour of the Book

The words *output, unemployment*, and *inflation* appear daily in newspapers and on the evening news. So when I used these words in Chapter 1, you knew roughly what we were talking about. It is now time to define these words more precisely, and this is what we do in the first three sections of this chapter.

Section 2-1 looks at output.

Section 2-2 looks at the unemployment rate.

Section 2-3 looks at the inflation rate.

Section 2-4 introduces two important relations between these three variables: Okun's law and the Phillips curve.

Section 2-5 then introduces the three central concepts around which the book is organized:

- **The *short run*: What happens to the economy from year to year**
- **The *medium run*: What happens to the economy over a decade or so**
- **The *long run*: What happens to the economy over a half century or longer**

Building on these three concepts, Section 2-6 gives you a road map to the rest of the book.

2-1 Aggregate Output

Economists studying economic activity in the nineteenth century or during the Great Depression had no measure of aggregate activity (*aggregate* is the word macroeconomists use for *total*) on which to rely. They had to put together bits and pieces of information, such as the shipments of iron ore, or sales at some department stores, to try to infer what was happening to the economy as a whole.

Two economists, Simon Kuznets, from Harvard University, and Richard Stone, from Cambridge University, received the Nobel Prize for their contributions to the development of the national income and product accounts—a gigantic intellectual and empirical achievement.

It was not until the end of World War II that **national income and product accounts** (or national income accounts, for short) were put together. Measures of aggregate output have been published on a regular basis in the United States since October 1947. (You will find measures of aggregate output for earlier times, but these have been constructed retrospectively.)

Like any accounting system, the national income accounts first define concepts and then construct measures corresponding to these concepts. You need only to look at statistics from countries that have not yet developed such accounts to realize that precision and consistency in such accounts are crucial. Without precision and consistency, numbers that should add up do not; trying to understand what is going on feels like trying to balance someone else's checkbook. I shall not burden you with the details of national income accounting here. But because you will occasionally need to know the definition of a variable and how variables relate to each other, Appendix 1 at the end of the book gives you the basic accounting framework used in the United States (and, with minor variations, in most other countries) today. You will find it useful whenever you want to look at economic data on your own.

GDP: Production and Income

You may come across another term, **gross national product**, or **GNP**. There is a subtle difference between "domestic" and "national," and thus between GDP and GNP. We examine the distinction in Chapter 18 and in Appendix 1 at the end of the book. For now, ignore it.

The measure of **aggregate output** in the national income accounts is called the **gross domestic product**, or **GDP**, for short. To understand how GDP is constructed, it is best to work with a simple example. Consider an economy composed of just two firms:

- Firm 1 produces steel, employing workers and using machines to produce the steel. It sells the steel for \$100 to Firm 2, which produces cars. Firm 1 pays its workers \$80, leaving \$20 in profit to the firm.
- Firm 2 buys the steel and uses it, together with workers and machines, to produce cars. Revenues from car sales are \$200. Of the \$200, \$100 goes to pay for steel and \$70 goes to workers in the firm, leaving \$30 in profit to the firm.

In reality, not only workers and machines are required for steel production, but so are iron ore, electricity, and so on. I ignore these to keep the example simple.

We can summarize this information in a table:

Steel Company (Firm 1)			Car Company (Firm 2)		
Revenues from sales		\$100	Revenues from sales		\$200
Expenses		\$80	Expenses		\$170
Wages	\$80		Wages	\$70	
			Steel purchases	\$100	
Profit		\$20	Profit		\$30

An intermediate good is a good used in the production of another good. Some goods can be both final goods and intermediate goods. Potatoes sold directly to consumers are final goods. Potatoes used to produce potato chips are intermediate goods. Can you think of other examples?

How would you define aggregate output in this economy? As the sum of the values of all goods produced in the economy—the sum of \$100 from the production of steel and \$200 from the production of cars, so \$300? Or as just the value of cars, which is equal to \$200?

Some thought suggests that the right answer must be \$200. Why? Because steel is an **intermediate good**: It is used in the production of cars. Once we count the

production of cars, we do not want to count the production of the goods that went into the production of these cars.

This motivates the first definition of GDP:

1. GDP Is the Value of the Final Goods and Services Produced in the Economy during a Given Period.

The important word here is *final*. We want to count only the production of **final goods**, not intermediate goods. Using our example, we can make this point in another way. Suppose the two firms merged, so that the sale of steel took place inside the new firm and was no longer recorded. The accounts of the new firm would be given by the following table:

Steel and Car Company	
Revenues from sales	$200
Expenses (wages)	$150
Profit	$50

All we would see would be one firm selling cars for $200, paying workers $80 + $70 = $150, and making $20 + $30 = $50 in profits. The $200 measure would remain unchanged—as it should. We do not want our measure of aggregate output to depend on whether firms decide to merge or not.

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This first definition gives us one way to construct GDP: by recording and adding up the production of all final goods—and this is indeed roughly the way actual GDP numbers are put together. But it also suggests a second way of thinking about and constructing GDP.

2. GDP Is the Sum of Value Added in the Economy during a Given Period.

The term **value added** means exactly what it suggests. The value added by a firm is defined as the value of its production minus the value of the intermediate goods used in production.

In our two-firms example, the steel company does not use intermediate goods. Its value added is simply equal to the value of the steel it produces, $100. The car company, however, uses steel as an intermediate good. Thus, the value added by the car company is equal to the value of the cars it produces minus the value of the steel it uses in production, $200 − $100 = $100. Total value added in the economy, or GDP, equals $100 + $100 = $200. (Note that aggregate value added would remain the same if the steel and car firms merged and became a single firm. In this case, we would not observe intermediate goods at all—because steel would be produced and then used to produce cars within the single firm—and the value added in the single firm would simply be equal to the value of cars, $200.)

This definition gives us a second way of thinking about GDP. Put together, the two definitions imply that the value of final goods and services—the first definition of GDP—can also be thought of as the sum of the value added by all the firms in the economy—the second definition of GDP.

So far, we have looked at GDP from the *production side*. The other way of looking at GDP is from the *income side.* Go back to our example and think about the revenues left to a firm after it has paid for its intermediate goods: Some of the revenues go to pay workers—this component is called *labor income.* The rest goes to the firm—that component is called *capital income* or *profit income* (the reason it is called capital income is that you can think of it as remuneration for the owners of the capital used in production).

Of the $100 of value added by the steel manufacturer, $80 goes to workers (labor income) and the remaining $20 goes to the firm (capital income). Of the $100 of value added by the car manufacturer, $70 goes to labor income and $30 to capital income. For the economy as a whole, labor income is equal to $150 ($80 + $70), capital income is equal to $50 ($20 + $30). Value added is equal to the sum of labor income and capital income is equal to $200 ($150 + $50).

The labor share in the example is thus 75%. In advanced countries, the share of labor is indeed typically between 60 and 75%.

This motivates the third definition of GDP.

3. GDP Is the Sum of Incomes in the Economy during a Given Period.

Two lessons to remember:

i. GDP is the measure of aggregate output, which we can look at from the production side (aggregate production), or the income side (aggregate income); and
ii. Aggregate production and aggregate income are always equal.

To summarize: You can think about aggregate output— *GDP*—in three different but equivalent ways.

- From the *production side*: GDP equals the value of the final goods and services produced in the economy during a given period.
- Also from the *production side*: GDP is the sum of value added in the economy during a given period.
- From the *income side*: GDP is the sum of incomes in the economy during a given period.

Nominal and Real GDP

U.S. GDP was $17,400 billion in 2014, compared to $543 billion in 1960. Was U.S. output really 32 times higher in 2014 than in 1960? Obviously not: Much of the increase reflected an increase in prices rather than an increase in quantities produced. This leads to the distinction between nominal GDP and real GDP.

Warning! People often use *nominal* to denote small amounts. Economists use *nominal* for variables expressed in current prices. And they surely do not refer to small amounts: The numbers typically run in the billions or trillions of dollars.

Nominal GDP is the sum of the quantities of final goods produced times their current price. This definition makes clear that nominal GDP increases over time for two reasons:

- First, the production of most goods increases over time.
- Second, the price of most goods also increases over time.

If our goal is to measure production and its change over time, we need to eliminate the effect of increasing prices on our measure of GDP. That's why **real GDP** is constructed as the sum of the quantities of final goods times *constant* (rather than *current*) prices.

If the economy produced only one final good, say, a particular car model, constructing real GDP would be easy: We would use the price of the car in a given year and then use it to multiply the quantity of cars produced in each year. An example will help here. Consider an economy that only produces cars—and to avoid issues we shall tackle later, assume the same model is produced every year. Suppose the number and the price of cars in three successive years are given by:

You may wonder why I chose these three particular years. Explanation given when I look at the actual numbers for the United States.

Nominal GDP, which is equal to the quantity of cars times their price, goes up from $200,000 in 2008 to $288,000 in 2009—a 44% increase—and from $288,000 in 2009 to $338,000 in 2010—a 16% increase.

Year	Quantity of Cars	Price of Cars	Nominal GDP	Real GDP (in 2009 dollars)
2008	10	$20,000	$200,000	$240,000
2009	12	$24,000	$288,000	$288,000
2010	13	$26,000	$338,000	$312,000

- To construct real GDP, we need to multiply the number of cars in each year by a *common* price. Suppose we use the price of a car in 2009 as the common price. This approach gives us in effect *real GDP in 2009 dollars.*
- Using this approach, real GDP in 2008 (in 2009 dollars) equals 10 cars $\times$ $24,000 per car = $240,000. Real GDP in 2009 (in 2009 dollars) equals 12 cars $\times$ $24,000 per car = $288,000, the same as nominal GDP in 2005. Real GDP in 2010 (in 2009 dollars) is equal to 13 $\times$ $24,000 = $312,000.

So real GDP goes up from $240,000 in 2008 to $288,000 in 2009—a 20% increase—and from $288,000 in 2009 to $312,000 in 2010—an 8% increase.

