CHAPTER

24

Measuring the Cost of Living

In 1931, as the U.S. economy was suffering through the Great Depression, the New York Yankees paid famed baseball player Babe Ruth a salary of $80,000. At the time, this pay was extraordinary, even among the stars of baseball. According to one story, a reporter asked Ruth whether he thought it was right that he made more than President Herbert Hoover, who had a salary of only $75,000. Ruth replied, "I had a better year."

In 2012, the median salary earned by a player on the New York Yankees was $1.9 million, and shortstop Alex Rodriguez was paid $30 million. At first, this fact might lead you to think that baseball has become vastly more lucrative over the past eight decades. But as everyone knows, the prices of goods and services have also risen. In 1931, a nickel would buy an ice-cream cone and a quarter would buy a ticket at the local movie theater. Because prices were so much lower in Babe Ruth's day than they are today, it is not clear whether Ruth enjoyed a higher or lower standard of living than today's players.

In the preceding chapter, we looked at how economists use gross domestic product (GDP) to measure the quantity of goods and services that the economy is producing. This chapter examines how economists measure the overall cost of living. To compare Babe Ruth's salary of $80,000 to salaries from today, we need to find some way of turning dollar figures into meaningful measures of purchasing power. That is exactly the job of a statistic called the *consumer price index*. After seeing how the consumer price index is constructed, we discuss how we can use such a price index to compare dollar figures from different points in time.

The consumer price index is used to monitor changes in the cost of living over time. When the consumer price index rises, the typical family has to spend more money to maintain the same standard of living. Economists use the term *inflation* to describe a situation in which the economy's overall price level is rising. The *inflation rate* is the percentage change in the price level from the previous period. The preceding chapter showed how economists can measure inflation using the GDP deflator. The inflation rate you are likely to hear on the nightly news, however, is calculated from the consumer price index, which better reflects the goods and services bought by consumers.

As we will see in the coming chapters, inflation is a closely watched aspect of macroeconomic performance and is a key variable guiding macroeconomic policy. This chapter provides the background for that analysis by showing how economists measure the inflation rate using the consumer price index and how this statistic can be used to compare dollar figures from different times.

24-1 The Consumer Price Index

consumer price index (CPI)
a measure of the overall cost of the goods and services bought by a typical consumer

The **consumer price index (CPI)** is a measure of the overall cost of the goods and services bought by a typical consumer. Each month, the Bureau of Labor Statistics (BLS), which is part of the Department of Labor, computes and reports the consumer price index. In this section, we discuss how the consumer price index is calculated and what problems arise in its measurement. We also consider how this index compares to the GDP deflator, another measure of the overall level of prices, which we examined in the preceding chapter.

24-1a How the CPI Is Calculated

When the BLS calculates the consumer price index and the inflation rate, it uses data on the prices of thousands of goods and services. To see exactly how these statistics are constructed, let's consider a simple economy in which consumers buy only two goods: hot dogs and hamburgers. Table 1 shows the five steps that the BLS follows.

1. *Fix the basket*. Determine which prices are most important to the typical consumer. If the typical consumer buys more hot dogs than hamburgers, then the price of hot dogs is more important than the price of hamburgers and, therefore, should be given greater weight in measuring the cost of living. The BLS sets these weights by surveying consumers to find the basket of goods and services bought by the typical consumer. In the example in the table, the typical consumer buys a basket of 4 hot dogs and 2 hamburgers.
2. *Find the prices.* Find the prices of each of the goods and services in the basket at each point in time. The table shows the prices of hot dogs and hamburgers for three different years.

TABLE 1

Calculating the Consumer Price Index and the Inflation Rate: An Example

This table shows how to calculate the consumer price index and the inflation rate for a hypothetical economy in which consumers buy only hot dogs and hamburgers.

Step 1: Survey Consumers to Determine a Fixed Basket of Goods

Basket = 4 hot dogs, 2 hamburgers

Step 2: Find the Price of Each Good in Each Year

Year	Price of Hot Dogs	Price of Hamburgers
2013	$1	$2
2014	2	3
2015	3	4

Step 3: Compute the Cost of the Basket of Goods in Each Year

2013	($1 per hot dog × 4 hot dogs) + ($2 per hamburger × 2 hamburgers) = $8 per basket
2014	($2 per hot dog × 4 hot dogs) + ($3 per hamburger × 2 hamburgers) = $14 per basket
2015	($3 per hot dog × 4 hot dogs) + ($4 per hamburger × 2 hamburgers) = $20 per basket

Step 4: Choose One Year as a Base Year (2013) and Compute the Consumer Price Index in Each Year

2013	($8 / $8) × 100 = 100
2014	($14 / $8) × 100 = 175
2015	($20 / $8) × 100 = 250

Step 5: Use the Consumer Price Index to Compute the Inflation Rate from Previous Year

2014	(175 − 100) / 100 × 100 = 75%
2015	(250 − 175) / 175 × 100 = 43%

3. *Compute the basket's cost.* Use the data on prices to calculate the cost of the basket of goods and services at different times. The table shows this calculation for each of the three years. Notice that only the prices in this calculation change. By keeping the basket of goods the same (4 hot dogs and 2 hamburgers), we are isolating the effects of price changes from the effects of any quantity changes that might be occurring at the same time.
4. *Choose a base year and compute the index.* Designate one year as the base year, the benchmark against which other years are compared. (The choice of base year is arbitrary, as the index is used to measure *changes* in the cost of living.) Once the base year is chosen, the index is calculated as follows:

$$\text{Consumer price index} = \frac{\text{Price of basket of goods and services in current year}}{\text{Price of basket in base year}} \times 100.$$

That is, the price of the basket of goods and services in each year is divided by the price of the basket in the base year, and this ratio is then multiplied by 100. The resulting number is the consumer price index.

