Chapter 6

MEASURING THE PRICE LEVEL AND INFLATION

Chapter Outline

Consider the story of a Canadian university graduate named Dym Witt. In 1972, Dym graduated and took a position with the firm of Sly Foxe at a starting annual salary of $12 000 (equivalent to $54 000 in 2001 dollars). Dym was delighted to receive salary increases of 3 percent per year. Each year, Dym's income went up and up. By 1982, Dym's annual salary had increased to over $16 000, and Dym felt a strong obligation to work hard to earn that salary.

In the meantime, Sly Foxe was delighted to have hired Dym Witt. Although Dym had been hired in 1972 at the going wage for a university graduate with Dym's qualifications, by 1982 Dym had become a great bargain for Sly. The 1972–1982 period was one of high inflation, during which prices had increased by almost 150 percent. Just to have kept up with inflation, Dym would have required an annual salary of about $30 000 in 1982. Instead, as we have noted, Dym received only $16 000, leaving all the more profit for Sly Foxe.

While happy to get annual 3 percent salary increases from Sly, Dym did have a nagging sense of falling behind. And that is not surprising. Between 1972 and 1982, inflation averaged about 9.5 percent. Dym's salary had been falling by several percentage points a year relative to the prices of goods and services.

The story illustrates a simple but crucial point: the value of your income depends on the prices of the goods and services you buy. If prices go up, your income has to increase at the same rate in order for you to maintain your buying power.

An important benefit of studying macroeconomics is learning how inflation must be accounted for in comparisons of economic conditions over time. In this chapter, we will see how both prices and inflation are measured and how dollar amounts, such as the wages earned for a summer job, can be "adjusted" to eliminate the effects of inflation. Quantities that are measured in dollars and then adjusted for inflation are called real quantities (recall, for example, the concept of real GDP in Chapter 5). By working with real quantities, you can avoid the kind of confusion that beset Dym Witt.

Knowledge about calculating real quantities, such as real wages or real interest rates, is important on its own. It also constitutes necessary background for understanding the consequences that various types of inflation have for income distribution and economic growth.

6.1 THE CONSUMER PRICE INDEX: MEASURING THE PRICE LEVEL

consumer price index (CPI) for any period, measures the cost in that period of a standard basket of goods and services relative to the cost of the same basket of goods and services in a fixed year, called the *base year*

The basic tool economists use to measure the price level and inflation in the Canadian economy is the **consumer price index**, or CPI for short. The CPI for any period measures the cost in that period of a standard set, or basket, of goods and services *relative* to the cost of the same basket of goods and services in a fixed year, called the *base year*.

To illustrate how the CPI is constructed, suppose Statistics Canada has designated 1992 as the base year. (In fact, currently 1992 is the base year but it will change in the future.) Assume for the sake of simplicity that in 1992 a typical Canadian family's monthly household budget consisted of spending on just three items: rent on a two-bedroom apartment, hamburgers, and movie tickets. In reality, of course, families purchase hundreds of different items each month, but the basic principles of constructing the CPI are the same no matter how many items are included. Suppose too that the family's average monthly expenditures in 1992, the base year, were as shown in Table 6.1.

TABLE 6.1
Monthly Household Budget of the Typical Family in 1992 (Base Year)

Item	Cost (in 1992)
Rent, two-bedroom apartment	$500
Hamburgers (60 at $2.00 each)	120
Movie tickets (10 at $6.00 each)	60
Total Expenditure	$680

Now let's fast-forward to the year 2005. Over that period, the prices of various goods and services are likely to have changed; some will have risen and some fallen. Let's suppose that by the year 2005 the rent that our family pays for the two-bedroom apartment has risen to $630. Hamburgers now cost $2.50 each, and the price of movie tickets has risen to $7.00 each. So, in general, prices have been rising.

By how much did the family's cost of living increase between 1992 and 2005? Table 6.2 shows that if the typical family wanted to consume the *same basket of goods and services* in the year 2002 as in the year 1992, it would have to spend $850 per month, or $170 more than the $680 per month spent in 1992. In other words, to live the same way in the year 2005 as in the year 1992, the family would have to spend 25 percent more ($170/$680) each month. So, in this example, the cost of living for the typical family rose 25 percent between 1992 and 2005.

TABLE 6.2
Cost of Reproducing the 1992 (Base-Year) Basket of Goods and Services in Year 2005

Item	Cost (in 2005)	Cost (in 1992)
Rent, two-bedroom apartment	$630	$500
Hamburgers (60 at $2.50 each)	150	120
Movie tickets (10 at $7.00 each)	70	60
Total Expenditure	$850	$680

Statistics Canada calculates the official consumer price index (CPI) using essentially the same method. The first step in deriving the CPI is to pick a base year and determine the basket of goods and services that were consumed by the typical family during that year. Statistics Canada determines the basket using information obtained from family expenditure surveys. Let's call the basket of goods and services that results the *base-year basket*. Then, each month trained interviewers operating out of the regional offices of Statistics Canada gather tens of thousands of price quotations on over 600 goods and services. The CPI in any given year is computed using this formula:

www.statcan.ca/english/subjects/Cpi/cpi-en.htm
Statistics Canada—CPI

$$\text{CPI} = \frac{\text{Cost of base-year basket of goods and services in current year}}{\text{Cost of base-year basket of goods and services in base year}} \times 100.$$

Returning to the example of the typical family that consumes three goods, we can calculate the CPI in the year 2005 as

$$\text{CPI in year 2005} = \frac{\$850}{\$680} \times 100 = 125.$$

In other words, in this example the cost of living in the year 2005 is 25 percent higher than it was in 1992, the base year. Notice that the base-year CPI is always equal to 100. The CPI for a given period (such as a month or year) measures the cost of living in that period *relative* to what it was in the base year.

EXAMPLE 6.1

Measuring the typical family's cost of living

Suppose that in addition to the three goods and services the typical family consumed in 1992, they also bought four sweaters at $30 each. In the year 2005 the same sweaters cost $50 each. The prices of the other goods and services in 1992 and 2005 were the same as in Table 6.2. Find the change in the family's cost of living between 1992 and 2005.

In the example in the text, the cost of the base-year (1992) basket was $680. Adding four sweaters at $30 each raises the cost of the base-year basket to $800. What does this same basket (including the four sweaters) cost in 2005? The cost of the apartment, the hamburgers, and the movie tickets is $850, as before. Adding the cost of the four sweaters at $50 each raises the total cost of the basket to $1050. The CPI equals the cost of the basket in 2005 divided by the cost of the basket in 1992 (the base year) multiplied by 100, or ($1050/$800) × 100 = 131. We conclude that the family's cost of living rose 31 percent between 1992 and 2005.

EXERCISE 6.1

Returning to the three-good example in Tables 6.1 and 6.2, find the year 2005 CPI if the rent on the apartment falls from $500 in 1992 to $400 in 2005. The prices for hamburgers and movie tickets in the two years remain the same as in the two tables.

The CPI is not itself the price of a specific good or service; it is a *price index*. A **price index** measures the average price of a class of goods or services relative to the price of those same goods or services in a base year. The CPI is an especially well-known price index, one of many that economists use to assess economic trends. For example, because manufacturers tend to pass on increases in the prices of raw materials to their customers, economists use Statistics Canada's *Raw Materials Price Index* (which includes goods not produced in Canada) to forecast changes in the prices of Canadian manufactured goods. Other price indexes supplied by Statistics Canada include the *Industrial Product Price Index* (which

price index a measure of the average price of a given class of goods or services relative to the price of the same goods and services in a base year

measures the prices that producers in Canada receive as their goods leave their production facilities) and the price indexes of the national accounts. One of the price indexes of the national accounts, the *GDP deflator* we mentioned in Chapter 5, is particularly important because it measures the price level of all the goods and services making up GDP.

EXERCISE 6.2

The CPI captures the change in prices affecting average households. Suppose you were to construct a price index to measure changes in the prices facing Canadian university students over the past decade. In general, how would you go about constructing such an index? Why might changes in a price index for university student expenditures differ from changes in the CPI?

6.2 INFLATION

rate of inflation the annual percentage rate of change in the price level as measured, for example, by the CPI

The CPI provides a measure of the average *level* of prices relative to prices in the base year. *Inflation,* in contrast, is a measure of how fast the average price level is *changing* over time. The **rate of inflation** is defined as the annual percentage rate of change in the price level, typically as measured by the CPI. For example, the Canadian CPI had a value of 122 in May 2003 and a value of 125 in May 2004. The rate of inflation between May 2003 and May 2004 is the percentage increase in the price level, or 100 times the increase in the price level (3) divided by the initial price level (122), which is equal to 2.5 percent.