- How different would our results have been if we had decided to construct real GDP using the price of a car in, say, 2010 rather than 2009? Obviously, the level of real GDP in each year would be different (because the prices are not the same in 2010 as in 2009); but its rate of change from year to year would be the same as shown.

To be sure, compute real GDP in 2010 dollars, and compute the rate of growth from 2008 to 2009, and from 2009 to 2010.

The problem when constructing real GDP in practice is that there is obviously more than one final good. Real GDP must be defined as a weighted average of the output of all final goods, and this brings us to what the weights should be.

The *relative prices* of the goods would appear to be the natural weights. If one good costs twice as much per unit as another, then that good should count for twice as much as the other in the construction of real output. But this raises the question: What if, as is typically the case, relative prices change over time? Should we choose the relative prices of a particular year as weights, or should we change the weights over time? More discussion of these issues, and of the way real GDP is constructed in the United States, is left to the appendix to this chapter. Here, what you should know is that the measure of real GDP in the U.S. national income accounts uses weights that reflect relative prices and which change over time. The measure is called **real GDP in chained (2009) dollars**. We use 2009 because, as in our example, at this point in time 2009 is the year when, by construction, real GDP is equal to nominal GDP. It is our best measure of the output of the U.S. economy, and its evolution shows how U.S. output has increased over time.

The year used to construct prices, at this point the year 2009, is called the *base year*. The base year is changed from time to time, and by the time you read this book, it may have changed again.

Figure 2-1 plots the evolution of both nominal GDP and real GDP since 1960. By construction, the two are equal in 2009. The figure shows that real GDP in 2014 was about 5.1 times its level of 1960—a considerable increase, but clearly much less than the 32-fold increase in nominal GDP over the same period. The difference between the two results comes from the increase in prices over the period.

Suppose real GDP was measured in 2000 dollars rather than 2009 dollars. Where would the nominal GDP and real GDP lines on the graph intersect?

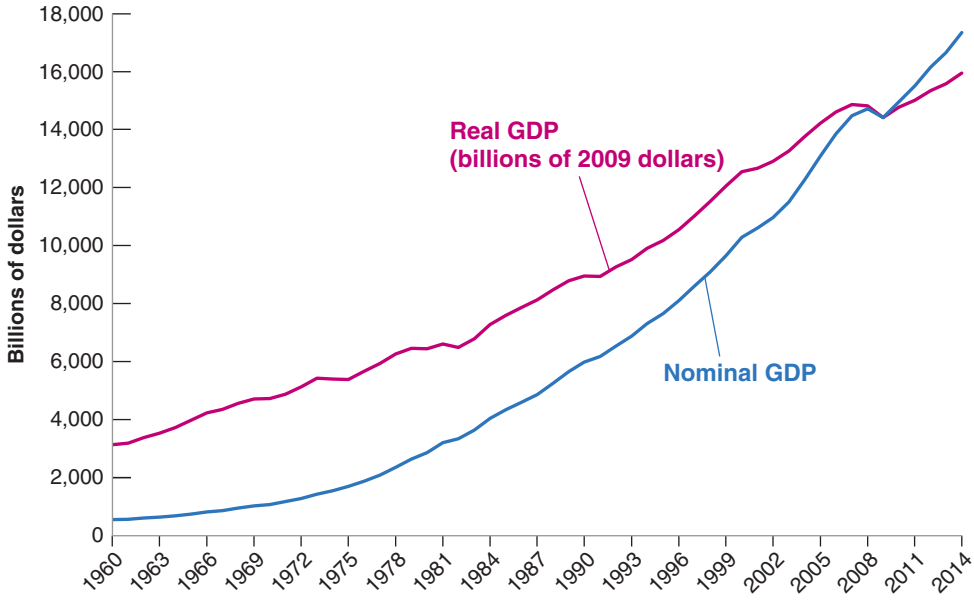

Figure 2-1

Nominal and Real U.S. GDP, 1960–2014

From 1960 to 2014, nominal GDP increased by a factor of 32. Real GDP increased by a factor of about 5.

Source: Series GDPCA, GDPA: Federal Reserve Economic Data (FRED) http://research.stlouisfed.org/fred2/.

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The terms *nominal GDP* and *real GDP* each have many synonyms, and you are likely to encounter them in your readings:

- Nominal GDP is also called **dollar GDP** or **GDP in current dollars**.
- Real GDP is also called: **GDP in terms of goods**, **GDP in constant dollars**, **GDP adjusted for inflation**, or **GDP in chained (2009) dollars** or **GDP in 2009 dollars** —if the year in which real GDP is set equal to nominal GDP is 2009, as is the case in the United States at this time.

In the chapters that follow, unless I indicate otherwise,

- GDP will refer to *real GDP* and Y_t will denote *real GDP in year t*.
- Nominal GDP, and variables measured in current dollars, will be denoted by a dollar sign in front of them—for example, $\$Y_t$ for nominal GDP in year t.

GDP: Level versus Growth Rate

We have focused so far on the *level* of real GDP. This is an important number that gives the economic size of a country. A country with twice the GDP of another country is economically twice as big as the other country. Equally important is the level of **real GDP per person**, the ratio of real GDP to the population of the country. It gives us the average standard of living of the country.

Warning: One must be careful about how one does the comparison: Recall the discussion in Chapter 1 about the standard of living in China. This is discussed further in Chapter 10.

In assessing the performance of the economy from year to year, economists focus, however, on the rate of growth of real GDP, often called just **GDP growth**. Periods of positive GDP growth are called **expansions**. Periods of negative GDP growth are called **recessions**.

The evolution of GDP growth in the United States since 1960 is given in Figure 2-2. GDP growth in year t is constructed as $(Y_t - Y_{t-1})/Y_{t-1}$ and expressed as a percentage. The figure shows how the U.S. economy has gone through a series of expansions, interrupted by short recessions. Again, you can see the effects of the recent crisis: zero growth in 2008, and a large negative growth rate in 2009.

Figure 2-2

Growth Rate of U.S. GDP, 1960–2014

Since 1960, the U.S. economy has gone through a series of expansions, interrupted by short recessions. The 2008–2009 recession was the most severe recession in the period from 1960 to 2014.

Source: Calculated using series GDPCA in Figure 2-1.

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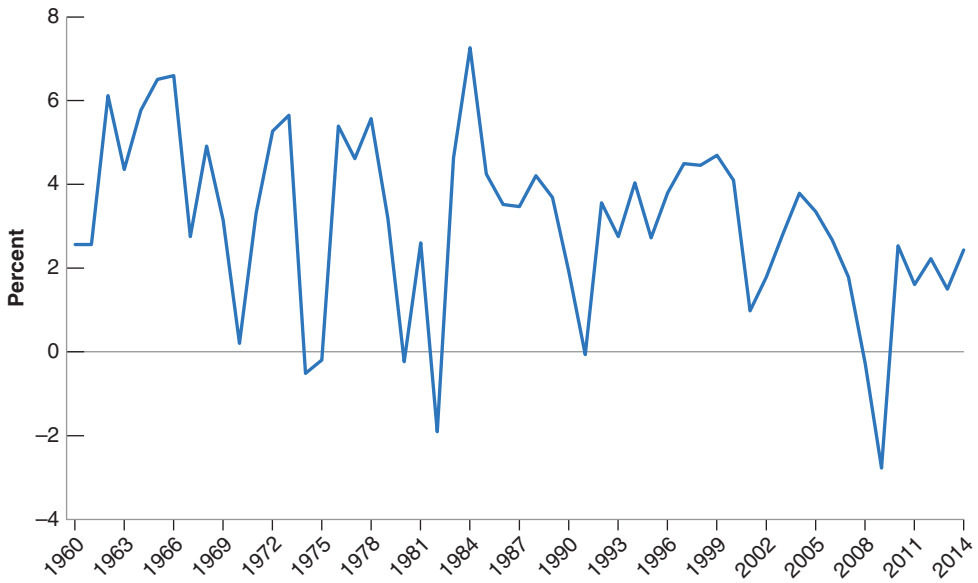

Real GDP, Technological Progress, and the Price of Computers

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A tough problem in computing real GDP is how to deal with changes in quality of existing goods. One of the most difficult cases is computers. It would clearly be absurd to assume that a personal computer in 2015 is the same good as a personal computer produced, say 20 years ago: The 2015 version can clearly do much more than the 1995 version. But how much more? How do we measure it? How do we take into account the improvements in internal speed, the size of the random access memory (RAM) or of the hard disk, faster access to the Internet, and so on?

The approach used by economists to adjust for these improvements is to look at the market for computers and how it values computers with different characteristics in a given year. Example: Suppose the evidence from prices of different models on the market shows that people are willing to pay 10% more for a computer with a speed of 4 GHz (4,000 megahertz) rather than 3 GHz. The first edition of this book, published in 1996, compared two computers, with speeds of 50 and 16 megahertz, respectively. This change is a good indication of technological progress. (A further indication of the complexity of technological progress is that, for the past few years, progress has not been made not so much by increasing the speed of processors, but rather by using multicore processors. We shall leave this aspect aside here, but people in charge of national income accounts cannot; they have to take this change into account as well.) Suppose new computers this year have a speed of 4 GHz compared to a speed of 3 GHz for new computers last year. And suppose the dollar price of new computers this year is the same as the dollar price of new computers last year. Then economists in charge of computing the adjusted price of computers will conclude that new computers are in fact 10% cheaper than last year.

This approach, which treats goods as providing a collection of characteristics—for computers, speed, memory, and so on—each with an implicit price, is called **hedonic pricing** ("hedone" means "pleasure" in Greek). It is used by the Department of Commerce—which constructs real GDP—to estimate changes in the price of complex and fast changing goods, such as automobiles and computers. Using this approach, the Department of Commerce estimates for example, that, for a given price, the quality of new laptops has increased on average by 18% a year since 1995. Put another way, a typical laptop in 2015 delivers $\mathbf{1.18}^{21} = 32$ times the computing services a typical laptop delivered in 1995. (Interestingly, in light of the discussion of slowing U.S. productivity growth in Chapter 1, the rate of improvement of quality has decreased substantially in the recent past, down closer to 10%.)