In the example in Table 1, 2013 is the base year. In this year, the basket of hot dogs and hamburgers costs $8. Therefore, to calculate the consumer price index, the price of the basket in each year is divided by $8 and multiplied

by 100. The consumer price index is 100 in 2013. (The index is always 100 in the base year.) The consumer price index is 175 in 2014. This means that the price of the basket in 2014 is 175 percent of its price in the base year. Put differently, a basket of goods that costs $100 in the base year costs $175 in 2014. Similarly, the consumer price index is 250 in 2015, indicating that the price level in 2015 is 250 percent of the price level in the base year.

5. *Compute the inflation rate.* Use the consumer price index to calculate the **inflation rate**, which is the percentage change in the price index from the preceding period. That is, the inflation rate between two consecutive years is computed as follows:

inflation rate
the percentage change in the price index from the preceding period

$$\text{Inflation rate in year 2} = \frac{\text{CPI in year 2} - \text{CPI in Year 1}}{\text{CPI in Year 1}} \times 100.$$

As shown at the bottom of Table 1, the inflation rate in our example is 75 percent in 2014 and 43 percent in 2015.

FYI

What Is in the CPI's Basket?

When constructing the consumer price index, the Bureau of Labor Statistics tries to include all the goods and services that the typical consumer buys. Moreover, it tries to weight these goods and services according to how much consumers buy of each item.

Figure 1 shows the breakdown of consumer spending into the major categories of goods and services. By far the largest category is housing, which makes up 41 percent of the typical consumer's budget. This category includes the cost of shelter (32 percent), fuel and other utilities (5 percent), and household furnishings and operation (4 percent). The next largest category, at 17 percent, is transportation, which includes spending on cars, gasoline, buses, subways, and so on. The next category, at 15 percent, is food and beverages; this includes food at home (8 percent), food away from home (6 percent), and alcoholic beverages (1 percent). Next are medical care, recreation, and education and communication, each at about 7 percent. This last category includes tuition (3 percent), telephone service (2 percent), information technology such as personal computers and Internet service (1 percent), and educational books and supplies such as this textbook (0.3 percent). Apparel, which includes clothing, footwear, and jewelry, makes up 4 percent of the typical consumer's budget.

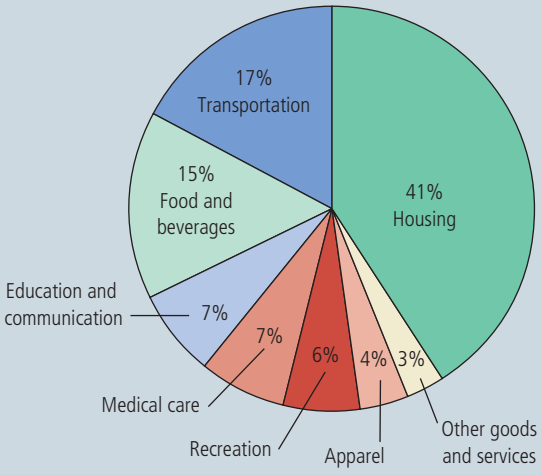
Also included in the figure, at 3 percent of spending, is a category for other goods and services. This is a catchall for consumer purchases (such as cigarettes, haircuts, and funeral expenses) that do not naturally fit into the other categories.

FIGURE 1

The Typical Basket of Goods and Services

This figure shows how the typical consumer divides spending among various categories of goods and services. The Bureau of Labor Statistics calls each percentage the "relative importance" of the category.

Source: Bureau of Labor Statistics.



Although this example simplifies the real world by including only two goods, it shows how the BLS computes the consumer price index and the inflation rate. The BLS collects and processes data on the prices of thousands of goods and services every month and, by following the five foregoing steps, determines how quickly the cost of living for the typical consumer is rising. When the BLS makes its monthly announcement of the consumer price index, you can usually hear the number on the evening television news or see it in the next day's newspaper.

In addition to the consumer price index for the overall economy, the BLS calculates several other price indexes. It reports the index for specific metropolitan areas within the country (such as Boston, New York, and Los Angeles) and for some narrow categories of goods and services (such as food, clothing, and energy). It also calculates the **producer price index** (PPI), which measures the cost of a basket of goods and services bought by firms rather than consumers. Because firms eventually pass on their costs to consumers in the form of higher consumer prices, changes in the producer price index are often thought to be useful in predicting changes in the consumer price index.

producer price index
a measure of the cost of a basket of goods and services bought by firms

24-1b Problems in Measuring the Cost of Living

The goal of the consumer price index is to measure changes in the cost of living. In other words, the consumer price index tries to gauge how much incomes must rise to maintain a constant standard of living. The consumer price index, however, is not a perfect measure of the cost of living. Three problems with the index are widely acknowledged but difficult to solve.

The first problem is called *substitution bias*. When prices change from one year to the next, they do not all change proportionately: Some prices rise more than others. Consumers respond to these differing price changes by buying less of the goods whose prices have risen by relatively large amounts and by buying more of the goods whose prices have risen less or perhaps even have fallen. That is, consumers substitute toward goods that have become relatively less expensive. If a price index is computed assuming a fixed basket of goods, it ignores the possibility of consumer substitution and, therefore, overstates the increase in the cost of living from one year to the next.

Let's consider a simple example. Imagine that in the base year, apples are cheaper than pears, so consumers buy more apples than pears. When the BLS constructs the basket of goods, it will include more apples than pears. Suppose that next year pears are cheaper than apples. Consumers will naturally respond to the price changes by buying more pears and fewer apples. Yet when computing the consumer price index, the BLS uses a fixed basket, which in essence assumes that consumers continue buying the now expensive apples in the same quantities as before. For this reason, the index will measure a much larger increase in the cost of living than consumers actually experience.