EXAMPLE 6.2

Calculating inflation rates: 1972–1976

The CPIs for the years 1972 through 1976 are shown below. Find the rates of inflation between 1972 and 1973, 1973 and 1974, 1974 and 1975, and 1975 and 1976.

Year	CPI
1972	26.1
1973	28.1
1974	31.1
1975	34.5
1976	37.1

The inflation rate between 1972 and 1973 is the percentage increase in the price level between those years, or

$$\frac{(28.1 - 26.1)}{26.1} = \frac{2}{26.1} = 0.077 = 7.7 \text{ percent.}$$

Do the calculations to confirm that inflation during each of the next three years was 10.7, 10.9, and 7.5 percent, respectively. During the 1970s, inflation rates were much higher than the 1 to 3 percent annual inflation rates that have prevailed in recent years.

EXERCISE 6.3

Below are CPIs for the years 1929 through 1933. Find the rates of inflation between 1929 and 1930, 1930 and 1931, 1931 and 1932, and 1932 and 1933.

Year	CPI
1929	11.0
1930	10.9
1931	9.8
1932	8.9
1933	8.5

How did inflation rates in the 1930s differ from those of the 1970s?

The results of the calculations for Exercise 6.3 include some examples of *negative* inflation rates. A situation in which the prices of most goods and services are falling over time so that inflation is negative is called **deflation.** The early 1930s was the last time Canada experienced significant deflation. Japan experienced relatively mild deflation beginning in the late 1990s.

deflation a situation in which the prices of most goods and services are falling over time so that inflation is negative

6.3 ADJUSTING FOR INFLATION

The CPI is an extremely useful tool. Not only does it allow us to measure changes in the *cost of living* (in terms of changes in the price of a fixed basket of goods and services), it can also be used to adjust economic data to eliminate the effects of inflation. In this section, we will see how the CPI can be used to convert quantities measured at current dollar values into real terms, a process called *deflating*. We will also see that the CPI can be used to convert real quantities into current-dollar terms, a procedure called *indexing*. Both procedures are useful not only to economists but to anyone who needs to adjust payments, accounting measures, or other economic quantities for the effects of inflation.

DEFLATING A NOMINAL QUANTITY WITH THE CPI

An important use of the CPI is to adjust **nominal quantities**—quantities measured at their current dollar values—for the effects of inflation. To illustrate, consider a Canadian family with a total income of $40 000 in 1992 and $44 000 in the year 2002. Did the family experience an increase in purchasing power over the ten-year period?

nominal quantity a quantity that is measured in terms of its current dollar value

Without any more information than this, we might be tempted to say yes. After all, the family's income has risen by 10 percent over the period. But prices might also have been rising, as fast or faster than the family's income. In fact, the CPI for Canada rose from 100 in 1992 to 119 for 2002. This means that prices rose by 19 percent. Since the family's income rose by only 10 percent, the family's purchasing power has declined.

We can make a more precise comparison of the family's purchasing power in 1992 and 2002 by calculating its income in those years in *real terms*. In general, a **real quantity** is one that is measured in base-year dollars, also known as *constant dollars*. To convert a nominal quantity to a real quantity, we must divide the nominal quantity by a price index for the period, as shown in Table 6.3. The calculations in the table show that in *real* or purchasing power terms, the family's income actually *decreased* by $1233, or by about 3.1 percent of the initial real income of $40 000, between 1992 and 2002.

real quantity a quantity that is measured in constant dollar terms

The problem for this family is that though its income has been rising in nominal (dollar) terms, it has not kept up with inflation. Dividing a nominal quantity by a price index to express the quantity in real terms is called **deflating** the nominal quantity. (Be careful not to confuse the idea of deflating a nominal quantity with deflation, or negative inflation. The two concepts are different.)

deflating (a nominal quantity) the process of dividing a nominal quantity by a price index (such as the CPI) to express the quantity in real terms

TABLE 6.3
Comparing the Real Values of a Family's Income in 1992 and 2002

Year	Nominal family income	CPI	Real family income = Nominal family income/CPI
1992	$40 000	100	$40 000
2002	$44 000	119	$100 \times \left(\frac{\$44\,000}{119}\right) = \$36\,975$

Dividing a nominal quantity by the current value of a price index to measure it in real or purchasing power terms is a very useful tool. It can be used to eliminate the effects of inflation from comparisons of any nominal quantity—workers' wages, healthcare expenditures, components of federal or provincial budgets—over time. Why does this method work? In general, if you know both how many dollars you have spent on a given item and the item's price, you can figure out how many of the items you bought (by dividing your expenditures by the price). For example, if you spent $100 on hamburgers last month and hamburgers cost $2.50 each, you can determine that you purchased 40 hamburgers. Similarly, if you divide a family's dollar income or expenditures by a price index, which is a measure of the average price of its purchased goods and services, you will obtain a measure of the real quantity of purchased goods and services. Such real quantities are sometimes referred to as *inflation-adjusted* quantities.

EXAMPLE 6.3

Which slugger earned more: Ruth in 1930 or McGwire in 1998?

In 1930, the U.S. baseball player Babe Ruth earned a salary of U.S.$80 000. When it was pointed out to him that he had earned more than U.S. President Hoover, Ruth replied, with some justification, "I had a better year than he did." In 1998, St. Louis Cardinals slugger Mark McGwire earned approximately U.S.$8.3 million in the process of breaking both Ruth's and Roger Maris's single-season home run records. Adjusting for inflation, who earned more, Ruth or McGwire?

To answer this question, we need to know that the U.S. CPI was 16.7 in 1930 and 164 in 1998. Dividing Ruth's salary by 16.7 and multiplying by 100, we obtain approximately $479 000, which is Ruth's salary in constant U.S. dollars. Deflating Mark McGwire's 1998 salary using the 1998 CPI yields a salary of $5.06 million in constant dollars.

The technique of deflation by the CPI has allowed us to compare the salaries of power hitters from two different eras. Although adjusting for inflation brings the two salaries closer together (since part of McGwire's higher salary results from the increase in prices between 1930 and 1998), in real terms McGwire still earned more than 10 times Ruth's salary.

real wage the wage paid to workers measured in terms of real purchasing power

Clearly, in comparing wages or earnings at two different points in time, we must adjust for changes in the price level. Doing so yields the **real wage**—the wage measured in terms of real purchasing power. The real wage for any given period is calculated by dividing the nominal (dollar) wage by the CPI for that period.

EXAMPLE 6.4

Real wages of Canadian hourly paid employees

Hourly paid employees (as distinguished from salaried employees) constituted about half of all Canadian employees in 2003. Statistics Canada reports that the average hourly paid employee earned $14.15 per hour in 1992 and $16.75 per hour in 2003. Determine what happened to the real wages of these employees between these two years.

To find the real wage in 1992 and 2003, we need to know that the CPI was 100 in 1992, the base year, and 122.3 in 2003. In the base year of 1992 the nominal wages equalled $14.15 times 100 and, by definition, the real wage was also $14.15. Deflating the 2003 nominal wage of $16.75 by the 2003 CPI, we find that the real wage in 2003 was only $13.70. In real or purchasing power terms, we find that the real hourly wages of paid employees fell between 1992 and 2003 even though the nominal or dollar wage increased by about 18 percent.

Figure 6.1 shows nominal wages and real wages for Canadian hourly paid employees for the period 1983–2003. Notice the dramatic difference between the two trends. Looking only at nominal wages, one might conclude that hourly paid employees were much better paid in 2003 than in 1985. But once wages are adjusted for inflation, we see that in terms of buying power the wages of hourly paid employees have stagnated at least since 1983. This example illustrates the crucial importance of adjusting for inflation when comparing dollar values over time.