Not only do laptops deliver more services, they have become cheaper as well: Their dollar price has declined by about 7% a year since 1995. Putting this together with the information in the previous paragraph, this implies that their quality–adjusted price has fallen at an average rate of $\mathbf{18\% + 7\% = 25\%}$ per year. Put another way, a dollar spent on a laptop today buys $\mathbf{1.25}^{21} = 108$ times more computing services than a dollar spent on a laptop in 1995.

2-2 The Unemployment Rate

Because it is a measure of aggregate activity, GDP is obviously the most important macroeconomic variable. But two other variables, unemployment and inflation, tell us about other important aspects of how an economy is performing. This section focuses on the unemployment rate.

We start with two definitions: **Employment** is the number of people who have a job. **Unemployment** is the number of people who do not have a job but are looking for one. The **labor force** is the sum of employment and unemployment:

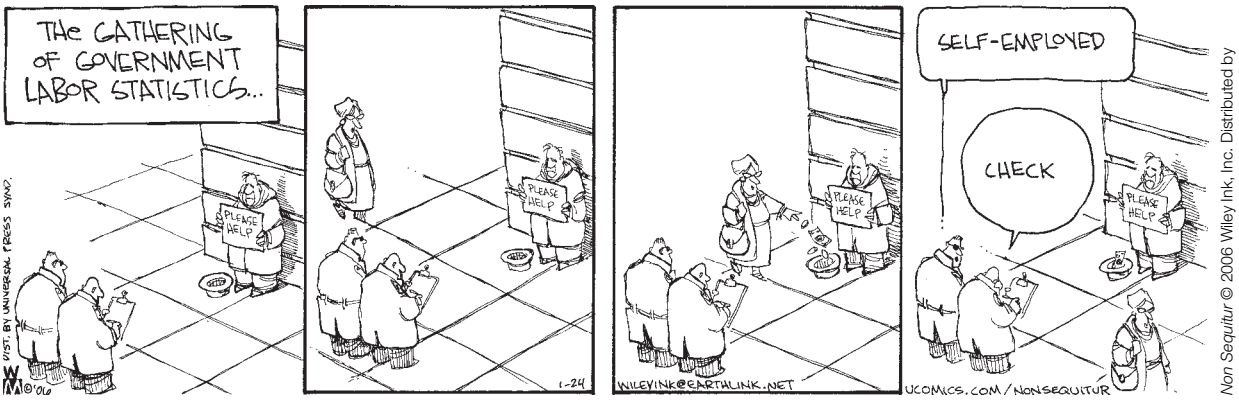
$$L = N + U$$

$$\text{labor force} = \text{employment} + \text{unemployment}$$

The **unemployment rate** is the ratio of the number of people who are unemployed to the number of people in the labor force:

$$u = \frac{U}{L}$$

$$\text{unemployment rate} = \text{unemployment} / \text{labor force}$$



Constructing the unemployment rate is less obvious than you might have thought. The cartoon notwithstanding, determining whether somebody is employed is relatively straightforward. Determining whether somebody is unemployed is more difficult. Recall from the definition that, to be classified as unemployed, a person must meet two conditions: that he or she does not have a job, and he or she is looking for one; this second condition is harder to assess.

Until the 1940s in the United States, and until more recently in most other countries, the only available source of data on unemployment was the number of people registered at unemployment offices, and so only those workers who were registered in unemployment offices were counted as unemployed. This system led to a poor measure of unemployment. How many of those looking for jobs actually registered at the unemployment office varied both across countries and across time. Those who had no incentive to register—for example, those who had exhausted their unemployment benefits—were unlikely to take the time to come to the unemployment office, so they were not counted. Countries with less generous benefit systems were likely to have fewer unemployed registering, and therefore smaller measured unemployment rates.

Today, most rich countries rely on large surveys of households to compute the unemployment rate. In the United States, this survey is called the **Current Population Survey (CPS)**. It relies on interviews of 60,000 households every month. The survey classifies a person as employed if he or she has a job at the time of the interview; it classifies a person as unemployed if he or she does not have a job *and has been looking for a job in the last four weeks.* Most other countries use a similar definition of unemployment. In the United States, estimates based on the CPS show that, in July 2015, an average of 148.9 million people were employed, and 8.3 million people were unemployed, so the unemployment rate was $8.3/(148.9 + 8.3) = 5.3\%$.

The 60,000 households are chosen as a representative sample of the whole U.S. population. Thus, the sample provides good estimates of what is happening for the population as a whole.

Note that only those *looking for a job* are counted as unemployed; those who do not have a job and are not looking for one are counted as **not in the labor force**. When unemployment is high, some of the unemployed give up looking for a job and therefore are no longer counted as unemployed. These people are known as **discouraged workers**. Take an extreme example: If all workers without a job gave up looking for one, the unemployment rate would go to zero. This would make the unemployment rate a poor indicator of what is actually happening in the labor market. This example is too extreme; in practice, when the economy slows down, we typically observe both an increase in unemployment and an increase in the number of people who drop out of

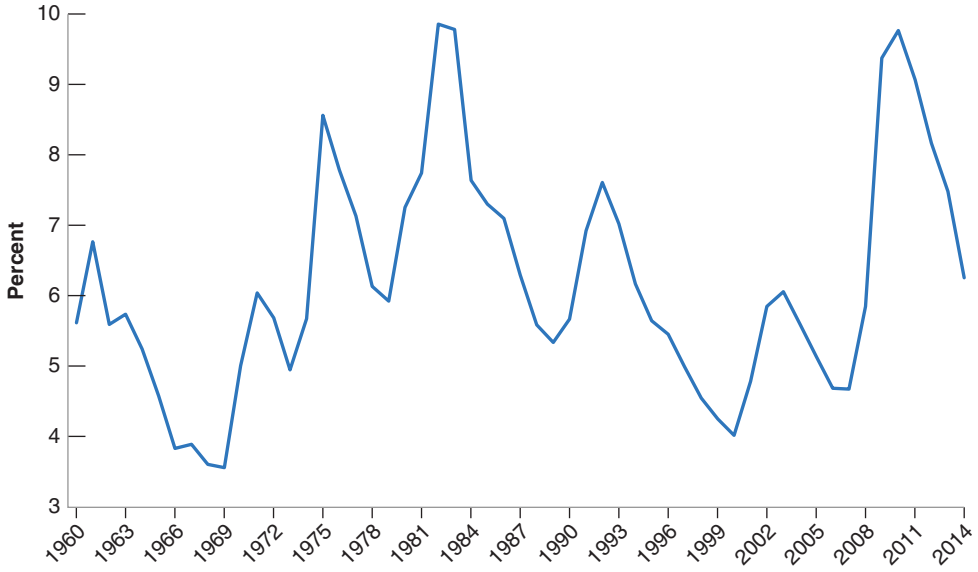


Figure 2-3

U.S. Unemployment Rate, 1960–2014

Since 1960, the U.S. unemployment rate has fluctuated between 3 and 10%, going down during expansions and going up during recessions. The effect of the recent crisis is highly visible, with the unemployment rate reaching close to 10% in 2010, the highest such rate since the early 1980s.

Source: Organization for Economic Co-operation and Development, Unemployment Rate: Aged 15-64: All Persons for the United States© [LRUN64TTUSA156N], retrieved from FRED, Federal Reserve Bank of St. Louis https://research.stlouisfed.org/fred2/series/LRUN64TTUSA156N/, January 13, 2016.

MyEconLab Real-time data

the labor force. Equivalently, a higher unemployment rate is typically associated with a lower **participation rate**, defined as the ratio of the labor force to the total population of working age.

During the crisis, as the U.S. unemployment rate increased, the participation rate decreased from 66% to 63%. But, surprisingly, as unemployment has decreased, the participation rate has not recovered. Why this is so is not fully understood. One hypothesis is the recession was so deep that some workers, who lost their job, have permanently given up on trying to become employed.

Figure 2-3 shows the evolution of unemployment in the United States since 1960. Since 1960, the U.S. unemployment rate has fluctuated between 3 and 10%, going up during recessions and down during expansions. Again, you can see the effect of the recent crisis, with the unemployment rate reaching a peak at nearly 10% in 2010, the highest such rate since the 1980s.

Why Do Economists Care about Unemployment?

Economists care about unemployment for two reasons. First, they care about unemployment because of its direct effect on the welfare of the unemployed. Although unemployment benefits are more generous today than they were during the Great Depression, unemployment is still often associated with financial and psychological suffering. How much suffering depends on the nature of unemployment. One image of unemployment is that of a stagnant pool, of people remaining unemployed for long periods of time. In normal times, in the United States, this image is not right: Every month, many people become unemployed, and many of the unemployed find jobs. When unemployment increases, however, We're at 5.3% now, so not increasing the image becomes more accurate. Not only are more people unemployed, but also many of them are unemployed for a long time. For example, the mean duration of unemployment, which was 16 weeks on average during 2000–2007, increased to 40 weeks in 2011; it has decreased since, but at the time of writing, remains at a relatively high 30 weeks. In short, when the unemployment increases, not only does unemployment become both more widespread, but it also becomes more painful for those who are unemployed.

Second, economists also care about the unemployment rate because it provides a signal that the economy may not be using some of its resources. When unemployment is high, many workers who want to work do not find jobs; the economy is clearly not using

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Unemployment and Happiness

How painful is unemployment? To answer the question, one needs information about particular individuals, and how their happiness varies as they become unemployed. This information is available from the German Socio-Economic Panel survey. The survey has followed about 11,000 households each year since 1984, asking each member of the household a number of questions about their employment status, their income, and their happiness. The specific question in the survey about happiness is the following: "How satisfied are you at present with your life as a whole?", with the answer rated from 0 ("completely dissatisfied") to 10 ("completely satisfied").