The second problem with the consumer price index is the *introduction of new goods*. When a new good is introduced, consumers have more variety from which to choose, and this in turn reduces the cost of maintaining the same level of economic well-being. To see why, consider a hypothetical situation: Suppose you could choose between a $100 gift certificate at a large store that offered a wide array of goods and a $100 gift certificate at a small store with the same prices but a more limited selection. Which would you prefer? Most people would pick the store with greater variety. In essence, the increased set of possible choices makes each dollar more valuable. The same is true with the evolution of the economy

over time: As new goods are introduced, consumers have more choices, and each dollar is worth more. Yet because the consumer price index is based on a fixed basket of goods and services, it does not reflect the increase in the value of the dollar that arises from the introduction of new goods.

Again, let's consider an example. When the iPod was introduced in 2001, consumers found it more convenient to listen to their favorite music. Devices to play music were available previously, but they were not nearly as portable and versatile. The iPod was a new option that increased consumers' set of opportunities. For any given number of dollars, the introduction of the iPod made people better off; conversely, achieving the same level of economic well-being required a smaller number of dollars. A perfect cost-of-living index would have reflected the introduction

IN THE NEWS

Monitoring Inflation in the Internet Age

The web is providing alternative ways to collect data on the overall level of prices.

Do We Need Google to Measure Inflation?

By Annie Lowrey

At some 23,000 retailers and businesses in 90 U.S. cities, hundreds of government workers find and mark down prices on very precise products. And I'm not kidding when I say "very precise."

Say the relevant worker is finding the price for a motel room. She might write a report like this: *Occupancy*—two adults; *Type of accommodation*—deluxe room; *Room classification/location*—ocean view, room 306; *Time of stay*—weekend; *Length of stay*—one night; *Bathroom facilities*—one full bathroom; *Kitchen facilities*—none; *Television*—one, includes free movie channel; *Telephone*—one telephone, free local calls; *Air-conditioned*—yes; *Meals included*—breakfast; *Parking*—free self parking; *Transportation*—Transportation to airport, no charge; *Recreation facilities*—an indoor and an outdoor pool, a private beach, three tennis courts, and an exercise room.

This mind-numbingly tedious process goes on for a dizzying panoply of items: wine, takeaway meals, bedroom furniture, surgical procedures, pet dogs, college tuition, cigarettes, haircuts, funerals. When all of the prices are marked down, the workers submit forms that are collated, checked, and input into massive spreadsheets. Then the government boils all those numbers down to one. It weights certain prices, taking into account that consumers spend more on rent than cereal, for instance. It considers product improvements and changes in spending habits. Then it comes up with a master number showing how much a customer's spending needed to increase to buy the same goods, month-on-month. That number is the Consumer Price Index, the government's main gauge of inflation.

Each month, the Bureau of Labor Statistics goes through all that hassle because knowing the rate of inflation is such an important measure of economic health—and it's important to the government's own budget. High inflation? Savers panic, watching the spending power of their accounts erode. Deflation? Everyone saves, awaiting cheaper prices in a few months. And wildly changing inflation makes it difficult for businesses and consumers to make economic decisions. Moreover, the government needs to know the rate of inflation to index certain payments, like Social Security benefits or interest payments on TIPS bonds.

But just because the government expends so much energy determining the rate of inflation does not mean it is tallying it in the smartest or most accurate way. The reigning methodology is, well, clunky. It costs Washington around $234 million a year to get all those people to go and bear witness to a $1.57 price increase in a packet of tube socks and then to massage those individual data points down to one number. Moreover, there is a weekslong lag between the checkers tallying up the numbers and the government announcing the changes: The inflation measure comes out only 12 times a year, though prices change, sometimes dramatically, all the time. Plus, the methodology is archaic, given that we live in the Internet age. Prices are easily available online and a lot of shopping happens on the Web rather than in stores.

But there might be a better way. In the last few months, economists have come up

of the iPod with a decrease in the cost of living. The consumer price index, however, did not decrease in response to the introduction of the iPod. Eventually, the BLS revised the basket of goods to include the iPod, and subsequently, the index reflected changes in iPod prices. But the reduction in the cost of living associated with the initial introduction of the iPod never showed up in the index.

The third problem with the consumer price index is *unmeasured quality change*. If the quality of a good deteriorates from one year to the next while its price remains the same, the value of a dollar falls, because you are getting a lesser good for the same amount of money. Similarly, if the quality rises from one year to the next, the value of a dollar rises. The BLS does its best to account for quality change. When the quality of a good in the basket changes—for example, when a car model has

with new methods for calculating inflation at Internet speed—nimbler, cheaper, faster, and perhaps even more accurate than Washington's. The first comes from the Massachusetts Institute of Technology. In 2007, economists Roberto Rigobon and Alberto Cavallo started tracking prices online and inputting them into a massive database. Then, last month, they unveiled the Billion Prices Project, an inflation measure based on 5 million items sold by 300 online retailers in 70 countries. (For the United States, the BPP collects about 500,000 prices.)

The BPP's inflation measure is markedly different from the government's. The economists just average all the prices culled online, meaning the basket of goods is whatever you can buy on the Web. (Some things, like books, are most often bought online. Some items, like cats, are not.) Plus, the researchers do not weight certain items' prices, even if they tend to make up a bigger proportion of household spending.

Still, thus far, the BPP has tracked the CPI closely. And the online-based measure has additional advantages. It comes out daily, giving a better sense of inflation's direction. It also lets researchers examine minute, day-to-day price changes. For instance, this month Rigobon and Cavallo noted that Black Friday discounts "had a smaller effect on average prices in 2010 than in 2009," contrary to reports of deeper discounting this year.

Photolove/Cultura/Getty Images

"I wonder how much this costs online."