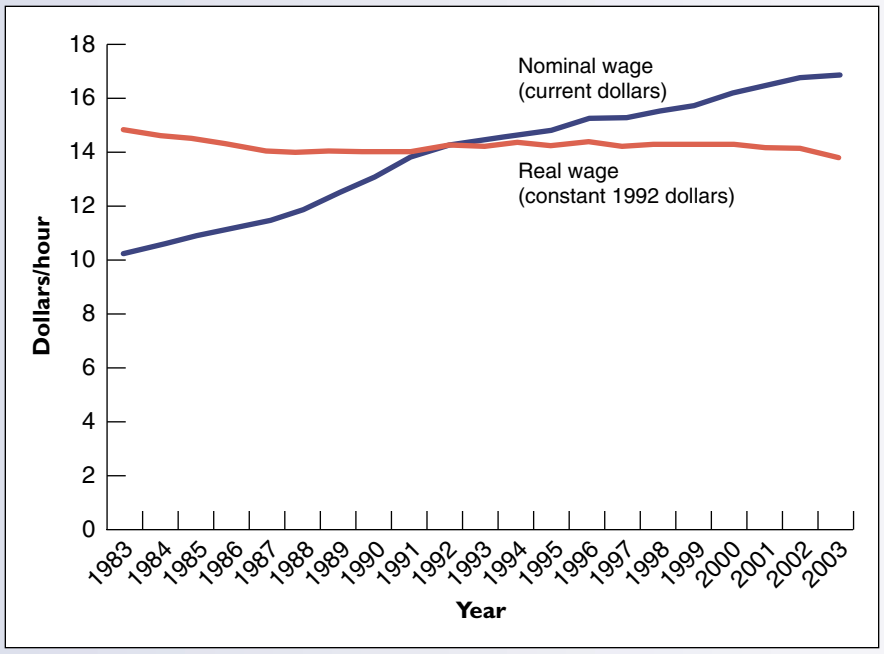


FIGURE 6.1
Nominal and Real Wages of Hourly-Paid Employees in Canada, 1983–2003
Although nominal wages of hourly-paid employees have risen in Canada over the past two decades, real wages have stagnated.
SOURCE: Adapted from the Statistics Canada CANSIM database http://cansim2.statcan.ca, series v256149, v1809109, and v737344.

EXERCISE 6.4

In 1995, when the Conservatives came to power in Ontario under Mike Harris, the Ontario minimum wage was $6.85. In 2003, when the Conservatives were voted out of office, the minimum wage was still $6.85, though it had been raised two or more times during the 1995–2003 period in all other provinces, and was raised to $7.15 by the new Ontario Liberal government effective February 2004. The Ontario CPI was 104.3 in 1995 and 123.3 in 2003. In real terms, by how much did the Ontario minimum wage decline between 1995 and 2003? In your view, is this decline the result of inflation or the result of provincial government policy?

DEFLATING BY THE CPI VERSUS DEFLATING BY THE GDP DEFLATOR

The CPI is commonly used to deflate nominal wages and incomes. But the CPI is not the only general price index. In particular, the GDP deflator is a price index for all the goods and services making up GDP, and it can be used to do more than

just deflate GDP. For example, while the nominal wage deflated by CPI gives a good measure of the real wage from the standpoint of workers, some economists think that the nominal wage divided by the GDP deflator provides a better measure of the real wage from the standpoint of employers.

Why would it make any difference whether one uses the CPI or the GDP deflator? First, the two can differ because the CPI includes import prices, whereas import prices are excluded from the GDP deflator (since imports are subtracted from exports in calculating GDP). Second, the CPI includes only the prices of consumer goods and services, while the GDP deflator also includes the prices of producer and intermediate goods. The third major difference is that the CPI compares the price of a fixed basket of goods and services today with the price of the same basket in the base year, whereas the composition of the goods and services used to compute the GDP deflator changes regularly.

INDEXING TO MAINTAIN BUYING POWER

The consumer price index can also be used to convert real quantities to nominal quantities. Suppose, for example, that in the year 1997 a married couple with children are divorced and they reach a settlement whereby the husband agrees to pay the wife spousal support of $1000 per month (in addition to child support payments) for three years. Suppose too that the agreement specifies that the spousal support payments should increase to prevent inflation from eroding their purchasing power.

The nominal or dollar amount the husband should pay the wife in the year 2003 to maintain the purchasing power of the spousal support payments depends on how much prices rose between 1997 and 2003. The CPI rose from 107.6 in 1997 to 122.3 in 2003, or by about 13.7 percent. For the spousal support payments to "keep up with inflation," they would be $1137 per month in 2003. In general, to keep purchasing power constant, the dollar benefit must be increased each year by the percentage increase in the CPI.

indexing the practice of increasing a nominal quantity each period by an amount equal to the percentage increase in a specified price index; indexing prevents the purchasing power of the nominal quantity from being eroded by inflation

The practice of increasing a nominal quantity according to changes in a price index is called **indexing**. As we will see later in this chapter, indexing is used to some degree in Canada, particularly by the public sector.

RECAP **METHODS TO ADJUST FOR INFLATION**

Deflating. To correct a nominal quantity, such as a family's dollar income, for changes in the price level, divide it by a price index such as the CPI. This process, called *deflating* the nominal quantity, expresses the nominal quantity in terms of real purchasing power. If nominal quantities from two different years are deflated by a price index with the same base year, the purchasing power of the two deflated quantities can be compared.

Indexing. To ensure that a nominal payment, such as a social insurance benefit, represents a constant level of real purchasing power, increase the nominal quantity each year by a percentage equal to the rate of inflation for that year (a procedure known as *indexing*).

6.4 NOMINAL VERSUS REAL INTEREST RATES

We have seen how to adjust nominal family income for inflation to get real family income and how to adjust nominal wages or salaries to get real wages or salaries. Our next task is to explain how to adjust nominal interest rates to get real inter-

est rates. We will also introduce the hypothesis, known as the *Fisher effect*, that high inflation rates will tend to produce high nominal interest rates.

The **nominal interest rate** is the type of interest rate you are apt to see reported in the financial pages of a newspaper or posted on a sign in your bank branch. It can be thought of as the price paid per dollar borrowed per year. If you borrow $1000 now and in a year's time you repay the principal of $1000 plus interest of $100, then your nominal interest rate is 10 percent (the interest payment divided by the principal, all multiplied by 100 for expression as a percentage). Looked at from the standpoint of a lender, the nominal interest rate is the annual percentage increase in the nominal, or current dollar, value of an asset. The **real interest rate**, like the real wage rate, is something we calculate given the inflation rate and the relevant nominal rate.

nominal interest rate the type of interest rate you usually encounter in everyday life—the price paid per dollar borrowed per year

real interest rate the nominal interest rate minus the inflation rate

More precisely, we can calculate the real interest rate for any financial asset, from a savings account to a government bond, by subtracting the rate of inflation from the market or nominal interest rate on that asset.[1] So if the nominal interest rate on short-term government bonds equals 6 percent and the inflation rate equals 3 percent, then the real interest rate on short-term government bonds is 3 percent. Or if the nominal interest rate on outstanding credit card debt (an asset from the perspective of the lender) is 17 percent and the inflation rate equals 3 percent, then the real rate of interest for credit-card borrowing is 14 percent.

We can write this definition of the real interest rate in mathematical terms:

$$r = i - \pi$$

where r = the real interest rate
i = the nominal, or market, interest rate
π = the inflation rate.

Real interest rates in recent decades **EXAMPLE 6.5**

Following are interest rates on short-term Canadian federal government bonds for selected years in the 1970s, 1980s, and 1990s. Ignoring the impact of taxation, in which of these years did the financial investors who bought government bonds get the best deal? The worst deal?

Year	Nominal interest rate (%)	Inflation rate (%)	Real interest rate (%)
1970	6.0	3.4	2.6
1975	7.4	10.9	−3.6
1980	12.7	10.1	2.6
1981	17.8	12.4	5.4
1987	8.2	4.4	3.8
1990	12.8	4.8	8.0
1995	7.1	2.2	4.9
2000	5.4	2.7	2.7
2003	2.9	2.8	0.1

Financial investors and lenders do best when the real (not the nominal) interest rate is high, since the real interest rate measures the increase in their purchasing

[1]An alternative way of calculating the real interest rate takes into account not just the change in the purchasing power of the loan, but also the change in the purchasing power of the interest payments.

power. We can calculate the real interest rate for each year by subtracting the inflation rate from the nominal interest rate. The results, as shown in the column above headed "Real interest rate (%)," are 2.6 percent for 1970, −3.6 percent for 1975, 2.6 percent for 1980, 5.4 percent for 1981, 3.8 percent for 1987, 8.0 percent for 1990, 4.9 percent for 1995, 2.7 percent for 2000, and 0.1 percent for 2003.