The effect of unemployment on happiness defined in this way is shown in Figure 1. The figure plots the average life satisfaction for those individuals who were unemployed during one year, and employed in the four years before and in the four years after. Year 0 is the year of unemployment. Years -1 to -4 are the years before unemployment, years 1 to 4 the years after.

The figure suggests three conclusions. The first and main one is indeed that becoming unemployed leads to a large decrease in happiness. To give you a sense of scale, other studies suggest that this decrease in happiness is close to the decrease triggered by a divorce or a separation. The second is that happiness declines before the actual unemployment spell. This suggests that either workers know they are more likely to become unemployed, or that they like their job less and less. The third is that happiness does not fully recover even four years after the unemployment spell. This suggests that unemployment may do some permanent damage, either because of the experience of unemployment itself, or because the new job is not as satisfying as the old one.

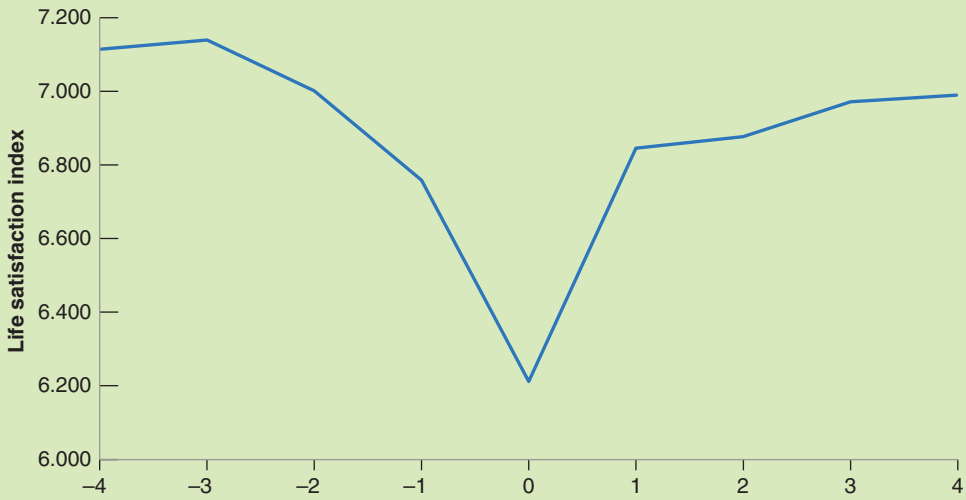
In thinking about how to deal with unemployment, it is essential to understand the channels through which unemployment decreases happiness. One important finding in this respect is that the decrease in happiness does not depend very much on the generosity of unemployment benefits. In other words, unemployment affects happiness not so much through financial channels than through psychological channels. To cite George Akerlof, a Nobel Prize winner, "A person without a job loses not just his income but often the sense that he is fulfilling the duties expected of him as a human being."

◀ The material in this box, and in particular the figure, comes in part from "Unemployment and happiness," by Rainer Winkelmann, *IZA world of labor*, 2014: 94, pp 1–9.

Figure 1

Effects of Unemployment on Happiness

Source: Winkelmann 2014.



It is probably because of statements like this that economics is known as the "dismal science." ▶

its human resources efficiently. What about when unemployment is low? Can very low unemployment also be a problem? The answer is yes. Like an engine running at too high a speed, an economy in which unemployment is very low may be overusing its resources and run into labor shortages. How low is "too low"? This is a difficult question, a question we will take up at more length later in the book. The question came up in 2000 in the United States. At the end of 2000, some economists worried that the unemployment rate, 4% at the time, was indeed too low. So, although they did not advocate triggering a

recession, they favored lower (but positive) output growth for some time, so as to allow the unemployment rate to increase to a somewhat higher level. It turned out that they got more than they had asked for: a recession rather than a slowdown.

2-3 The Inflation Rate

Inflation is a sustained rise in the general level of prices—the **price level**. The **inflation rate** is the rate at which the price level increases. (Symmetrically, **deflation** is a sustained decline in the price level. It corresponds to a negative inflation rate.)

Deflation is rare, but it happens. The United States experienced sustained deflation in the 1930s during the Great Depression (see the Focus box in Chapter 9). Japan has had deflation, off and on, since the late 1990s. More recently, the Euro area has had short spells of deflation.

The practical issue is how to define the price level so the inflation rate can be measured. Macroeconomists typically look at two measures of the price level, at two *price indexes*: the GDP deflator and the Consumer Price Index.

The GDP Deflator

We saw how increases in nominal GDP can come either from an increase in real GDP, or from an increase in prices. Put another way, if we see nominal GDP increase faster than real GDP, the difference must come from an increase in prices.

This remark motivates the definition of the GDP deflator. The **GDP deflator** in year t, P_t, is defined as the ratio of nominal GDP to real GDP in year t:

$$P_t = \frac{\text{Nominal GDP}_t}{\text{Real GDP}_t} = \frac{\$Y_t}{Y_t}$$

Index numbers are often set equal to 100 (in the base year) rather than to 1. If you look at the Economic Report of the President (see Chapter 1) you will see that the GDP deflator, reported in Table B3 is equal to 100 for 2009 (the base year), 102.5 in 2010, and so on.

Note that, in the year in which, by construction, real GDP is equal to nominal GDP (2009 at this point in the United States), this definition implies that the price level is equal to 1. This is worth emphasizing: The GDP deflator is called an **index number**. Its level is chosen arbitrarily—here it is equal to 1 in 2009—and has no economic interpretation. But its rate of change, $(P_t - P_{t-1})/P_{t-1}$ (which we shall denote by π_t in the rest of the book), has a clear economic interpretation: It gives the rate at which the general level of prices increases over time—the rate of inflation.

Compute the GDP deflator and the associated rate of inflation from 2008 to 2009 and from 2009 to 2010 in our car example in Section 2-1, when real GDP is constructed using the 2009 price of cars as the common price.

One advantage to defining the price level as the GDP deflator is that it implies a simple relation between *nominal GDP*, *real GDP*, and the *GDP deflator*. To see this, reorganize the previous equation to get:

$$\$Y_t = P_t Y_t$$

Nominal GDP is equal to the GDP deflator times real GDP. Or, putting it in terms of rates of change: The rate of growth of nominal GDP is equal to the rate of inflation plus the rate of growth of real GDP.

For a refresher for going from levels to rates of change, see Appendix 2, Proposition 7.

The Consumer Price Index

The GDP deflator gives the average price of output—the final goods *produced* in the economy. But consumers care about the average price of consumption—the goods they *consume*. The two prices need not be the same: The set of goods produced in the economy is not the same as the set of goods purchased by consumers, for two reasons:

- Some of the goods in GDP are sold not to consumers but to firms (machine tools, for example), to the government, or to foreigners.
- Some of the goods bought by consumers are not produced domestically but are imported from abroad.

Do not confuse the CPI with the PPI, or *producer price index*, which is an index of prices of domestically produced goods in manufacturing, mining, agriculture, fishing, forestry, and electric utility industries.

To measure the average price of consumption, or, equivalently, the **cost of living**, macroeconomists look at another index, the **Consumer Price Index, or CPI**. The CPI has been in existence in the United States since 1917 and is published monthly (in contrast, numbers for GDP and the GDP deflator are only constructed and published quarterly).

The CPI gives the cost in dollars of a specific list of goods and services over time. The list, which is based on a detailed study of consumer spending, attempts to represent the consumption basket of a typical urban consumer and is updated every two years.

Each month, Bureau of Labor Statistics (BLS) employees visit stores to find out what has happened to the price of the goods on the list; prices are collected for 211 items in 38 cities. These prices are then used to construct the CPI.

Do not ask why such a strange base period was chosen. Nobody seems to remember.

Like the GDP deflator (the price level associated with aggregate output, GDP), the CPI is an index. It is set equal to 100 in the period chosen as the base period and so its level has no particular significance. The current base period is 1982 to 1984, so the average for the period 1982 to 1984 is equal to 100. In 2014, the CPI was 236.7; thus, it cost more than twice as much in dollars to purchase the same consumption basket than in 1982–1984.

You may wonder how the rate of inflation differs depending on whether the GDP deflator or the CPI is used to measure it. The answer is given in Figure 2-4, which plots the two inflation rates since 1960 for the United States. The figure yields two conclusions:

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You may wonder why the effect of the 50% decrease in the price of oil in the second half of 2014 does not similarly show up as a larger decline of the CPI relative to the GDP deflator. The reason is that, although CPI inflation was indeed negative during the second half of 2014, this was offset by positive inflation in the first half of the year, and so does not show up in annual data.

- The CPI and the GDP deflator move together most of the time. In most years, the two inflation rates differ by less than 1%.
- But there are clear exceptions. In 1979 and 1980, the increase in the CPI was significantly larger than the increase in the GDP deflator. The reason is not hard to find. Recall that the GDP deflator is the price of goods *produced* in the United States, whereas the CPI is the price of goods *consumed* in the United States. That means when the price of imported goods increases relative to the price of goods produced in the United States, the CPI increases faster than the GDP deflator. This is precisely what happened in 1979 and 1980. The price of oil doubled. And although the United States is a producer of oil, it produces less than it consumes: It was and still is an oil importer. The result was a large increase in the CPI compared to the GDP deflator.

Figure 2-4

Inflation Rate, Using the CPI and the GDP Deflator, 1960–2014

The inflation rates, computed using either the CPI or the GDP deflator, are largely similar.

Source: Calculated using series USAGDPDEFAISMEI, CPALTT01USA659N Federal Reserve Economic Data (FRED) http://research.stlouisfed.org/fred2/.