And it has already produced some academic insights. For instance, Cavallo found that retailers change prices less often, but more, percentage-wise, than economists previously thought.

A second inflation measure comes from Web behemoth Google and is a pet project of the company's chief economist, Hal Varian. As reported by the *Financial Times*, earlier this year, Varian decided to use Google's vast database of Web prices to construct the "Google Price Index," a constantly updated measure of price changes and inflation. (The idea came to him when he was searching for a pepper grinder online.) Google has not yet decided whether it will publish the price index, and has not released its methodology. But Varian said that his preliminary index tracked CPI closely, though it did show periods of deflation—the worrisome incidence of prices actually falling—where the CPI did not.

The new indices lead to the big question of whether the government *needs* to update its methods to account for changes in the economy—taking new pricing trends into consideration, rejiggering its formula, updating more frequently. The answer might be yes. (Economists have reformed the CPI before.) But the CPI and its Stone Age method of calculation boasts one huge benefit: It's a stable, tested measure, consistent over time, since its methodology doesn't change much. Moreover, and somewhat remarkably, the Google and Billion Prices Project indices actually seem to confirm the accuracy of the old-fashioned CPI, tracking it closely rather than showing it to be off-base.

Ultimately, there is a good argument for *more* inflation measures, not just better or newer ones. The government already calculates a number of rates of inflation to give a fuller picture of price changes, the value of money, and the economy. Most notably, the BLS publishes a "core inflation" number, a measure of inflation outside volatile food and energy prices. There are dozens of other measures, as well. The new Web-based yardsticks provide even more alternatives and opportunities to examine the accuracy of the CPI—and to make new findings. That means, for now, those detective-like government rubes painstakingly checking prices on clipboards get to stay in work.

Source: *Slate*, December 20, 2010.

more horsepower or gets better gas mileage from one year to the next—the Bureau adjusts the price of the good to account for the quality change. It is, in essence, trying to compute the price of a basket of goods of constant quality. Despite these efforts, changes in quality remain a problem because quality is so hard to measure.

There is still much debate among economists about how severe these measurement problems are and what should be done about them. Several studies written during the 1990s concluded that the consumer price index overstated inflation by about 1 percentage point per year. In response to this criticism, the BLS adopted several technical changes to improve the CPI, and many economists believe the bias is now only about half as large as it once was. The issue is important because many government programs use the consumer price index to adjust for changes in the overall level of prices. Recipients of Social Security, for instance, get annual increases in benefits that are tied to the consumer price index. Some economists have suggested modifying these programs to correct for the measurement problems by, for instance, reducing the magnitude of the automatic benefit increases.

24-1c The GDP Deflator versus the Consumer Price Index

In the preceding chapter, we examined another measure of the overall level of prices in the economy—the GDP deflator. The GDP deflator is the ratio of nominal GDP to real GDP. Because nominal GDP is current output valued at current prices and real GDP is current output valued at base-year prices, the GDP deflator reflects the current level of prices relative to the level of prices in the base year.

Economists and policymakers monitor both the GDP deflator and the consumer price index to gauge how quickly prices are rising. Usually, these two statistics tell a similar story. Yet two important differences can cause them to diverge.

The first difference is that the GDP deflator reflects the prices of all goods and services *produced domestically*, whereas the consumer price index reflects the prices of all goods and services *bought by consumers*. For example, suppose that the price of an airplane produced by Boeing and sold to the Air Force rises. Even though the plane is part of GDP, it is not part of the basket of goods and services bought by a typical consumer. Thus, the price increase shows up in the GDP deflator but not in the consumer price index.

As another example, suppose that Volvo raises the price of its cars. Because Volvos are made in Sweden, the car is not part of U.S. GDP. But U.S. consumers buy Volvos, so the car is part of the typical consumer's basket of goods. Hence, a price increase in an imported consumption good, such as a Volvo, shows up in the consumer price index but not in the GDP deflator.

This first difference between the consumer price index and the GDP deflator is particularly important when the price of oil changes. The United States produces some oil, but much of the oil we use is imported. As a result, oil and oil products such as gasoline and heating oil make up a much larger share of consumer spending than of GDP. When the price of oil rises, the consumer price index rises by much more than does the GDP deflator.

The second and subtler difference between the GDP deflator and the consumer price index concerns how various prices are weighted to yield a single number for the overall level of prices. The consumer price index compares the price of a *fixed* basket of goods and services to the price of the basket in the base year. Only occasionally does the BLS change the basket of goods. By contrast, the GDP deflator compares the price of *currently produced* goods and

"The price may seem a little high, but you have to remember that's in today's dollars."