For purchasers of government bonds, then, the best of these years was 1990, when they enjoyed a real return of 8.0 percent, a higher real return than associated with the whopping 17.8 percent nominal interest rate of 1981. The worst year was 1975, when their real return was actually negative. In other words, despite receiving 7.4 percent nominal interest, financial investors ended up losing buying power in 1975, as the inflation rate exceeded the interest rate on their investments.

Figure 6.2 shows the real interest rate in Canada since 1962 as measured by the nominal interest rate paid on the federal government's short-term bonds minus the inflation rate. Note that real interest rates were negative for several years in the 1970s but were high during the 1980s and reached a peak in 1990. They declined after the early 1990s, but still tended to be somewhat higher than during the 1960s. Over the period shown the inflation rate was always positive so the nominal rate always exceeded the real rate. In 1994, when the inflation rate fell to nearly zero, the nominal and real interest rates were nearly the same. If the inflation rate had actually dropped below zero (that is, if there had been deflation), then the real interest rate would have exceeded the nominal rate.

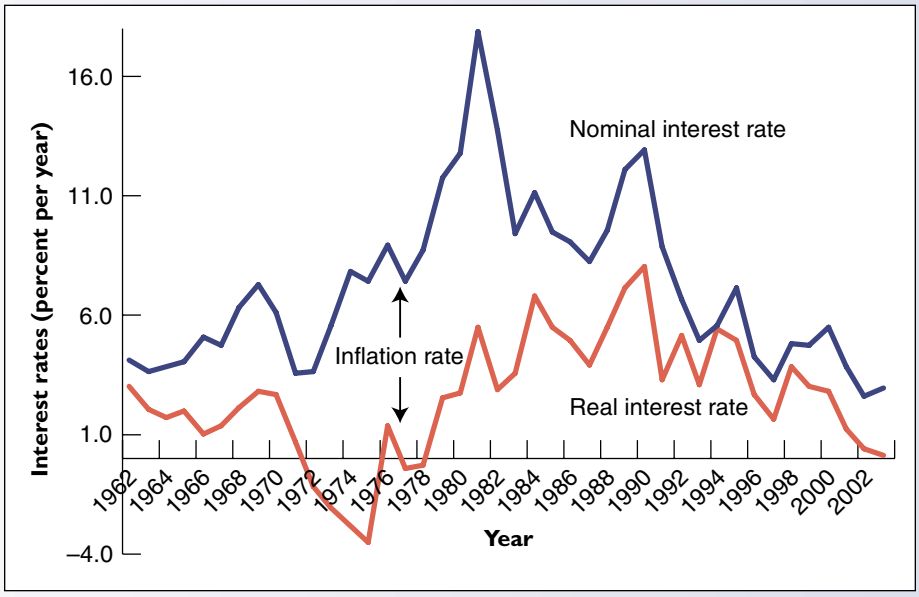


FIGURE 6.2
Real and Nominal Interest Rates in Canada, 1962–2003
The real interest rate (shown by the red line) is the nominal interest rate (blue line) minus the rate of CPI inflation. Real interest rates rose sharply during the 1980s, especially at the end of the decade. They declined after the early 1990s but until the slowdown of 2001, they still tended to be somewhat higher than during the 1960s.
SOURCE: Adapted from the Statistics Canada CANSIM database http://cansim2.statcan.ca, series v122531 and v737344.

EXERCISE 6.5

The discussion above deals with real and nominal returns before taxation. But suppose that a financial investor pays a 40 percent rate of income tax on nominal interest earnings (and has no access to tax breaks like the Registered Retirement Savings Program). Then if the nominal interest rate is, say, 6 percent, the after-tax nominal interest rate will be 3.6 per-

cent. The after-tax real interest rate will equal the after-tax nominal interest rate minus the inflation rate. If, for example, the inflation rate happens to equal the after-tax nominal interest rate, then the after-tax real interest rate will be zero.

Given these assumptions and definitions, examine the after-tax real returns in 1980 and 2000 using the interest rate and inflation rate data given in Example 6.5. The before-tax real returns, 2.6 percent in 1980 and 2.8 percent in 2000, are fairly similar. How do the after-tax real returns compare?

ANTICIPATED INFLATION AND THE FISHER EFFECT

Economists generally assume that people are forward-looking. People take actions not just in response to past events but in the expectation of future events. To give a simple illustration, Canadian shopping malls regularly enjoy an upsurge in business during November and December due to Christmas shopping. The action of shopping during November and December comes before the event of Christmas on December 25.

People also take actions based upon expectations about uncertain economic outcomes, such as investors buying a company's shares in the hope the shares will go up in value. If expectations turn out to be correct, economists say that the outcome was *anticipated*. If the expectations prove wrong, outcomes are *unanticipated*.

So if the inflation rate for a given period fits with general expectations people had for it in the previous period, economists say that there has been **anticipated inflation**. If the inflation rate proves to be considerably higher or lower than generally expected, there has been **unanticipated inflation**.[2]

anticipated inflation when the rate of inflation turns out to be roughly what most people had expected

unanticipated inflation when the rate of inflation turns out to be substantially different from what most people had expected

With the concepts of anticipated and unanticipated inflation, we can explain why nominal interest rates tend to be high when inflation rates are high and low when inflation rates are low.

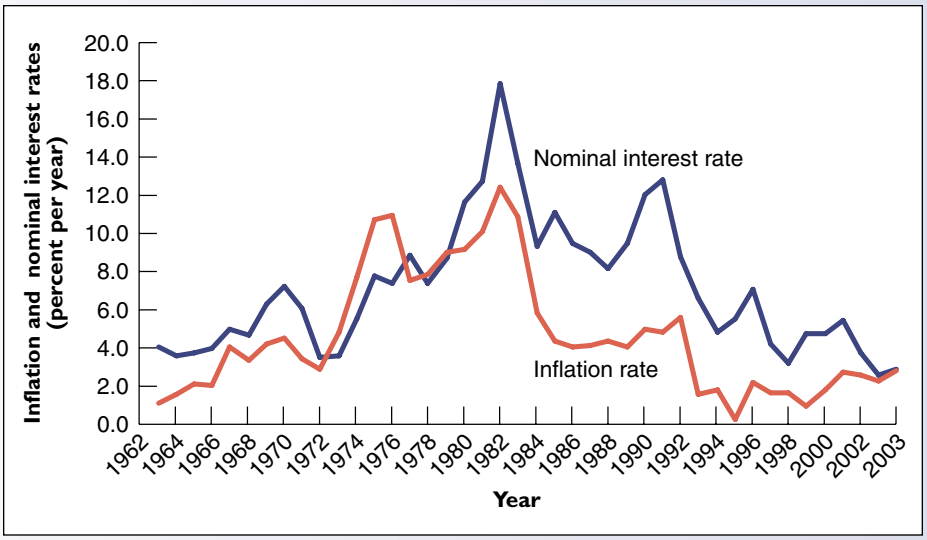
Suppose inflation has recently been high, so borrowers and lenders anticipate that it will be high in the near future. We would expect lenders to raise their nominal interest rate so that their real rate of return will be unaffected. For their part, borrowers are willing to pay higher nominal interest rates when inflation is high, because they understand that the higher nominal interest rate only serves to compensate the lender for the loan being repaid in dollars of reduced real value—in real terms, their cost of borrowing is unaffected by an equal increase in the nominal interest rate and the inflation rate. Conversely, when inflation is low, lenders do not need to charge as high a nominal interest rate to ensure a given real return. Thus, nominal interest rates will be high when anticipated inflation is high and low when anticipated inflation is low. This tendency for nominal interest rates to follow inflation rates is called the **Fisher effect**, after the early twentieth-century American economist Irving Fisher, who first pointed out the relationship.

Fisher effect the tendency for nominal interest rates to be high when inflation is high and low when inflation is low

Some evidence for the Fisher effect is shown in Figure 6.3. Nominal interest rates were much lower in the low-inflation 1960s than in the high-inflation 1973–1982 period. Nominal interest rates were also lower in the low-inflation years of 1992–2003 than they were in the moderate-inflation years of 1983–1991. But the relationship between nominal interest rates and the inflation rate is not exact.

[2]Some economists use these terms differently. They define anticipated inflation as that part of any actual inflation rate that people anticipated and they define unanticipated inflation as the difference between the actual inflation rate that occurs and the inflation rate people had anticipated.