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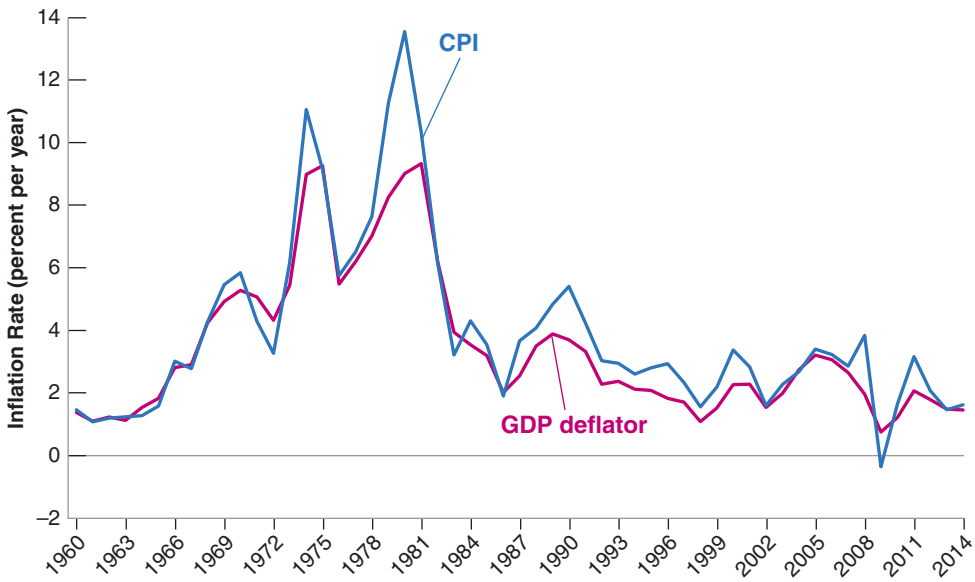


In what follows, we shall typically assume that the two indexes move together so we do not need to distinguish between them. We shall simply talk about *the price level* and denote it by P_t, without indicating whether we have the CPI or the GDP deflator in mind.

Why Do Economists Care about Inflation?

If a higher inflation rate meant just a faster but proportional increase in all prices and wages—a case called *pure inflation*—inflation would be only a minor inconvenience because relative prices would be unaffected.

Take, for example, the workers' *real wage*—the wage measured in terms of goods rather than in dollars. In an economy with 10% inflation, prices would, by definition, increase by 10% a year. But wages in dollars would also increase by 10% a year, so real wages would be unaffected by inflation. Inflation would not be entirely irrelevant; people would have to keep track of the increase in prices and wages when making decisions. But this would be a small burden, hardly justifying making control of the inflation rate one of the major goals of macroeconomic policy.

So why do economists care about inflation? Precisely because there is no such thing as pure inflation:

- During periods of inflation, not all prices and wages rise proportionately. Because they don't, inflation affects income distribution. For example, retirees in some countries receive payments that do not keep up with the price level, so they lose in relation to other groups when inflation is high. This is not the case in the United States, where Social Security benefits automatically rise with the CPI, protecting retirees from inflation. But during the very high inflation that took place in Russia in the 1990s, retirement pensions did not keep up with inflation, and many retirees were pushed to near starvation.
- Inflation leads to other distortions. Variations in relative prices also lead to more uncertainty, making it harder for firms to make decisions about the future, such as investment decisions. Some prices, which are fixed by law or by regulation, lag behind the others, leading to changes in relative prices. Taxation interacts with inflation to create more distortions. If tax brackets are not adjusted for inflation, for example, people move into higher and higher tax brackets as their nominal income increases, even if their real income remains the same.

This is known as *bracket creep*. In the United States, the tax brackets are adjusted automatically for inflation: If inflation is 5%, all tax brackets also go up by 5%—in other words, there is no bracket creep. By contrast, in Italy, where inflation averaged 17% a year in the second half of the 1970s, bracket creep led to a rise of almost 9 percentage points in the rate of income taxation.

If inflation is so bad, does this imply that deflation (negative inflation) is good?

The answer is no. First, high deflation (a large negative rate of inflation) would create many of the same problems as high inflation, from distortions to increased uncertainty. Second, as we shall see later in the book, even a low rate of deflation limits the ability of monetary policy to affect output. So what is the "best" rate of inflation? Most macroeconomists believe that the best rate of inflation is a low and stable rate of inflation, somewhere between 1 and 4%.

Newspapers sometimes confuse deflation and recession. They may happen together but they are not the same. Deflation is a decrease in the price level. A recession is a decrease in real output.

We shall look at the pros and cons of different rates of inflation in Chapter 23.

2-4 Output, Unemployment, and the Inflation Rate: Okun's Law and the Phillips Curve

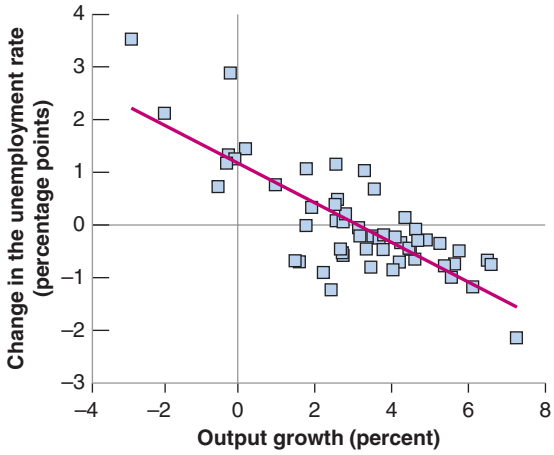
We have looked separately at the three main dimensions of aggregate economic activity: output growth, the unemployment rate, and the inflation rate. Clearly they are not independent, and much of this book will be spent looking at the relations among them in detail. But it is useful to have a first look now.

Figure 2-5

Changes in the Unemployment Rate versus Growth in the United States, 1960–2014

Output growth that is higher than usual is associated with a reduction in the unemployment rate; output growth that is lower than usual is associated with an increase in the unemployment rate.

Source: Series GDPCA,GDPA: Federal Reserve Economic Data (FRED) http://research.stlouisfed.org/fred2/.



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Okun's Law

Arthur Okun was an adviser to President John F. Kennedy in the 1960s. Okun's law is, of course, not a law, but an empirical regularity.

Intuition suggests that if output growth is high, unemployment will decrease, and this is indeed true. This relation was first examined by U.S. economist Arthur Okun and for this reason has become known as **Okun's law**. Figure 2-5 plots the change in the unemployment rate on the vertical axis against the rate of growth of output on the horizontal axis for the United States since 1960. It also draws the line that best fits the cloud of points in the figure. Looking at the figure and the line suggests two conclusions:

Such a graph, plotting one variable against another, is called a *scatterplot*. The line is called *a regression line*. For more on regressions, see Appendix 3.

- The line is downward sloping and fits the cloud of points quite well. Put in economic terms: There is a tight relation between the two variables: Higher output growth leads to a decrease in unemployment. The slope of the line is −0.4. This implies that, on average, an increase in the growth rate of 1% decreases the unemployment rate by roughly −0.4%. This is why unemployment goes up in recessions and down in expansions. This relation has a simple but important implication: The key to decreasing unemployment is a high enough rate of growth.

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- This line crosses the horizontal axis at the point where output growth is roughly equal to 3%. In economic terms: It takes a growth rate of about 3% to keep unemployment constant. This is for two reasons. The first is that population, and thus the labor force, increases over time, so employment must grow over time just to keep the unemployment rate constant. The second is that output per worker is also increasing with time, which implies that output growth is higher than employment growth. Suppose, for example, that the labor force grows at 1% and that output per worker grows at 2%. Then output growth must be equal to 3%(1% + 2%) just to keep the unemployment rate constant.

In recent years, the growth rate at which the unemployment rate remains constant has been lower, around 2.5%. This reflects again the decrease in productivity growth (the rate of growth of output per worker), discussed in Chapter 1.

The Phillips Curve

It should probably be known as the Phillips relation, but it is too late to change that.

Okun's law implies that, with strong enough growth, one can decrease the unemployment rate to very low levels. But intuition suggests that, when unemployment becomes very low, the economy is likely to overheat, and that this will lead to upward pressure on inflation. And, to a large extent, this is true. This relation was first explored in 1958 by a New Zealand economist, A. W. Phillips, and has become known as the **Phillips curve**. Phillips plotted the rate of inflation against the unemployment rate. Since then, the Phillips curve has been redefined as a relation between the *change in the rate of inflation* and the unemployment rate. Figure 2-6 plots the change in the inflation rate (measured

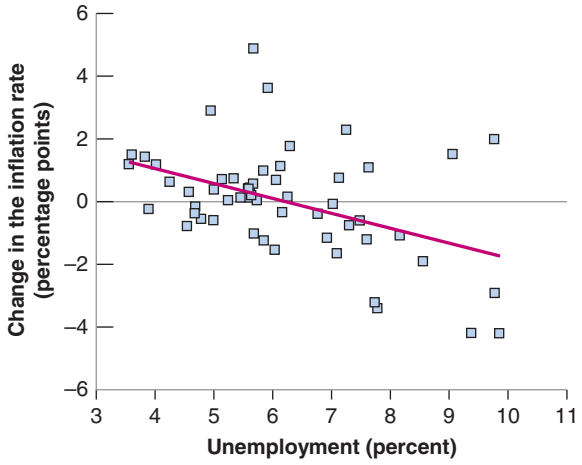

Figure 2-6

Changes in the Inflation Rate versus the Unemployment Rate in the United States, 1960–2014

A low unemployment rate leads to an increase in the inflation rate, a high unemployment rate to a decrease in the inflation rate.

Source: Series GDPCA,GDPA: Federal Reserve Economic Data (FRED) http://research.stlouisfed.org/fred2/.