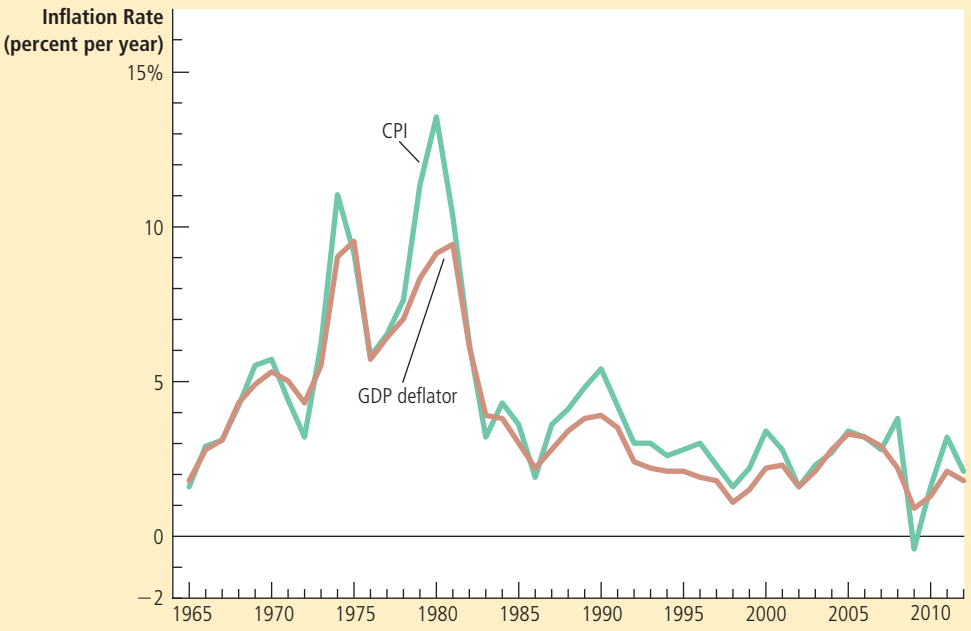


FIGURE 2

Two Measures of Inflation
This figure shows the inflation rate—the percentage change in the level of prices—as measured by the GDP deflator and the consumer price index using annual data since 1965. Notice that the two measures of inflation generally move together.

Source: U.S. Department of Labor; U.S. Department of Commerce.

services to the price of the same goods and services in the base year. Thus, the group of goods and services used to compute the GDP deflator changes automatically over time. This difference is not important when all prices are changing proportionately. But if the prices of different goods and services are changing by varying amounts, the way we weight the various prices matters for the overall inflation rate.

Figure 2 shows the inflation rate as measured by both the GDP deflator and the consumer price index for each year since 1965. You can see that sometimes the two measures diverge. When they do diverge, it is possible to go behind these numbers and explain the divergence with the two differences we have discussed. For example, in 1979 and 1980, CPI inflation spiked up more than the GDP deflator largely because oil prices more than doubled during these two years. Yet divergence between these two measures is the exception rather than the rule. In the 1970s, both the GDP deflator and the consumer price index show high rates of inflation. In the late 1980s, 1990s, and the first decade of the 2000s, both measures show low rates of inflation.

Quick Quiz *Explain briefly what the CPI measures and how it is constructed.*
• *Identify one reason why the CPI is an imperfect measure of the cost of living.*

24-2 Correcting Economic Variables for the Effects of Inflation

The purpose of measuring the overall level of prices in the economy is to allow us to compare dollar figures from different times. Now that we know how price indexes are calculated, let's see how we might use such an index to compare a dollar figure from the past to a dollar figure in the present.

24-2a Dollar Figures from Different Times

We first return to the issue of Babe Ruth's salary. Was his salary of $80,000 in 1931 high or low compared to the salaries of today's players?

To answer this question, we need to know the level of prices in 1931 and the level of prices today. Part of the increase in baseball salaries compensates players for higher prices today. To compare Ruth's salary to those of today's players, we need to inflate Ruth's salary to turn 1931 dollars into today's dollars.

The formula for turning dollar figures from year T into today's dollars is the following:

$$\text{Amount in today's dollars} = \text{Amount in year } T \text{ dollars} \times \frac{\text{Price level today}}{\text{Price level in year } T}.$$

A price index such as the consumer price index measures the price level and thus determines the size of the inflation correction.

Let's apply this formula to Ruth's salary. Government statistics show a consumer price index of 15.2 for 1931 and 229.5 for 2012. Thus, the overall level of prices has risen by a factor of 15.1 (calculated from 229.5/15.2). We can use these numbers to measure Ruth's salary in 2012 dollars, as follows:

$$\begin{aligned}\text{Salary in 2012 dollars} &= \text{Salary in 1931 dollars} \times \frac{\text{Price level in 2012}}{\text{Price level in 1931}} \\ &= \$80{,}000 \times \frac{229.5}{15.2} \\ &= \$1{,}207{,}894.\end{aligned}$$

We find that Babe Ruth's 1931 salary is equivalent to a salary today of over $1.2 million. That is a good income, but it is a third less than the median Yankee salary today and only 4 percent of what the Yankees pay A-Rod. Various forces, including overall economic growth and the increasing income shares earned by superstars, have substantially raised the living standards of the best athletes.

Let's also examine President Hoover's 1931 salary of $75,000. To translate that figure into 2012 dollars, we again multiply the ratio of the price levels in the two years. We find that Hoover's salary is equivalent to $75,000 × (229.5/15.2), or $1,132,401, in 2012 dollars. This is well above President Barack Obama's salary of $400,000. It seems that President Hoover did have a pretty good year after all.

24-2b Indexation

As we have just seen, price indexes are used to correct for the effects of inflation when comparing dollar figures from different times. This type of correction shows up in many places in the economy. When some dollar amount is automatically corrected for changes in the price level by law or contract, the amount is said to be **indexed** for inflation.

indexation
the automatic correction by law or contract of a dollar amount for the effects of inflation

For example, many long-term contracts between firms and unions include partial or complete indexation of the wage to the consumer price index. Such a provision is called a *cost-of-living allowance*, or COLA. A COLA automatically raises the wage when the consumer price index rises.

Indexation is also a feature of many laws. Social Security benefits, for example, are adjusted every year to compensate the elderly for increases in prices. The brackets

FYI

Mr. Index Goes to Hollywood

What is the most popular movie of all time? The answer might surprise you.

Movie popularity is usually gauged by box office receipts. By that measure, *Avatar* is the number 1 movie of all time with domestic receipts of $761 million, followed by *Titanic* ($659 million) and *Marvel's The Avengers* ($623 million). But this ranking ignores an obvious but important fact: Prices, including those of movie tickets, have been rising over time. Inflation gives an advantage to newer films.

Screen Prod/PhotoNonStop/Glow Images

"Frankly, my dear, I don't care much for the effects of inflation."

When we correct box office receipts for the effects of inflation, the story is very different. The number 1 movie is now *Gone with the Wind* ($1,604 million), followed by *Star Wars* ($1,414 million) and *The Sound of Music* ($1,131 million). *Avatar* falls to number 14.