FIGURE 6.3
Inflation and Nominal Interest Rates in Canada, 1962–2003
The tendency for nominal interest rates to be high when the inflation rate is high and low when inflation is low is called the Fisher effect. Some evidence for the Fisher effect is shown in Figure 6.3. For example, nominal interest rates were much lower in the low-inflation 1960s than in the high-inflation 1973–1982 period.
SOURCE: Adapted from Statistics Canada, CANSIM II series v122531 (3 month Government of Canada treasury bills) and v737344 (CPI).



6.1 ECONOMIC NATURALIST

Bad month to take out a mortgage

Why was September 1981 an incredibly bad month to take out a five-year mortgage? The answer might seem obvious from the average interest rate for five-year mortgages signed in Canada that month—an astounding 21.5 percent. That's about three times as high as the average five-year mortgage rate during 2001, for example.

But the 21.5 percent rate is a nominal one, and nominal rates tend to be high when inflation rates are high. In late August 1981, Statistics Canada had announced that inflation between July 1980 and July 1981 had been 12.9 percent. So a borrower taking out a mortgage in September 1981 would typically be doing so with the idea that inflation was running at an annual rate of about 12.9 percent. Subtracting 12.9 percent inflation from a 21.5 percent nominal rate yields a real interest rate of 8.4 percent.

It is true that a real interest rate of 8.4 percent on a five-year mortgage is no bargain by historical standards. The average rate over the 1981–2001 period was about 6.9 percent. But real mortgage interest rates have been higher—for example, they hovered around 10 percent for most of 1994.

So why was September 1981 such a bad month to take out a five-year mortgage? Inflation rates dropped to about 4 percent within two years and stayed at about 4 percent through to September 1986. Those who borrowed at 21.5 percent interest knew that their nominal mortgage payments would be high but they expected that their nominal incomes would be growing in line with inflation of about 12.9 percent. Instead, inflation rates declined and so did nominal income growth rates. While a 21.5 percent nominal rate corresponded to an 8.4 percent real interest rate in September 1981, for over half of the mortgage period (when inflation averaged 4 percent) it corresponded to a crippling 17.5 percent real rate.

In short, September 1981 was an incredibly bad month to take out a mortgage because borrowers failed to anticipate the sharp *disinflation* (fall in the inflation rate) that followed.

6.5 CONTROVERSY OVER THE "TRUE" INFLATION RATE

You may have concluded that measuring inflation is straightforward, but as with GDP and the unemployment rate, the issue is not free from controversy. Indeed, the question of whether inflation is properly measured has been the subject of serious debates in recent years, both in Canada and in the United States.

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In Canada, the question of inflation measurement has been especially important in the context of the central bank's pursuit of inflation targets. The Bank of Canada has a stated target rate of inflation of 2 percent. Bank of Canada economists have argued that the maximum amount by which the measured inflation rate for Canada could exceed the "true" rate is 0.5 percentage points, and therefore that the CPI is a highly accurate measure of true inflation. But suppose that the measured inflation rate overstated the "true" inflation rate by, say, 1.5 percentage points, as other economists have argued. Then a case might be made for allowing the measured inflation rate to persistently exceed 2 percent as long as the "true" inflation rate did not do so.

Although the central bank of the United States, the Federal Reserve, does not have an explicit inflation rate target, the question of inflation measurement has also been fiercely debated south of the border. The debate has been primarily about the Bureau of Labor Statistics changing how it measures the U.S. CPI. Changes in the CPI have major implications for the living standards of senior citizens and unionized workers, among others, because of the use of the CPI for indexing. If the CPI rises by, say, 3 percent during a given year, by law Social Security benefits (similar to Canada Pension Plan benefits in Canada) increase automatically by 3 percent. Many collective bargaining agreements are indexed to the CPI as well.

When the 1996 Boskin Commission Report concluded that inflation rates as measured by the U.S. CPI overstated the "true" inflation rate by as much as one or two percentage points a year, a major controversy ensued. The report recommended changes to CPI measurement (some of which have since been implemented) that would take billions of dollars away from senior citizens and unionized workers, who would then get smaller increases in their indexed incomes.

The report's claim that the U.S. CPI overstated "true" inflation had implications not just for income distribution but also for measured economic growth. For example, changes to the CPI that reduce the measured rate of inflation automatically result in higher estimates of growth in real income. If the average family's nominal income increases by 4 percent per year, and inflation is reported to be 3 percent per year, economists would conclude that families are experiencing a 1 percent annual rate of growth in real income. But if the inflation rate is measured as 2 percent per year because of changes in the way that the CPI is calculated, then the family's real income will be calculated as rising by 2 percent per year (the 4 percent increase in nominal income minus 2 percent inflation) instead of 1 percent. With a 1 percent growth rate, the family's calculated real income would take 70 years to double, but with a 2 percent growth rate it would double in 35 years, half the time!

These debates in Canada and the United States demonstrate the importance of inflation measurement, but why do some economists argue that inflation as measured by change in the CPI overstates the "true" inflation rate? One argument is that government statisticians do not adequately adjust the CPI for changes in the quality of goods and services. Suppose a new personal computer has 20 percent more memory, processor speed, and data storage capacity than last year's model. Suppose too that its price is 20 percent higher. Have computer prices become inflated? Some economists would say no; although consumers are paying 20 percent more for a computer, they are getting a 20 percent better machine. The situation, they say, is really no different than paying 20 percent more for a pizza that is 20 percent bigger. The term *quality adjustment bias* is used to describe the increase in the CPI that is due to the reluctance of government statisticians to make quality adjustments as large as some economists think appropriate.

The government statisticians, however, have long made adjustments for quality changes and there are reasons for a cautious approach to larger adjustments. With computers, for example, increases of 20 percent in processor speed and

storage capacity may have little or no benefit for typical users. Adjusting for quality is a complex business, and it is just as possible to adjust too much as to adjust too little. Moreover, for the sake of maintaining comparability of statistics across countries, it is important that statistical agencies in different countries follow common procedures for quality adjustment. If one country, such as the United States, starts making much larger adjustments than other countries for the same quality improvements, then the relative growth performance of the United States would appear to improve. But the appearance would be an illusion created by the lack of common procedures for quality adjustment.

A second major argument employed by economists who claim that official measures of inflation overstate the "true" inflation rate arises from the fact that the CPI is calculated for a fixed basket of goods and services. This procedure does not allow for the possibility that consumers can switch from products whose prices are rising to those whose prices are stable or falling. Ignoring the fact that consumers can switch from more expensive to less expensive goods, these economists say, leads statisticians to overestimate the true increase in the cost to consumers of achieving a given level of utility or consumer satisfaction. The term for this alleged type of overstatement of inflation is *substitution bias*.

Suppose, such economists have argued, that people like coffee and tea equally well and in the base year consumed equal amounts of each. Then a frost hits a major coffee-producing nation, causing the price of coffee to double. The increase in coffee prices encourages consumers to forego coffee and drink tea instead, a switch that hardly makes them worse off since they like coffee and tea equally well. But the CPI, which measures the cost of buying the base-year basket of goods and services, will rise when the price of coffee doubles. This rise in the CPI, which ignores the fact that people can substitute tea for coffee without being made significantly worse off in terms of their utility levels, is said to exaggerate the true increase in the cost of living.

Again, the defenders of existing practice have counter-arguments. For example, government statisticians typically argue that, despite what some economists assume, the CPI is not intended as an index that measures changes over time in the amount that consumers need to spend to reach a certain utility level. The CPI is intended as a price index that allows us to measure change over time in the amount of money income required to purchase a fixed basket of goods. Obviously, the basket of goods will have to be updated from time to time in order to be relevant—the 1996 basket, for example, included airfares but commercial airline services did not even exist when the CPI basket for 1914 was assembled. But to criticize the CPI for failing to take into account all the factors that produce changes in the utility levels of consumers is to criticize it for failing to achieve an objective it was never intended to achieve.

Furthermore, defenders of the existing CPI argue, it is not possible to calculate a price index for any large group of people (such as the Canadian population) that would show changes in the cost of achieving a given level of utility or consumer satisfaction. Calculating such an index may sound like a straightforward task if we assume, as in the coffee–tea example above, that all individuals have identical, known tastes (they "like coffee and tea equally well.") This is like calculating an index of the cost of achieving a given level of utility for one individual when we have complete information about that individual's given tastes. Statistics Canada acknowledges that we could compute such an index. But to "do this for a large number of people, let alone the total population of Canada, is impossible."[3] We each have different tastes, our tastes are extremely complex, and they may change from time to time.

