



## 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 2007, the median salary earned by a player on the New York Yankees was \$4.8 million, and shortstop Alex Rodriguez was paid \$28 million. At first, this fact might lead you to think that baseball has become vastly more lucrative over the past seven 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 not calculated from this statistic. Because the consumer price index better reflects the goods and services bought by consumers, it is the more common gauge of inflation.

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.

## 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.

### HOW THE CONSUMER PRICE INDEX IS CALCULATED

When the Bureau of Labor Statistics 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 Bureau of Labor Statistics 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 3 different years.
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 3 years. Notice that only the prices in this calculation

TABLE 1

## 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 |
|------|-------------------|---------------------|
| 2008 | \$1               | \$2                 |
| 2009 | 2                 | 3                   |
| 2010 | 3                 | 4                   |

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

|      |   |
|------|---|
| 2008 | $(\$1 \text{ per hot dog} \times 4 \text{ hot dogs}) + (\$2 \text{ per hamburger} \times 2 \text{ hamburgers}) = \$8 \text{ per basket}$  |
| 2009 | $(\$2 \text{ per hot dog} \times 4 \text{ hot dogs}) + (\$3 \text{ per hamburger} \times 2 \text{ hamburgers}) = \$14 \text{ per basket}$ |
| 2010 | $(\$3 \text{ per hot dog} \times 4 \text{ hot dogs}) + (\$4 \text{ per hamburger} \times 2 \text{ hamburgers}) = \$20 \text{ per basket}$ |

## Step 4: Choose One Year as a Base Year (2008) and Compute the Consumer Price Index in Each Year

|      |                                 |
|------|---------------------------------|
| 2008 | $(\$8 / \$8) \times 100 = 100$  |
| 2009 | $(\$14 / \$8) \times 100 = 175$ |
| 2010 | $(\$20 / \$8) \times 100 = 250$ |

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

|      |                                       |
|------|---------------------------------------|
| 2009 | $(175 - 100) / 100 \times 100 = 75\%$ |
| 2010 | $(250 - 175) / 175 \times 100 = 43\%$ |

## 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.

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 effect 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 the table, 2008 is the base year. In this year, the basket of hot dogs and hamburgers costs \$8. Therefore, the price of the basket in all



years is divided by \$8 and multiplied by 100. The consumer price index is 100 in 2008. (The index is always 100 in the base year.) The consumer price index is 175 in 2009. This means that the price of the basket in 2009 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 2009. Similarly, the consumer price index is 250 in 2010, indicating that the price level in 2010 is 250 percent of the price level in the base year.

**inflation rate**

the percentage change in the price index from the preceding period

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:

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

As shown at the bottom of Table 1, the inflation rate in our example is 75 percent in 2009 and 43 percent in 2010.

Although this example simplifies the real world by including only two goods, it shows how the Bureau of Labor Statistics 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.

**producer price index**

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

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.

## 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.

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# 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.

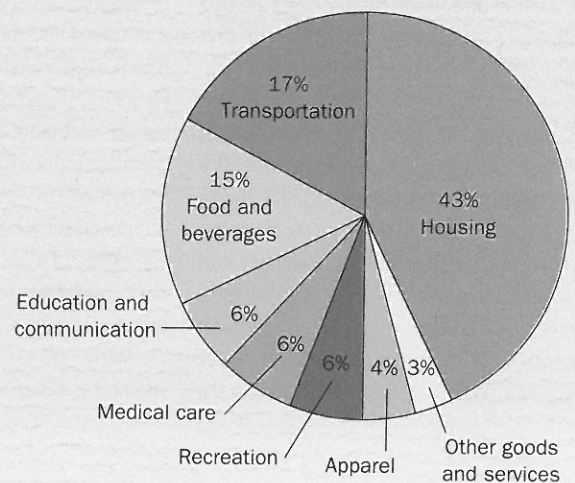
Figure 1 shows the breakdown of consumer spending into the major categories of goods and services. By far the largest category is housing, which makes up 43 percent of the typical consumer's budget. This category includes the cost of shelter (33 percent), fuel and other utilities (5 percent), and household furnishings and operation (5 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 6 percent. This last category includes, for example, college tuition and personal computers. 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 things consumers buy that do not naturally fit into the other categories, such as cigarettes, haircuts, and funeral expenses.

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.



Let's consider a simple example. Imagine that in the base year, apples are cheaper than pears, and so consumers buy more apples than pears. When the Bureau of Labor Statistics 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



## In The News

### Accounting for Quality Change

*Behind every macroeconomic statistic are thousands of individual pieces of data, as well as a few key judgment calls.*

#### An Inflation Debate Brews over Intangibles at the Mall

By Timothy Aepfel

To most people, when the price of a 27-inch television set remains \$329.99 from one month to the next, the price hasn't changed.