Gone with the Wind was released in 1939, before everyone had televisions in their homes. In the 1930s, about 90 million Americans went to the cinema each week, compared to about 25 million today. But the movies from that era don't show up in conventional popularity rankings because ticket prices were only a quarter. And indeed, in the ranking based on nominal box office receipts, *Gone with the Wind* does not make the top 50 films. Scarlett and Rhett fare a lot better once we correct for the effects of inflation.

of the federal income tax—the income levels at which the tax rates change—are also indexed for inflation. There are, however, many ways in which the tax system is not indexed for inflation, even when perhaps it should be. We discuss these issues more fully when we discuss the costs of inflation later in this book.

24-2c Real and Nominal Interest Rates

Correcting economic variables for the effects of inflation is particularly important, and somewhat tricky, when we look at data on interest rates. The very concept of an interest rate necessarily involves comparing amounts of money at different points in time. When you deposit your savings in a bank account, you give the bank some money now, and the bank returns your deposit with interest in the future. Similarly, when you borrow from a bank, you get some money now, but you will have to repay the loan with interest in the future. In both cases, to fully understand the deal between you and the bank, it is crucial to acknowledge that future dollars could have a different value than today's dollars. That is, you have to correct for the effects of inflation.

Let's consider an example. Suppose Sally Saver deposits $1,000 in a bank account that pays an annual interest rate of 10 percent. A year later, after Sally has accumulated $100 in interest, she withdraws her $1,100. Is Sally $100 richer than she was when she made the deposit a year earlier?

The answer depends on what we mean by "richer." Sally does have $100 more than she had before. In other words, the number of dollars in her possession has

risen by 10 percent. But Sally does not care about the amount of money itself: She cares about what she can buy with it. If prices have risen while her money was in the bank, each dollar now buys less than it did a year ago. In this case, her purchasing power—the amount of goods and services she can buy—has not risen by 10 percent.

To keep things simple, let's suppose that Sally is a movie fan and buys only DVDs. When Sally made her deposit, a DVD at her local movie store cost $10. Her deposit of $1,000 was equivalent to 100 DVDs. A year later, after getting her 10 percent interest, she has $1,100. How many DVDs can she buy now? It depends on what has happened to the price of a DVD. Here are some examples:

- Zero inflation: If the price of a DVD remains at $10, the amount she can buy has risen from 100 to 110 DVDs. The 10 percent increase in the number of dollars means a 10 percent increase in her purchasing power.
- Six percent inflation: If the price of a DVD rises from $10 to $10.60, then the number of DVDs she can buy has risen from 100 to approximately 104. Her purchasing power has increased by about 4 percent.
- Ten percent inflation: If the price of a DVD rises from $10 to $11, she can still buy only 100 DVDs. Even though Sally's dollar wealth has risen, her purchasing power is the same as it was a year earlier.
- Twelve percent inflation: If the price of a DVD increases from $10 to $11.20, the number of DVDs she can buy has fallen from 100 to approximately 98. Even with her greater number of dollars, her purchasing power has decreased by about 2 percent.

And if Sally were living in an economy with deflation—falling prices—another possibility could arise:

- Two percent deflation: If the price of a DVD falls from $10 to $9.80, then the number of DVDs she can buy rises from 100 to approximately 112. Her purchasing power increases by about 12 percent.

These examples show that the higher the rate of inflation, the smaller the increase in Sally's purchasing power. If the rate of inflation exceeds the rate of interest, her purchasing power actually falls. And if there is deflation (that is, a negative rate of inflation), her purchasing power rises by more than the rate of interest.

To understand how much a person earns in a savings account, we need to consider both the interest rate and the change in prices. The interest rate that measures the change in dollar amounts is called the **nominal interest rate**, and the interest rate corrected for inflation is called the **real interest rate**. The nominal interest rate, the real interest rate, and inflation are related approximately as follows:

nominal interest rate
the interest rate as usually reported without a correction for the effects of inflation

real interest rate
the interest rate corrected for the effects of inflation

$$\text{Real interest rate} = \text{Nominal interest rate} - \text{Inflation rate}.$$

The real interest rate is the difference between the nominal interest rate and the rate of inflation. The nominal interest rate tells you how fast the number of dollars in your bank account rises over time, while the real interest rate tells you how fast the purchasing power of your bank account rises over time.

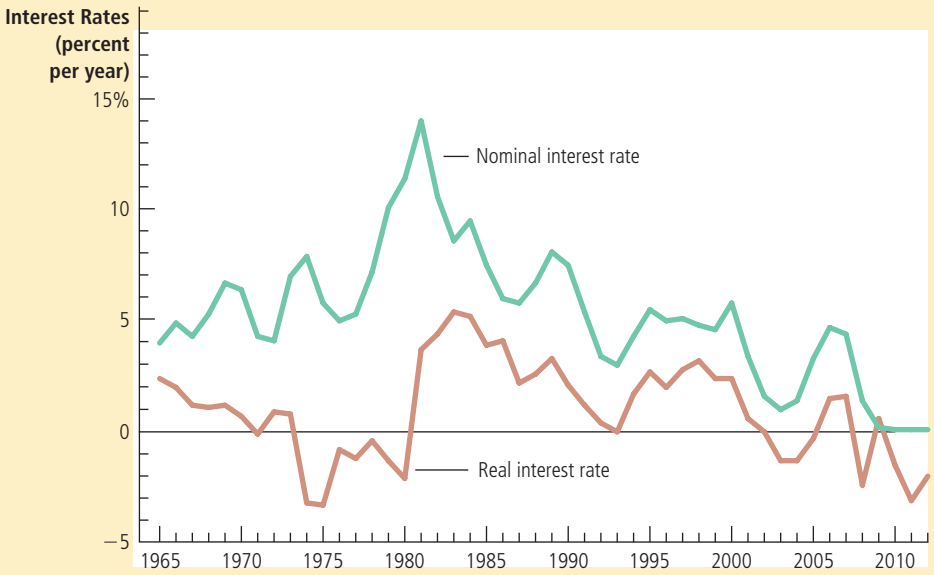


FIGURE 3

Real and Nominal Interest Rates
This figure shows nominal and real interest rates using annual data since 1965. The nominal interest rate is the rate on a three-month Treasury bill. The real interest rate is the nominal interest rate minus the inflation rate as measured by the consumer price index. Notice that nominal and real interest rates often do not move together.