[3]Statistics Canada, *Your Guide to the Consumer Price Index*, 1996, Catalogue no. 62-557-XIB, http://www.statcan.ca/english/freepub/62-557-XIB/english.pdf, p. 3.

6.2 ECONOMIC NATURALIST

Why has the growth of information technology (IT) investment been so much higher in the United States than in Germany?

The United States and Germany are both high income, high productivity economies. But from 1992 to 1999, real private sector expenditure on IT hardware and equipment (roughly speaking, computers) rose by around 40 percent per year in the United States (according to official U.S. statistics) compared to only 6 percent per year in Germany (according to official German statistics). International investors and other observers generally took these statistics at face value.

Then the August 2000 monthly report of the Deutsche Bundesbank, the central bank of Germany, called attention to a little-noticed fact—differences in real expenditure on IT hardware and equipment between the United States and Germany are greatly overstated because the two countries have come to follow sharply different procedures for measuring quality improvement in IT technology. The Bundesbank showed that if U.S. quality-adjustment procedures were applied to German data, the rate of increase of computer prices was much lower and so real expenditure on IT investment in Germany rose at an annual rate of 26.5 percent per year from 1992 to 1999, far higher than the 6 percent per year shown by official German statistics.

EXERCISE 6.6

Robert Gordon, a leading U.S. economist who served on the Boskin Commission, has made the following observation about improvements in the quality of personal computers:

> **In performing the two activities that were revolutionized by the personal computer, namely word processing and spreadsheets, I cannot type or think any faster than I did with my first 1983 personal computer that contained one-fiftieth of the memory and operated at one-thirtieth of the speed of my present model. The capital stock [i.e., the constant dollar value of the computer] with which I work has increased by a factor of at least fifteen, according to … the U.S. [price indexes], yet my productivity has hardly budged…"[4]**

Does Gordon think that the official U.S. statistics under-adjust or over-adjust for quality improvements in personal computers?

6.6 TYPES OF PRICE CHANGES

Economists have developed precise terminology for describing different types of price changes. This terminology is essential for understanding analysis of the consequences of inflation.

THE PRICE LEVEL, RELATIVE PRICES, AND INFLATION

Economists distinguish carefully between the *price level* and the *relative price* of a good or service. The **price level** is a measure of the overall level of prices at a particular point in time as measured by a price index such as the CPI. Recall that the inflation rate is the percentage change in the price level from year to year. In contrast, a **relative price** is the price of a specific good or service *in comparison to* the prices of other goods and services. In Chapter 3 when we looked at price determination in specific markets using supply and demand diagrams, we were dealing with relative price determination. The diagrams were drawn under the assumption that all else was equal, including the general price level.

price level the overall level of prices at a point in time as measured by a price index such as the CPI

relative price the price of a specific good or service *in comparison* to the prices of other goods and services

[4]Robert Gordon, "Has the New Economy Finally Revived Productivity Growth?," CSLS-Industry Canada Conference on Canada in the 21st Century, Ottawa, September 1999, http://www.csls.ca/events/sept1999/gord.pdf, p. 13.

How do we measure a relative price change when the price level also changes? For example, if the price of gasoline were to rise by 10 percent while the prices of other goods and services were rising on average by 3 percent, the relative price of gasoline would increase. But if gasoline prices rose by 3 percent while other prices rose by 10 percent, the relative price of gasoline would decrease. That is, gasoline would become cheaper relative to other goods and services, even though it would not become cheaper in absolute terms.

Why is the distinction between relative price changes and changes in the price level important? To illustrate, suppose that the price of gas at the pump increases by 20 percent because of a new tax to reduce carbon emissions from gasoline consumption, but the overall price level is unaffected. Some people might demand that the government do something about "this inflation." But while the increase in gas prices hits the wallets of gasoline consumers, is it an example of inflation? In this example, the overall price level is unaffected so inflation is not an issue. What upsets some gasoline consumers is the change in the relative price of gasoline, particularly compared to the price of labour (wages). By increasing the cost of using gasoline, the increase in the relative price of gasoline makes driving a car more expensive.

In general, changes in relative prices are not the same as a rise in the overall price level. Increases in the prices of some goods could well be counterbalanced by decreases in the prices of other goods, in which case the price level and the inflation rate would be largely unaffected. Conversely, in theory inflation can exist without changes in relative prices. Imagine, for example, that all prices in the economy, including wages and salaries, go up exactly 5 percent each year. The inflation rate is 5 percent, but relative prices are not changing. Indeed, because wages (the price of labour) and other sources of income are increasing by 5 percent per year, people's ability to buy goods and services is unaffected by the inflation.

One reason to distinguish between increases in the average price level (inflation) and increases in the relative prices of specific goods is that the appropriate responses to the two issues may be quite different. To counteract high inflation in an economy that is expanding too rapidly, it may be appropriate (as we will see) for the government to make changes in macroeconomic policies, such as monetary or fiscal policies but it would not be appropriate for the government to make changes in its macroeconomic policies in response to an increase in gasoline prices caused by the imposition of a carbon tax.

EXAMPLE 6.6

How to calculate changes in relative prices

Suppose the value of the CPI is 120 in the year 2010, 132 in 2011, and 140 in 2012. Assume also that the price of oil increases 8 percent between 2010 and 2011 and another 8 percent between 2011 and 2012. What is happening to the price level, the inflation rate, and the relative price of oil?

The price level can be measured by the CPI. Since the CPI is higher in 2011 than in 2010 and higher still in 2012 than in 2011, the price level is rising throughout the period. The inflation rate is the percentage increase in the CPI. Since the CPI increases by 10 percent between 2010 and 2011, the inflation rate between those years is 10 percent. However, the CPI increases only about 6 percent between 2011 and 2012 ($140 \div 132 = 1.06$), so the inflation rate decreases to about 6 percent between those years. The decline in the inflation rate implies that although the price level is still rising, it is doing so at a slower pace than the year before.

The price of oil rises 8 percent between 2010 and 2011. But because the general inflation over that period is 10 percent, the relative price of oil—that is, its price relative to all other goods and services—falls by about 2 percent (8 percent − 10 percent = −2 percent). Between 2011 and 2012 the price of oil rises by another 8 percent, while the general inflation rate is about 6 percent. Hence the relative price of oil rises between 2011 and 2012 by about 2 percent (8 percent − 6 percent).

TERMINOLOGY USED TO DESCRIBE OVERALL PRICE CHANGE

The CPI measures the level of overall prices and the inflation rate is typically calculated by the percentage change in the CPI. But the price level and the inflation rate are not the only terms economists use to describe overall price change in the economy. In debates about monetary policy, for example, additional specialized terms are employed.

Figure 6.4 uses hypothetical data to show how change in the CPI is related to the CPI inflation rate and to several specialized terms for describing overall price changes. (Recall that Figure 6.2 showed, among other things, how change in the actual CPI from 1992 to 2002 was related to change in the actual CPI inflation rate.) The blue line shows the value of the CPI in periods from 0 to 12. You can think of the periods as corresponding to calendar years. The red line shows the inflation rate. For any period, it is calculated as

$$100 \times \frac{(\text{CPI current period} - \text{CPI previous period})}{\text{CPI previous period}}.$$

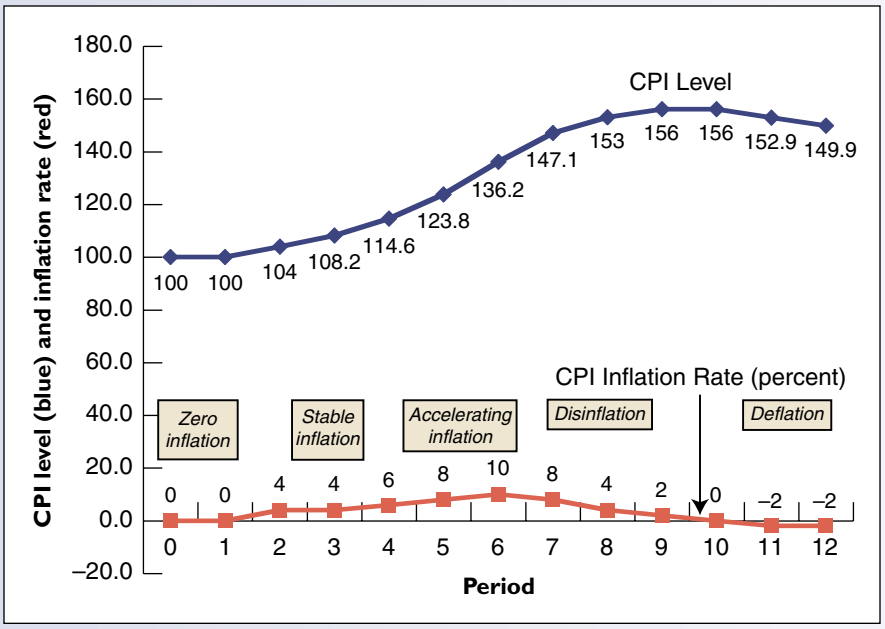


FIGURE 6.4
The Terminology of Price Change Illustrated
The CPI is shown by the blue line. The CPI inflation rate, shown by the red line, is the percentage change in the CPI.