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using the CPI) on the vertical axis against the unemployment rate on the horizontal axis, together with the line that fits the cloud of points best, for the United States since 1960. Looking at the figure again suggests two conclusions:

- The line is downward sloping, although the fit is not as good as it was for Okun's law: Higher unemployment leads, on average, to a decrease in inflation; lower unemployment leads to an increase in inflation. But this is only true on average. Sometimes, high unemployment is associated with an increase in inflation.
- The line crosses the horizontal axis at the point where the unemployment rate is roughly equal to 6%. When unemployment has been below 6%, inflation has typically increased, suggesting that the economy was overheating, operating above its potential. When unemployment has been above 6%, inflation has typically decreased, suggesting that the economy was operating below potential. But, again here, the relation is not tight enough that the unemployment rate at which the economy overheats can be pinned down precisely. This explains why some economists believe that we should try to maintain a lower unemployment rate, say 4 or 5%, and others believe that it may be dangerous, leading to overheating and increasing inflation.

As we shall see later in Chapter 8, the Phillips curve relation has evolved over time, in ways which cannot be captured in Figure 2-6. This explains why the fit is not as good as, say, for Okun's law.

Clearly, a successful economy is an economy that combines high output growth, low unemployment, and low inflation. Can all these objectives be achieved simultaneously? Is low unemployment compatible with low and stable inflation? Do policy makers have the tools to sustain growth, to achieve low unemployment while maintaining low inflation? These are the questions we shall take up as we go through the book. The next two sections give you the road map.

2-5 The Short Run, the Medium Run, and the Long Run

What determines the level of aggregate output in an economy? Consider three answers:

- Reading newspapers suggests a first answer: Movements in output come from movements in the demand for goods. You probably have read news stories that begin like this: "Production and sales of automobiles were higher last month due to a surge in consumer confidence, which drove consumers to showrooms in record numbers." Stories like these highlight the role demand plays in determining aggregate output;

they point to factors that affect demand, ranging from consumer confidence to government spending to interest rates.

- But, surely, no amount of Indian consumers rushing to Indian showrooms can increase India's output to the level of output in the United States. This suggests a second answer: What matters when it comes to aggregate output is the supply side—how much the economy can produce. How much can be produced depends on how advanced the technology of the country is, how much capital it is using, and the size and the skills of its labor force. These factors—not consumer confidence—are the fundamental determinants of a country's level of output.
- The previous argument can be taken one step further: Neither technology, nor capital, nor skills are given. The technological sophistication of a country depends on its ability to innovate and introduce new technologies. The size of its capital stock depends on how much people have saved. The skills of workers depend on the quality of the country's education system. Other factors are also important: If firms are to operate efficiently, for example, they need a clear system of laws under which to operate and an honest government to enforce those laws. This suggests a third answer: The true determinants of output are factors like a country's education system, its saving rate, and the quality of its government. If we want to understand what determines the level of output, we must look at these factors.

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You might be wondering at this point, which of the three answers is right? The fact is that all three are right. But each applies over a different time frame:

- In the **short run**, say, a few years, the first answer is the right one. Year-to-year movements in output are primarily driven by movements in demand. Changes in demand, perhaps as a result of changes in consumer confidence or other factors, can lead to a decrease in output (a recession) or an increase in output (an expansion).
- In the **medium run**, say, a decade, the second answer is the right one. Over the medium run, the economy tends to return to the level of output determined by supply factors: the capital stock, the level of technology, and the size of the labor force. And, over a decade or so, these factors move sufficiently slowly that we can take them as given.
- In the **long run**, say, a few decades or more, the third answer is the right one. To understand why China has been able to achieve such a high growth rate since 1980, we must understand why both the capital stock and the level of technology in China are increasing so fast. To do so, we must look at factors like the education system, the saving rate, and the role of the government.

This way of thinking about the determinants of output underlies macroeconomics, and it underlies the organization of this book.

2-6 A Tour of the Book

The book is organized in three parts: A core; two extensions; and, finally, a comprehensive look at the role of macroeconomic policy. This organization is shown in Figure 2-7. We now describe it in more detail.

The Core

The core is composed of three parts—the short run, the medium run, and the long run.

- Chapters 3 to 6 look at how output is determined in the short run. To focus on the role of demand, we assume that firms are willing to supply any quantity at a given price. In other words, we ignore supply constraints. Chapter 3 shows

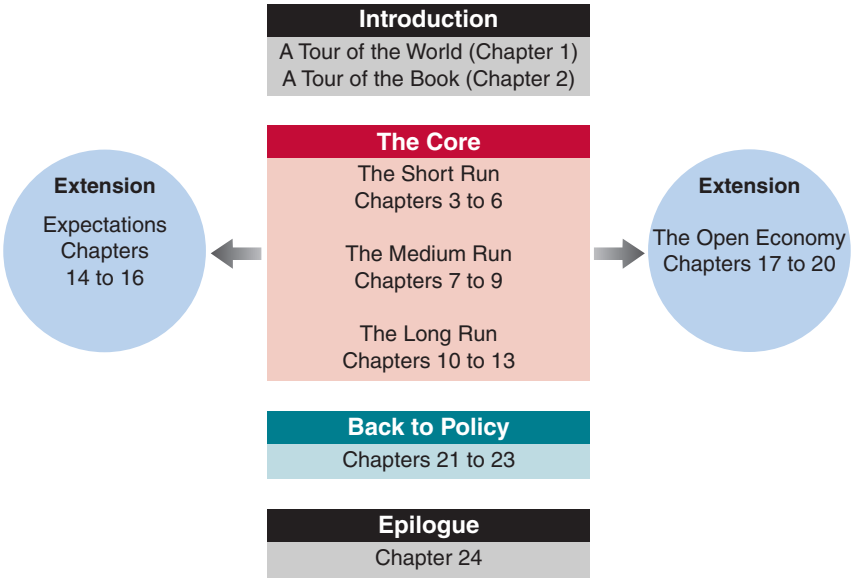

Figure 2-7

The Organization of the Book

how the demand for goods determines output. Chapter 4 shows how monetary policy determines the interest rate. Chapter 5 puts the two together, by allowing demand to depend on the interest rate, and then showing the role of monetary and fiscal policy in determining output. Chapter 6 extends the model by introducing a richer financial system, and using it to explain what happened during the recent crisis.

- Chapters 7 to 9 develop the supply side and look at how output is determined in the medium run. Chapter 7 introduces the labor market. Chapter 8 builds on it to derive the relation between inflation and unemployment. Chapter 9 puts all the parts together, and shows the determination of output, unemployment, and inflation both in the short and the medium run.
- Chapters 10 to 13 focus on the long run. Chapter 10 introduces the relevant facts by looking at the growth of output both across countries and over long periods of time. Chapters 11 and 12 discuss how both capital accumulation and technological progress determine growth. Chapter 13 looks at the interaction among technological progress, wages, unemployment, and inequality.

Extensions

The core chapters give you a way of thinking about how output (and unemployment, and inflation) is determined over the short, medium, and long run. However, they leave out several elements, which are explored in two extensions:

- Expectations play an essential role in macroeconomics. Nearly all the economic decisions people and firms make depend on their expectations about future income, future profits, future interest rates, and so on. Fiscal and monetary policies affect economic activity not only through their direct effects, but also through their effects on people's and firms' expectations. Although we touch on these issues in the core, Chapters 14 to 16 offer a more detailed treatment and draw the implications for fiscal and monetary policy.
- The core chapters treat the economy as *closed*, ignoring its interactions with the rest of the world. But the fact is, economies are increasingly *open*, trading goods and services and financial assets with one another. As a result, countries are becoming

more and more interdependent. The nature of this interdependence and the implications for fiscal and monetary policy are the topics of Chapters 17 to 20.

Back to Policy

Monetary policy and fiscal policy are discussed in nearly every chapter of this book. But once the core and the extensions have been covered, it is useful to go back and put things together in order to assess the role of policy.

- Chapter 21 focuses on general issues of policy, whether macroeconomists know enough about how the economy works to use policy as a stabilization tool at all, and whether policy makers can be trusted to do what is right.
- Chapters 22 and 23 return to the role of fiscal and monetary policies.

Epilogue

Macroeconomics is not a fixed body of knowledge. It evolves over time. The final chapter, Chapter 24, looks at the history of macroeconomics and how macroeconomists have come to believe what they believe today. From the outside, macroeconomics sometimes looks like a field divided among schools—"Keynesians," "monetarists," "new classicals," "supply-siders," and so on—hurling arguments at each other. The actual process of research is more orderly and more productive than this image suggests. We identify what we see as the main differences among macroeconomists, the set of propositions that define the core of macroeconomics today, and the challenges posed to macroeconomists by the crisis.

Summary

- We can think of GDP, the measure of aggregate output, in three equivalent ways: (1) GDP is the value of the final goods and services produced in the economy during a given period; (2) GDP is the sum of value added in the economy during a given period; and (3) GDP is the sum of incomes in the economy during a given period.
- Nominal GDP is the sum of the quantities of final goods produced times their current prices. This implies that changes in nominal GDP reflect both changes in quantities and changes in prices. Real GDP is a measure of output. Changes in real GDP reflect changes in quantities only.
- A person is classified as unemployed if he or she does not have a job and is looking for one. The unemployment rate is the ratio of the number of people unemployed to the number of people in the labor force. The labor force is the sum of those employed and those unemployed.
- Economists care about unemployment because of the human cost it represents. They also look at unemployment because it sends a signal about how efficiently the economy is using its resources. High unemployment indicates that the country is not using its resources efficiently.
- Inflation is a rise in the general level of prices—the price level. The inflation rate is the rate at which the price level increases. Macroeconomists look at two measures of the price level. The first is the GDP deflator, which is the average price of the goods produced in the economy. The second is the Consumer Price Index (CPI), which is the average price of goods consumed in the economy.
- Inflation leads to changes in income distribution, to distortions, and to increased uncertainty.
- There are two important relations among output, unemployment, and inflation. The first, called Okun's law, is a relation between output growth and the change in unemployment: High output growth typically leads to a decrease in the unemployment rate. The second, called the Phillips curve, is a relation between unemployment and inflation: A low unemployment rate typically leads to an increase in the inflation rate.
- Macroeconomists distinguish between the short run (a few years), the medium run (a decade), and the long run (a few decades or more). They think of output as being determined by demand in the short run. They think of output as being determined by the level of technology, the capital stock, and the labor force in the medium run. Finally, they think of output as being determined by factors like education, research, saving, and the quality of government in the long run.