Source: U.S. Department of Labor; U.S. Department of Treasury.

case study

Interest Rates in the U.S. Economy

Figure 3 shows real and nominal interest rates in the U.S. economy since 1965. The nominal interest rate in this figure is the rate on three-month Treasury bills (although data on other interest rates would be similar). The real interest rate is computed by subtracting the rate of inflation from this nominal interest rate. Here the inflation rate is measured as the percentage change in the consumer price index.

One feature of this figure is that the nominal interest rate almost always exceeds the real interest rate. This reflects the fact that the U.S. economy has experienced rising consumer prices in almost every year during this period. By contrast, if you look at data for the U.S. economy during the late 19th century or for the Japanese economy in some recent years, you will find periods of deflation. During deflation, the real interest rate exceeds the nominal interest rate.

The figure also shows that because inflation is variable, real and nominal interest rates do not always move together. For example, in the late 1970s, nominal interest rates were high. But because inflation was very high, real interest rates were low. Indeed, during much of the 1970s, real interest rates were negative, for inflation eroded people's savings more quickly than nominal interest payments increased them. By contrast, in the late 1990s, nominal interest rates were lower than they had been two decades earlier. But because inflation was much lower, real interest rates were higher. In the coming chapters, we will examine the economic forces that determine both real and nominal interest rates.

Quick Quiz *Henry Ford paid his workers $5 a day in 1914. If the consumer price index was 10 in 1914 and 230 in 2012, how much is the Ford paycheck worth in 2012 dollars?*

24-3 Conclusion

"A nickel ain't worth a dime anymore," baseball player Yogi Berra once observed. Indeed, throughout recent history, the real values behind the nickel, the dime, and the dollar have not been stable. Persistent increases in the overall level of prices have been the norm. Such inflation reduces the purchasing power of each unit of money over time. When comparing dollar figures from different times, it is important to keep in mind that a dollar today is not the same as a dollar 20 years ago or, most likely, 20 years from now.

This chapter has discussed how economists measure the overall level of prices in the economy and how they use price indexes to correct economic variables for the effects of inflation. Price indexes allow us to compare dollar figures from different points in time and, therefore, get a better sense of how the economy is changing.

The discussion of price indexes in this chapter, together with the preceding chapter's discussion of GDP, is only a first step in the study of macroeconomics. We have not yet examined what determines a nation's GDP or the causes and effects of inflation. To do that, we need to go beyond issues of measurement. Indeed, that is our next task. Having explained how economists measure macroeconomic quantities and prices in the past two chapters, we are now ready to develop the models that explain movements in these variables.

Here is our strategy in the upcoming chapters. First, we look at the long-run determinants of real GDP and related variables, such as saving, investment, real interest rates, and unemployment. Second, we look at the long-run determinants of the price level and related variables, such as the money supply, inflation, and nominal interest rates. Last of all, having seen how these variables are determined in the long run, we examine the more complex question of what causes short-run fluctuations in real GDP and the price level. In all of these chapters, the measurement issues we have just discussed will provide the foundation for the analysis.

Summary

- The consumer price index shows the cost of a basket of goods and services relative to the cost of the same basket in the base year. The index is used to measure the overall level of prices in the economy. The percentage change in the consumer price index measures the inflation rate.
- The consumer price index is an imperfect measure of the cost of living for three reasons. First, it does not take into account consumers' ability to substitute toward goods that become relatively cheaper over time. Second, it does not take into account increases in the purchasing power of the dollar due to the introduction of new goods. Third, it is distorted by unmeasured changes in the quality of goods and services. Because of these measurement problems, the CPI overstates true inflation.
- Like the consumer price index, the GDP deflator measures the overall level of prices in the economy. The two price indexes usually move together, but there are important differences. The GDP deflator differs from the CPI because it includes goods and services produced rather than goods and services consumed. As a result, imported goods affect the consumer price index but not the GDP deflator. In addition, while the consumer price index uses a fixed basket of goods, the GDP deflator automatically changes the group of goods and services over time as the composition of GDP changes.
- Dollar figures from different times do not represent a valid comparison of purchasing power. To compare a dollar figure from the past to a dollar figure today, the older figure should be inflated using a price index.
- Various laws and private contracts use price indexes to correct for the effects of inflation. The tax laws, however, are only partially indexed for inflation.
- A correction for inflation is especially important when looking at data on interest rates. The nominal interest rate is the interest rate usually reported; it is the rate at which the number of dollars in a savings account increases over time. By contrast, the real interest rate takes into account changes in the value of the dollar over time. The real interest rate equals the nominal interest rate minus the rate of inflation.

Key Concepts

consumer price index (CPI), *p. 506*
inflation rate, *p. 508*
producer price index, *p. 509*
indexation, *p. 514*
nominal interest rate, *p. 516*
real interest rate, *p. 516*

Questions for Review

1. Which do you think has a greater effect on the consumer price index: a 10 percent increase in the price of chicken or a 10 percent increase in the price of caviar? Why?
2. Describe the three problems that make the consumer price index an imperfect measure of the cost of living.
3. If the price of imported French wine rises, is the consumer price index or the GDP deflator affected more? Why?
4. Over a long period of time, the price of a candy bar rose from $0.20 to $1.20. Over the same period, the consumer price index rose from 150 to 300. Adjusted for overall inflation, how much did the price of the candy bar change?
5. Explain the meaning of *nominal interest rate* and *real interest rate*. How are they related?