When the CPI stays the same from one period to the next, we have *zero inflation*.

When the CPI rises but at a constant rate, we have *stable inflation*.

When the CPI rises at a rate that increases from one period to the next, we have *accelerating inflation*.

When the CPI rises, but at a rate that decreases from one period to the next, we have *disinflation*.

And when the CPI falls from one period to the next, we have *deflation*.

The yellow boxes show the specialized terminology used to describe overall price changes in the periods associated with the boxes.

In periods 0 and 1, the CPI is 100. Because the CPI undergoes no change between periods 0 and 1, we calculate an inflation rate of 0 percent for period 1. Economists use the term **zero inflation** to describe a situation like this when the CPI does not change from one period to the next. (Note that we have arbitrarily assumed a value of 0 for the inflation rate in period 0.) In Canadian history, zero inflation prevailed during the period 1926–1930 when the CPI held quite stable at a level of about 10.9 and the inflation rate fluctuated around 0 (see Figure 4.4 for data on the Canadian inflation rate for the period 1915–2003).

zero inflation when the price level stays roughly constant from one year to the next

The CPI rises to 104 and 108.2 in periods 2 and 3 respectively. The inflation rate is the same 4 percent in each period. When the CPI rises at a constant rate, we have **stable inflation** or, more precisely, stable positive inflation. Even if the CPI rises by a roughly constant rate (say, 4 percent followed by 5 percent followed by 4 percent), economists tend to say there is stable inflation. For example, the period from 1992 to 2000 when the annual inflation rate averaged less than 2 percent was one of stable inflation.

stable inflation when the inflation rate stays roughly constant from one year to the next

From period 3 to period 6, the CPI rises from 108.2 all the way to 136.2. Each period-to-period increase is proportionately larger than the one before it. The inflation rate goes up from 4 percent to 6 percent to 8 percent to 10 percent. When the CPI rises at a rate that increases from one period to the next—in other words, when the inflation rate is rising—we have **accelerating inflation**. Canada experienced accelerating inflation during the period 1971–1975 (when the inflation rate rose from about 3 percent to about 11 percent) and again during the period 1976–1981. Accelerating inflation is often unanticipated.

accelerating inflation when the inflation rate rises from one year to the next

From periods 6 to 10 the CPI increases from 136.2 to 156. But it increases at a decreasing rate. The inflation rate falls from 10 percent all the way to 0 percent. When the inflation rate is falling, but the price level does not drop, we have **disinflation**. Canada experienced disinflation during the recessions of the early 1980s and 1990s. Between 1981 and 1984, for example, the inflation rate dropped from over 12 percent to just over 4 percent. Like accelerating inflation, disinflation is often unanticipated.

disinflation when the inflation rate falls from one year to the next

Finally, from period 10 to period 12 the CPI drops from 156 to 149.9. The inflation rate turns negative, as it did in Canada during the Great Depression of the 1930s. When the CPI falls from one period to the next, we have negative inflation or *deflation*. In periods 11 and 12 the deflation rate is −2 percent.

EXERCISE 6.7

Flip back to Figure 4.4. Practise using the terms *zero inflation*, *stable inflation*, *accelerating inflation*, *disinflation*, and *deflation* to describe how the inflation rate behaved in different periods of Canadian economic history.

Describing the intensity of inflation

It is useful to have terms not just to describe the rate of change of inflation, but also to describe its intensity. If you read research published by the Bank of Canada, for example, you will encounter terms such as those shown in italics in the following sentence: "In the case of Canada, there is evidence that uncertainty about long-run inflation fell considerably between the *high*-inflation period of the 1970s and early 1980s and the subsequent *moderate*-inflation period, and decreased still further in the *low*-inflation period that has been evident since the early 1990s."[5] (Italics added.)

low inflation typically means inflation between 1 and 3 percent per year

moderate inflation typically means inflation between 3 and 6 percent per year

high inflation typically means inflation greater than 6 percent per year

hyperinflation typically means inflation greater than 500 percent per year

Canadian economists have generally described annual inflation in the 1 to 3 percent range that Canada has experienced since 1992 as **low inflation**. Inflation in the range of roughly 3 to 6 percent, as Canada experienced between 1983 and 1991, is often described as **moderate inflation**. Canada's inflation in the 1974–1982 period, when the inflation rate continually exceeded 6 percent, has been described as **high inflation**.

Hyperinflation is used to describe very, very high inflation. While there is no official threshold above which high inflation becomes hyperinflation, inflation rates exceeding 500 percent per year would surely qualify. Several European countries experienced episodes of hyperinflation in the wake of the First and Second World Wars. In the past few decades, episodes of hyperinflation have

[5]Gerald Stuber, "Implications of Uncertainty about Long-Run Inflation and the Price Level," Working Paper 2001-16, October 2001, http://www.bankofcanada.ca/en/res/wp01-16.htm.

occurred in several Latin American countries (including Argentina, Bolivia, Brazil, and Peru), in Israel, and in some "transition" economies, including Russia and Yugoslavia (Serbia and Montenegro).

EXERCISE 6.8

An article in a November 2001 issue of *The Economist* contained the following paragraph:

> **Everybody agrees that high inflation damages economic growth, but there is a dispute about the optimal rate of inflation. The European Central Bank has an inflation target of 0–2% and the Bank of England's is 2.5%… But some say that economies work better with a bit more inflation, say 3–4%. Their argument is that during a severe downturn such inflation makes it easier to cut real wages and to push real interest rates below zero, thereby helping recovery.[6]**

What term would be used to describe the intensity of inflation associated with the inflation targets of the European Central Bank and the Bank of England (also a central bank)? What term would be used to describe the intensity of inflation favoured by those who say economies work better with a "bit more inflation"?

6.7 THE ECONOMIC CONSEQUENCES OF VARIOUS TYPES OF INFLATION

Previous sections of this chapter have dealt with the distinction between inflation and relative price changes. We have also introduced several terms (zero inflation, stable inflation, accelerating inflation, disinflation and deflation) for describing what is happening to the inflation rate. We have explained that both increases in the inflation rate (accelerating inflation) and decreases in the inflation rate (disinflation) are often unanticipated. And we have mentioned some adjectives economists use to describe the intensity of inflation (low, moderate, high, and hyper). We are now in a position to consider the economic *consequences* of various types of inflation. The *sources* of inflation rate change are analyzed in Chapter 15.

As you can now imagine, it is difficult to speak exactly about the consequences of anything so general as "inflation." The consequences of anticipated inflation differ from those of unanticipated inflation. Low inflation may have different consequences than moderate inflation. The consequences of disinflation must be distinguished from those of deflation. Hyperinflation constitutes a category all of its own. For these reasons, we will discuss specific consequences of various types of inflation. Take note that some consequences relate to income distribution, while others relate to economic growth.

UNANTICIPATED INFLATION AND INCOME DISTRIBUTION

One of the most widely accepted statements about inflation is that unanticipated changes in the inflation rate can have consequences for the distribution of income.

Consider a group of unionized workers who have signed a contract setting their wages for the next three years in nominal terms. The inflation rate has been 4 percent in recent years. Expecting inflation to continue along at 4 percent, the employer and representatives of the workers negotiate wages accordingly, providing nominal wage increases of 6 percent per year, and real wage increases of 2 percent per year, for each year of the contract.