Key Terms

national income and product accounts, 42
aggregate output, 42
gross domestic product (GDP), 42
gross national product (GNP), 42
intermediate good, 42
final good, 43
value added, 43
nominal GDP, 44
real GDP, 44
real GDP in chained (2009) dollars, 45
dollar GDP, GDP in current dollars, 46
GDP in terms of goods, GDP in constant dollars, GDP adjusted for inflation, GDP in chained (2009) dollars, GDP in 2009 dollars, 46
real GDP per person, 46
GDP growth, 46
expansions, 46
recessions, 46
hedonic pricing, 47
employment, 47
unemployment, 47
labor force, 47
unemployment rate, 47
Current Population Survey (CPS), 48
not in the labor force, 48
discouraged workers, 48
participation rate, 49
inflation, 51
price level, 51
inflation rate, 51
deflation, 51
GDP deflator, 51
index number, 51
cost of living, 52
Consumer Price Index (CPI), 52
Okun's law, 54
Phillips curve, 54
short run, 56
medium run, 56
long run, 56

Questions and Problems

QUICK CHECK

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1. Using the information in this chapter, label each of the following statements true, false, or uncertain. Explain briefly.

a. U.S. GDP was 32 times higher in 2014 than it was in 1960.
b. When the unemployment rate is high, the participation rate is also likely to be high.
c. The rate of unemployment tends to fall during expansions and rise during recessions.
d. If the Japanese CPI is currently at 108 and the U.S. CPI is at 104, then the Japanese rate of inflation is higher than the U.S. rate of inflation.
e. The rate of inflation computed using the CPI is a better index of inflation than the rate of inflation computed using the GDP deflator.
f. Okun's law shows that when output growth is lower than normal, the unemployment rate tends to rise.
g. Periods of negative GDP growth are called recessions.
h. When the economy is functioning normally, the unemployment rate is zero.
i. The Phillips curve is a relation between the level of prices and the level of unemployment.

2. Suppose you are measuring annual U.S. GDP by adding up the final value of all goods and services produced in the economy. Determine the effect on GDP of each of the following transactions.

a. A seafood restaurant buys $100 worth of fish from a fisherman.
b. A family spends $100 on a fish dinner at a seafood restaurant.
c. Delta Air Lines buys a new jet from Boeing for $200 million.
d. The Greek national airline buys a new jet from Boeing for $200 million.
e. Delta Air Lines sells one of its jets to Jennifer Lawrence for $100 million.

3. Suppose that an economy shows only the following activities in a specific year:

i. It costs an automobile manufacturing company €10 million to assemble 5,000 cars. The cars are then sold to stores for €12 million.
ii. The stores pay their workers an annual wage of €1 million and then sell the cars directly to the consumers for €15 million. Please find other instances like this and correct them.

a. Calculate the GDP in this economy using the production-of-final-goods approach.
b. Calculate the GDP using the value-added approach. Show the value added at each stage of production.
c. Calculate the GDP using the income approach. Show the costs incurred and profits earned.

4. An economy produces three goods: cars, computers, and oranges. Quantities and prices per unit for years 2009 and 2010 are as follows:

	2009		2010	
	Quantity	Price	Quantity	Price
Cars	10	$2,000	12	$3,000
Computers	4	$1,000	6	$500
Oranges	1,000	$1	1,000	$1

a. What is nominal GDP in 2009 and in 2010? By what percentage does nominal GDP change from 2009 to 2010?
b. Using the prices for 2009 as the set of common prices, what is real GDP in 2009 and in 2009? By what percentage does real GDP change from 2009 to 2010?
c. Using the prices for 2010 as the set of common prices, what is real GDP in 2009 and in 2010? By what percentage does real GDP change from 2009 to 2010?
d. Why are the two output growth rates constructed in (b) and (c) different? Which one is correct? Explain your answer.

5. Consider the economy described in Problem 4.

a. Use the prices for 2009 as the set of common prices to compute real GDP in 2009 and in 2010. Compute the GDP deflator for 2009 and for 2010, and compute the rate of inflation from 2009 to 2010.
b. Use the prices for 2010 as the set of common prices to compute real GDP in 2009 and in 2010. Compute the GDP deflator for 2009 and for 2010 and compute the rate of inflation from 2009 to 2010.
c. Why are the two rates of inflation different? Which one is correct? Explain your answer.

6. Consider the economy described in Problem 4.

a. Construct real GDP for years 2009 and 2010 by using the average price of each good over the two years.
b. By what percentage does real GDP change from 2009 to 2010?
c. What is the GDP deflator in 2009 and 2010? Using the GDP deflator, what is the rate of inflation from 2009 to 2010?
d. Is this an attractive solution to the problems pointed out in Problems 4 and 5 (i.e., two different growth rates and two different inflation rates, depending on which set of prices is used)? (The answer is yes and is the basis for the construction of chained-type deflators. See the appendix to this chapter for more discussion.)

7. The Consumer Price Index

The Consumer Price Index (CPI) is a measure of the average price of goods that a typical household consumes. To calculate the CPI, a basket of 700 goods and services that reflects the U.K. society's buying habits is used to construct the index. Assume that U.K. consumers buy only meat and movie tickets as their basket of goods and services. Below is a representation of the kind of data that the Office for National Statistics collects to construct the consumer price index. In the base year, 2010, both the prices and quantities of goods and services purchased are collected. In subsequent years, price changes are calculated for the same set of goods and services. The Office uses the Inflation Calculator to measure by how the cost of goods and services has changed over time. The Inflation Calculator can calculate the future cost of goods and services based on price changes from a date in the past. Alternatively, it can calculate the past cost of goods and services based on price changes from a date in the future.

The data: In an average week in 2010, the Office for National Statistics surveys thousands of households and determines that the average consumer purchases two pounds of meat and one ticket in a month. In subsequent years, the price per pound of meat and per movie ticket are found below:

Year	Price of Meat	Price of Movie Ticket
2010	£2	£5
2011	£1.9	£4.8
2012	£2	£4.9
2013	£2	£5
2014	£2	£5.2
2015	£2.1	£5.3

a. What is the cost of the consumer price basket in 2010?
b. What is the cost of the consumer price basket in 2011 and in subsequent years?
c. Represent the cost of the consumer price basket as an index number in the year 2008 to 2013. Set the value of the index number equal to 100 in 2008.
d. Calculate the annual rate of inflation using the percent change in the value of the index number between each year from 2010 through 2015.
You would find it helpful to fill in the table below

Year	Consumer Price Index 2010 = 100	Inflation Rate
2010		
2011		
2012		
2013		
2014		
2015		

e. Is there a year where inflation is negative? What does deflation imply?
f. The international price of oil has declined since 2014. What do you expect the response of consumers would be to such a decline in oil prices?
g. How many baskets of goods and services can £100 buy a household in 2010 and in 2014? What has happened to the purchasing power of money during this period? How can households ensure that their purchasing power does not decline?
h. Bank of England sets the target for the annual inflation rate of the Consumer Prices Index at 2%. Why would the Bank set such an inflation target?
i. Prices of oil and agricultural products decreased during the period 2010–2015. The Office for National Statistics calculates core inflation, which excludes energy and food prices. Complete the table below to calculate core inflation for the same period. How does core inflation compare to the CPI?

Year	Core Inflation Price Index 2013 = 100	Core Inflation Rate
2010	100	
2011	98.8	
2012	98.9	
2013	100.04	
2014	101.6	
2015	102.1	

8. Using macroeconomic relations:

a. Okun's law stated that when output growth is higher than usual, the unemployment rate tends to fall. Explain why usual output growth is positive.

b. In which year, a year where output growth is 2% or a year where output growth is –2%, will the unemployment rate rise more?

c. The Phillips curve is a relation between the change in the inflation rate and the level of the unemployment rate. Using the Phillips curve, is the unemployment rate zero when the rate of inflation is neither rising nor falling?

d. The Phillips curve is often portrayed as a line with a negative slope. In the text, the slope is about –0.5. In your opinion, is this a "better" economy if the line has a large slope, say –0.8, or a smaller slope, say –0.2?

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9. Hedonic pricing

As the first Focus box in this chapter explains, it is difficult to measure the true increase in prices of goods whose characteristics change over time. For such goods, part of any price increase can be attributed to an increase in quality. Hedonic pricing offers a method to compute the quality-adjusted increase in prices.

a. Consider the case of a routine medical check-up. Name some reasons you might want to use hedonic pricing to measure the change in the price of this service.

Now consider the case of a medical check-up for a pregnant woman. Suppose that a new ultrasound method is introduced. In the first year that this method is available, half of doctors offer the new method, and half offer the old method. A check-up using the new method costs 10% more than a check-up using the old method.

b. In percentage terms, how much of a quality increase does the new method represent over the old method? (*Hint:* Consider the fact that some women *choose* to see a doctor offering the new method when they could have chosen to see a doctor offering the old method.)

Now, in addition, suppose that in the first year the new ultrasound method is available, the price of check-ups using the new method is 15% higher than the price of check-ups in the previous year (when everyone used the old method).

c. How much of the higher price for check-ups using the new method (as compared to check-ups in the previous year) reflects a true price increase of check-ups and how much represents a quality increase? In other words, how much higher is the quality-adjusted price of check-ups using the new method as compared to the price of check-ups in the previous year?