Quick Check Multiple Choice

1. The consumer price index measures approximately the same economic phenomenon as
   a. nominal GDP.
   b. real GDP.
   c. the GDP deflator.
   d. the unemployment rate.
2. The largest component in the basket of goods and services used to compute the CPI is
   a. food and beverages.
   b. housing.
   c. medical care.
   d. apparel.
3. If a Pennsylvania gun manufacturer raises the price of rifles it sells to the U.S. Army, its price hikes will increase
   a. both the CPI and the GDP deflator.
   b. neither the CPI nor the GDP deflator.
   c. the CPI but not the GDP deflator.
   d. the GDP deflator but not the CPI.
4. Because consumers can sometimes substitute cheaper goods for those that have risen in price,
   a. the CPI overstates inflation.
   b. the CPI understates inflation.
   c. the GDP deflator overstates inflation.
   d. the GDP deflator understates inflation.
5. If the consumer price index is 200 in year 1980 and 300 today, then $600 in 1980 has the same purchasing power as _____ today.
   a. $400
   b. $500
   c. $700
   d. $900
6. You deposit $2,000 in a savings account, and a year later you have $2,100. Meanwhile, the consumer price index rises from 200 to 204. In this case, the nominal interest rate is _____ percent, and the real interest rate is _____ percent.
   a. 1, 5
   b. 3, 5
   c. 5, 1
   d. 5, 3

Problems and Applications

1. Suppose that the year you were born someone bought $100 of goods and services for your baby shower. How much would you guess it would cost today to buy a similar amount of goods and services? Now find data on the consumer price index and compute the answer based on it. (You can find the BLS's inflation calculator here: http://www.bls.gov/data/inflation_calculator.htm.)

2. The residents of Vegopia spend all of their income on cauliflower, broccoli, and carrots. In 2013, they spend a total of $200 for 100 heads of cauliflower, $75 for 50 bunches of broccoli, and $50 for 500 carrots. In 2014, they spend a total of $225 for 75 heads of cauliflower, $120 for 80 bunches of broccoli, and $100 for 500 carrots.
   a. Calculate the price of one unit of each vegetable in each year.
   b. Using 2013 as the base year, calculate the CPI for each year.
   c. What is the inflation rate in 2014?
3. Suppose that people consume only three goods, as shown in this table:

	Tennis Balls	Golf Balls	Bottles of Gatorade
2014 price	$2	$4	$1
2014 quantity	100	100	200
2015 price	$2	$6	$2
2015 quantity	100	100	200

   a. What is the percentage change in the price of each of the three goods?
   b. Using a method similar to the consumer price index, compute the percentage change in the overall price level.
   c. If you were to learn that a bottle of Gatorade increased in size from 2014 to 2015, should that information affect your calculation of the inflation rate? If so, how?
   d. If you were to learn that Gatorade introduced new flavors in 2015, should that information affect your calculation of the inflation rate? If so, how?
4. Go to the website of the BLS (http://www.bls.gov) and find data on the consumer price index. By how much has the index including all items risen over the past year? For which categories of spending have prices risen the most? The least? Have any categories experienced price declines? Can you explain any of these facts?
5. A small nation of ten people idolizes the TV show *American Idol*. All they produce and consume are karaoke machines and CDs, in the following amounts:

	Karaoke Machines		CDs	
	Quantity	Price	Quantity	Price
2014	10	$40	30	$10
2015	12	60	50	12

   a. Using a method similar to the consumer price index, compute the percentage change in the overall price level. Use 2014 as the base year and fix the basket at 1 karaoke machine and 3 CDs.
   b. Using a method similar to the GDP deflator, compute the percentage change in the overall price level. Also use 2014 as the base year.
   c. Is the inflation rate in 2015 the same using the two methods? Explain why or why not.
6. Which of the problems in the construction of the CPI might be illustrated by each of the following situations? Explain.
   a. the invention of the cell phone
   b. the introduction of air bags in cars
   c. increased personal computer purchases in response to a decline in their price
   d. more scoops of raisins in each package of Raisin Bran
   e. greater use of fuel-efficient cars after gasoline prices increase
7. The *New York Times* cost $0.15 in 1970 and $2.00 in 2011. The average wage in manufacturing was $3.36 per hour in 1970 and $23.09 in 2011.
   a. By what percentage did the price of a newspaper rise?
   b. By what percentage did the wage rise?
   c. In each year, how many minutes did a worker have to work to earn enough to buy a newspaper?
   d. Did workers' purchasing power in terms of newspapers rise or fall?
8. The chapter explains that Social Security benefits are increased each year in proportion to the increase in the CPI, even though most economists believe that the CPI overstates actual inflation.
   a. If the elderly consume the same market basket as other people, does Social Security provide the elderly with an improvement in their standard of living each year? Explain.
   b. In fact, the elderly consume more healthcare compared to younger people, and healthcare costs have risen faster than overall inflation. What would you do to determine whether the elderly are actually better off from year to year?
9. Suppose that a borrower and a lender agree on the nominal interest rate to be paid on a loan. Then inflation turns out to be higher than they both expected.
   a. Is the real interest rate on this loan higher or lower than expected?
   b. Does the lender gain or lose from this unexpectedly high inflation? Does the borrower gain or lose?
   c. Inflation during the 1970s was much higher than most people had expected when the decade began. How did this affect homeowners who obtained fixed-rate mortgages during the 1960s? How did it affect the banks that lent the money?