But not to Tim LaFleur. He's a commodity specialist for televisions at the Bureau of Labor Statistics, the government agency that assembles the Consumer Price Index. In this case, which landed on his desk last December, he decided the newer set had important improvements, including a better screen. After running the changes through a complex government computer model, he determined that the improvement in the

screen was valued at more than \$135. Factoring that in, he concluded the price of the TV had actually fallen 29%.

Mr. LaFleur was applying the principles of hedonics, an arcane statistical technique that's become a flashpoint in a debate over how the U.S. government measures inflation. Hedonics is essentially a way of accounting for the changing quality of products when calculating price movements. That's vital in the dynamic U.S. economy, marked by rapid technological advances. Without hedonics, the effect of consumers getting more for their money wouldn't get fully reflected in inflation numbers. . . .

Many critics complain the hedonic method is distorting the picture of what's

going on in the economy. They say hedonics is too subjective and fear it helps keep inflation figures artificially low. . . .

It's critically important for consumers, business, the government and the economy as a whole that the CPI is as accurate as possible. The CPI is used to benchmark how much is paid to Social Security recipients, who last year received outlays of \$487 billion. It also plays a role in adjusting lease payments, wages in union contracts, food-stamp benefits, alimony and tax brackets. . . .

Inflation watchers at the statistics bureau say critics exaggerate the significance of hedonics, noting that it's used in only seven out of 211 product categories in the CPI. In most of those, officials say, hedonics actually

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 video cassette recorders (VCRs) were introduced in the late 1970s, consumers were able to watch their favorite movies at home. Although not a perfect substitute for a first-run movie on a large screen, an old movie in the comfort of your family room was a new option that increased consumers' set of opportunities. For any given number of dollars, the introduction of the VCR made people better off; conversely, to achieve the same level of economic well-being required a smaller number of dollars. A perfect cost-of-living index would have reflected the introduction of the VCR with a decrease in the cost of living. The consumer price index, however, did not decrease in response to the introduction of the VCR. Eventually, the Bureau of Labor Statistics did revise the basket of goods to include VCRs, and subsequently, the index reflected changes



magnifies price increases rather than suppressing them. . . .

The bureau says hedonics actually helps boost the housing component of the CPI. In order to take into account the aging of housing, and presumably falling quality that goes with it, the CPI applies a form of hedonics that links the age of a housing unit to rents. If someone is paying the equivalent of \$500 a month in rent for several years, the rent has actually gone up as the unit ages and becomes less desirable, according to the government. . . .

The hub of this effort is a warren of beige-walled cubicles at the Bureau of Labor Statistics a few blocks from the Capitol. Here 40 commodity specialists hunch over reports with 85,000 price quotes that flow in from around the country every month. The numbers are gathered by 400 part-time data collectors. They visit stores and note prices on the items that make up the basket of goods in the CPI, ranging from ladies' shoes to skim milk to microwave ovens.

One of the biggest challenges in this process is finding substitutes for products that disappear from store shelves or change so much that they are hard to recognize from one month to the next. With TVs, for instance, data collectors find the models they priced the previous month missing about 19% of the time over the course of a year.

When that happens, the data gatherer goes through a four-page checklist of features such as screen size and the type of remote control to find the nearest comparable model. Once this process identifies a product that appears to be the closest match, the data gatherer notes its price. The commodity specialists back in Washington check over these choices and decide whether to accept them. . . .

Many price adjustments in the CPI are straightforward: When candy bars get smaller, but are sold for the same price, the CPI reflects that as a price increase.

Todd Reese, the commodity specialist for autos, says he doesn't need hedonics

to extrapolate the value of quality changes, because auto makers present him with a list of changes to the car and the corresponding prices. Still, Mr. Reese must make some tough calls as he does his job. For instance, he recently considered a 2005 model in which the sticker price went from \$17,890 to \$18,490. The manufacturer cited an extra cost of \$230 to make antilock brakes standard, while it said it saved \$5 by dropping the cassette portion of the CD player.

The bureau accepted both those items, so the ostensible price increase shrank by \$225. But the car maker also told Mr. Reese it wanted to subtract \$30 from the price increase for the cost of putting audio controls on the steering wheel, allowing drivers to change channels without reaching for the radio dial. "We didn't allow that claim," says Mr. Reese. "We didn't judge that to be a functional change."

Source: *The Wall Street Journal*, May 9, 2005.

in VCR prices. But the reduction in the cost of living associated with the initial introduction of the VCR 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 Bureau of Labor Statistics 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 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 Bureau of Labor Statistics 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 the measurement problems by, for instance, reducing the magnitude of the automatic benefit increases.

## 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, and 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. Although the United States does produce some oil, much of the oil we use is imported. As a result, oil and oil products such as gasoline and heating oil are 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 Bureau of Labor Statistics change the basket of goods. By contrast, the GDP deflator compares the price of *currently produced* goods and 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.

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"THE PRICE MAY SEEM A LITTLE HIGH, BUT YOU HAVE TO REMEMBER THAT'S IN TODAY'S DOLLARS."