In many cases, the kind of information we used in parts (b) and (c) is not available. For example, suppose that in the year the new ultrasound method is introduced, all doctors adopt the new method, so the old method is no longer used. In addition, continue to assume that the price of check-ups in the year the new method is introduced is 15% higher than the price of check-ups in the previous year (when everyone used the old method). Thus, we observe a 15% price increase in check-ups, but we realize that the quality of check-ups has increased.

d. Under these assumptions, what information required to compute the quality-adjusted price increase of check-ups is lacking? Even without this information, can we say anything about the quality-adjusted price increase of check-ups? Is it more than 15%? less than 15%? Explain.

10. Measured and true GDP

Suppose that instead of cooking dinner for an hour, you decide to work an extra hour, earning an additional $12. You then purchase some (takeout) Chinese food, which costs you $10.

a. By how much does measured GDP increase?

b. Do you think the increase in measured GDP accurately reflects the effect on output of your decision to work? Explain.

EXPLORE FURTHER

11. Comparing the 2008 global financial crisis and the European Sovereign debt crisis.

EUROSTAT is the statistical agency of the European Commission that provides data to the institutions of the 28 nations (note, the number of nations may be affected by Brexit results) of the European Union (EU-28) and harmonizes statistical methods across member states. GDP at market prices and the GDP deflator can be downloaded from the database under the prefix: National accounts indicator ESA10.

a. Look at the data on both the GDP deflator and GDP at market prices during the global financial crisis from 2007 till 2009 and then during the European Sovereign Debt Crisis from 2010 till 2015. Which of the two crises had a larger recessionary impact?

b. According to the EUROSTAT's labor force survey, which of the two crises marked a higher level unemployment level?

c. EUROSTAT presents statistical data on business demography in the nations of the EU-28, measuring the total number of active enterprises in the business economy, their birth rates, death rates, and the survival rates. While the enterprise birth rate is seen as an indicator of job creation and GDP growth, enterprise death rate is an indicator of a recession. The two recessions showed that the enterprise death rate was slightly higher than the birth rate. How does this relate to your answers in parts (a) and (b)?

For more on the impact of recessions on business activities and economic growth as well as the methodology of business demography, visit www.ec.europa.eu.

Further Readings

- If you want to learn more about the definition and the construction of the many economic indicators that are regularly reported on the news—from the help-wanted index to the retail sales index—two easy-to-read references are:
  The *Guide to Economic Indicators*, by Norman Frumkin, 3rd edition, M.E. Sharpe, 4th edition, New York, 2005.
  The Economist Guide to Economic Indicators, by the staff of *The Economist*, 6th edition, Bloomberg, New York, 2007.
- In 1995, the U.S. Senate set up a commission to study the construction of the CPI and make recommendations about potential changes. The commission concluded that the rate of inflation computed using the CPI was on average about 1% too high. If this conclusion is correct, this implies in particular that real wages (nominal wages divided by the CPI) have grown 1% more per year than is currently being reported. For more on the conclusions of the commission and some of the exchanges that followed, read *Consumer Prices, the Consumer Price Index, and the Cost of Living*, by Michael Boskin et al., *Journal of Economic Perspectives*, 1998, 12(1): pp. 3–26.
- For a short history of the construction of the National Income Accounts, read *GDP: One of the Great Inventions of the 20th Century*, Survey of Current Business, January 2000, 1–9. (http://www.bea.gov/scb/pdf/BEAWIDE/2000/0100od.pdf).
- For a discussion of some of the problems involved in measuring activity, read Katherine Abraham, "What We Don't Know Could Hurt Us; Some Reflections on the Measurement of Economic Activity," *Journal of Economic Perspectives*, 2005, 19(3): pp. 3–18.
- To see why it is hard to measure the price level and output correctly, read "Viagra and the Wealth of Nations" by Paul Krugman, 1998 (www.pkarchive.org/theory/viagra.html). (Paul Krugman is a Nobel Prize winner, and a columnist at the *New York Times*. His columns are opinionated, insightful, and fun to read.)

APPENDIX: The Construction of Real GDP and Chain-Type Indexes

The example we used in the chapter had only one final good—cars—so constructing real GDP was easy. But how do we construct real GDP when there is more than one final good? This appendix gives the answer.

To understand how real GDP in an economy with many final goods is constructed, all you need to do is look at an economy where there are just two final goods. What works for two goods works just as well for millions of goods.

Suppose that an economy produces two final goods, say wine and potatoes:

- In year 0, it produces 10 pounds of potatoes at a price of \$1 a pound, and 5 bottles of wine at a price of \$2 a bottle.
- In year 1, it produces 15 pounds of potatoes at a price of \$1 a pound, and 5 bottles of wine at a price of \$3 a bottle.
- Nominal GDP in year 0 is therefore equal to \$20. Nominal GDP in year 1 is equal to \$30.

This information is summarized in the following table.

Nominal GDP in Year 0 and in Year 1.

	Year 0		
	Quantity	**\$ Price**	**\$ Value**
Potatoes (pounds)	10	1	10
Wine (bottles),	5	2	10
Nominal GDP			20
	Year 1		
	Quantity	**\$ Price**	**\$ Value**
Potatoes (pounds)	15	1	15
Wine (bottles),	5	3	15
Nominal GDP			30

The rate of growth of nominal GDP from year 0 to year 1 is equal to $(\$30 - \$20)/(\$20) = 50\%$. But what is the rate of growth of real GDP?

Answering this question requires constructing real GDP for each of the two years. The basic idea behind constructing real GDP is to evaluate the quantities in each year using the *same set of prices.*

Suppose we choose, for example, the prices in year 0. Year 0 is then called the **base year**. In this case, the computation is as follows:

- Real GDP in year 0 is the sum of the quantity in year 0 times the price in year 0 for both goods: $(10 \times \$1) + (5 \times \$2) = \$20$.
- Real GDP in year 1 is the sum of the quantity in year 1 times the price in year 0 for both goods: $(15 \times \$1) + (5 \times \$2) = \$25$.
- The rate of growth of real GDP from year 0 to year 1 is then $(\$25 - \$20)/(\$20)$, or 25%.

This answer raises however an obvious issue: Instead of using year 0 as the base year, we could have used year 1, or any other year. If, for example, we had used year 1 as the base year, then:

- Real GDP in year 0 would be equal to $(10 \times \$1 + 5 \times \$3) = \$25$.
- Real GDP in year 1 would be equal to $(15 \times \$1 + 5 \times \$3) = \$30$.
- The rate of growth of real GDP from year 0 to year 1 would be equal to \$5/\$25, or 20%.

The answer using year 1 as the base year would therefore be different from the answer using year 0 as the base year. So if

the choice of the base year affects the constructed percentage rate of change in output, which base year should one choose?

Until the mid-1990s in the United States—and still in most countries today—the practice was to choose a base year and change it infrequently, say, every five years or so. For example, in the United States, 1987 was the base year used from December 1991 to December 1995. That is, measures of real GDP published, for example, in 1994 for both 1994 and for all earlier years were constructed using 1987 prices. In December 1995, national income accounts shifted to 1992 as a base year; measures of real GDP for all earlier years were recalculated using 1992 prices.

This practice was logically unappealing. Every time the base year was changed and a new set of prices was used, all past real GDP numbers—and all past real GDP growth rates—were recomputed: Economic history was, in effect, rewritten every five years! Starting in December 1995, the U.S. Bureau of Economic Analysis (BEA)—the government office that produces the GDP numbers—shifted to a new method that does not suffer from this problem.

The method requires four steps:

- Constructing the rate of change of real GDP from year t to year $t + 1$ in two different ways. First using the prices from year t as the set of common prices; second, using the prices from year $t + 1$ as the set of common prices. For example, the rate of change of GDP from 2006 to 2007 is computed by:
  (1) Constructing real GDP for 2006 and real GDP for 2007 using 2006 prices as the set of common prices, and computing a first measure of the rate of growth of GDP from 2006 to 2007.
  (2) Constructing real GDP for 2006 and real GDP for 2007 using 2007 prices as the set of common prices, and computing a second measure of the rate of growth of GDP from 2006 to 2007.
- Constructing the rate of change of real GDP as the average of these two rates of change.
- Constructing an index for the level of real GDP by *linking*—or *chaining*—the constructed rates of change for each year. The index is set equal to 1 in some arbitrary year. At the time this book is written, the arbitrary year is 2009. Given that the constructed rate of change from 2009 to 2010 by the BEA is 2.5%, the index for 2010 equals $(1 + 2.5\%) = 1.025$. The index for 2010 is then obtained by multiplying the index for 2009 by the rate of change from 2009 to 2010, and so on. (You will find the value of this index—multiplied by 100—in the second column of Table B3 in the Economic Report of the President. Check that it is 100 in 2009 and 102.6 in 2010, and so on.)
- Multiplying this index by nominal GDP in 2009 to derive *real GDP in chained (2009) dollars*. As the index is 1 in 2009, this implies that real GDP in 2009 equals nominal GDP in 2009.

  Chained refers to the chaining of rates of change described previously. *(2009)* refers to the year where, by construction, real GDP is equal to nominal GDP. (You will find the value of real GDP in chained (2009) dollars in the first column of Table B2 of the Economic Report of the President.)

  This index is more complicated to construct than the indexes used before 1995. (To make sure you understand the steps, construct real GDP in chained (year 0) dollars for year 1 in our example.) But it is clearly better conceptually: The prices used to evaluate real GDP in two adjacent years are the right prices, namely the average prices for those two years. And, because the rate of change from one year to the next is constructed using the prices in those two years rather than the set of prices in an arbitrary base year, history will not be rewritten every five years—as it used to be when, under the previous method for constructing real GDP, the base year was changed every five years.

(For more details, go to http://www.bea.gov/scb/pdf/national/nipa/1995/0795od.pdf.)

Key Term

base year, 62