[6] "The New Bogey," *The Economist*, November 25, 2001.

But then suppose that, to everyone's surprise, there is disinflation and the inflation rate falls to 1 percent for the duration of the contract. The nominal wage increases of 6 percent per year will continue but the inflation-adjusted or real wages of the workers will be higher than before. In the first year, for example, real wages will increase by 5 percent instead of 2 percent. They will be 3 percentage points higher than anyone expected when the contract was negotiated. All else being equal, income will shift from the employer to the employees. Workers will benefit at the expense of the employer provided, of course, the employer does not resort to layoffs or get driven out of business.

The opposite type of situation would occur if, instead of unexpectedly shifting from 4 percent down to 1 percent, the inflation rate unexpectedly rose, say to 6 percent, for the rest of the contract. Then the workers, who had been expecting real wages to increase by 2 percent per year, would instead be getting no real wage increases at all. With nominal wage increases just equal to the inflation rate, their real wages would stagnate, and income would shift to the employer. Of course, depending on the availability of jobs, some workers might quit and seek higher real wages elsewhere.

It is to prevent unexpected changes in the rate of inflation from having an impact on real wages that union contracts are sometimes indexed to the CPI.[7] Indexing can help prevent unanticipated shifts in income between employers and employees as a consequence of unanticipated changes in the rate of inflation. So although unanticipated changes in inflation *can* have consequences for the distribution of income between employers and employees, such consequences are sometimes avoided by the indexing of wages.

Unanticipated changes in the inflation rate can also have consequences for the distribution of income between borrowers (debtors) and lenders (creditors). One illustration of this was provided by Economic Naturalist 6.1, which dealt with why September 1981 was a bad month to take out a mortgage. In general, unexpectedly high inflation rates help borrowers at the expense of lenders, because borrowers are able to repay their loans in less-valuable dollars. Unexpectedly low inflation rates, on the other hand, help lenders and hurt borrowers by forcing borrowers to repay in dollars that are worth more than expected when the loan was made.

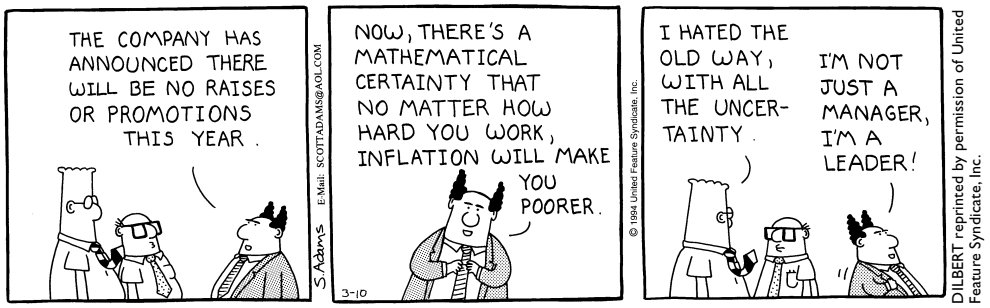
Loan contracts, like union wage contracts, can in principle be indexed to the rate of inflation. In practice, full indexing of loans to the CPI is not common in Canada, though the practice is frequently observed in countries with high inflation rates. Even in Canada, however, variable rate mortgage loans are widespread. To the extent that nominal mortgage interest rates reflect changes in the rate of inflation, variable rate mortgages provide a form of indexing.

ANTICIPATED INFLATION AND INCOME DISTRIBUTION

Economists tend to assume that if people anticipate changes in inflation they will design contracts to prevent inflation from eroding their incomes. As prices of goods and services go up, incomes go up as well, even without indexation. With anticipated inflation, employees and employers are expected to set wages with the inflation rate in mind, just as borrowers and lenders set interest rates in accordance with their expectations about inflation. But many non-economists tend to be concerned that moderate or high inflation, even if anticipated, would lead to a substantial erosion of their living standards. Are such concerns justified?

Historically, senior citizens on public pensions have been concerned about inflation. Before the early 1970s, public pensions in Canada were not fully

[7]Paul Jenkins and Brian O'Reilly, "Monetary Policy and the Economic Well-Being of Canadians," *Review of Economic and Social Progress*, 2001, p. 101, cite evidence that the proportion of Canadian wage settlements with indexing clauses dropped from over 23 percent during 1978–1990 to under 11 percent during 1996–2000.



indexed to the rate of inflation. When inflation rates picked up in the early 1970s, however, the government of the late Pierre Elliott Trudeau did index public pensions, and they have remained indexed to the CPI ever since.

Historically, as well, the income tax system was not fully indexed for inflation, and this meant that inflation could erode the after-tax disposable incomes of taxpayers. Taxpayers would get bumped into tax brackets with higher marginal income tax rates and the value of credits or exemptions would be eroded. Around the time the Trudeau government indexed public pensions, however, it also indexed the federal income tax system. The Brian Mulroney government elected in the 1980s removed full indexing of the income tax system as part of a campaign to reduce federal government deficits. But then in 2000 the Jean Chrétien government, facing large federal budget surpluses, moved to restore the indexing first implemented in the Trudeau years.

In short, both public pensions and the basic features of the federal income tax system are now fully indexed for inflation. On the other hand, private company pensions are a significant source of income for some people, and they are seldom indexed to inflation, at least explicitly. Economists would point out that although anticipated inflation may in special cases result in the erosion of living standards, the income lost by one group is largely gained by another—it does not just go up in smoke. For example, if program spending in some area is eroded by inflation, then program spending in some other area can be increased or, for example, taxes can be cut.

Finally, it is simplistic to just blame inflation when government spending fails to match increases in inflation or when government taxation is higher in real terms when inflation is higher, just as it is simplistic to regard erosion of the minimum wage by inflation as something caused by inflation alone (recall Exercise 6.4). When inflation is anticipated and governments fail to increase nominal program spending to offset the impact of inflation, then the decline in the real value of program spending is more the result of a government spending decision than it is the result of inflation. Similarly, when the Mulroney government removed full indexing of the tax system in the 1980s, it did so with an understanding that partial removal of indexing would increase government revenues. At most, inflation can help to cloak such decisions.

LOW INFLATION, MODERATE INFLATION, AND ECONOMIC GROWTH

Which is better for economic growth—low inflation or moderate inflation? The question evokes considerable controversy among economists. Here we will simply sketch some of the arguments.

On one side of the debate are economists, such as the ones with the Bank of Canada, who argue that low inflation, perhaps even zero inflation, is optimal for economic growth. A key argument of theirs is that inflation interferes with the information conveyed by price changes. In an economy with negligible inflation,

the supplier of a product will recognize an increase in its price as a relative price increase signaling the profitability of bringing more of the product to market. Conversely, demanders will interpret the price increase as a relative price increase signaling that they should economize on their use of the product. But in the presence of inflation, not all price changes represent relative price changes. Participants in a market need to know not only the price of the product sold in the market but also what is happening to the prices of other goods and services. With inflation, then, the signals that are transmitted through the price system may become more difficult to interpret, much in the way that static, or "noise," makes a radio message harder to interpret. According to this **price signal distortion hypothesis**, even moderate inflation creates "noise" in the price system, and thereby reduces economic efficiency.

price signal distortion hypothesis the claim that any substantial amount of change in the price level will make it difficult for market participants to interpret the extent to which price changes involve relative price changes

A second argument for little or no inflation is that inflation interferes with the long-term planning of households and firms. Suppose that you want to enjoy a certain standard of living when you retire. How much of your income do you need to save? That depends on what the goods and services you plan to buy will cost 30 or 40 years from now, assuming such goods and services would still be available then. Planning for retirement would be simplest if you knew that the future price level would be pretty much the same as the price level today.

A related argument is that when inflation is negligible and expected to stay negligible, people will tend to sign relatively long-term contracts involving interest rates, wages, and so on. They will avoid wasting time with frequent renegotiation of contracts and the economy will be more efficient as a consequence. By contrast, when inflation is higher and more volatile, people will generally judge long-term contracts as being too risky, and so will endure the time and trouble associated with short-term contracts.

On the other side of the debate are economists who favour moderate inflation over low or zero inflation.[8] Some of these economists argue that low or zero inflation can produce lower economic growth than moderate inflation because low inflation hampers flexibility of real wages. The argument is known as the **downward nominal wage rigidity hypothesis**, and is often attributed to the Nobel Prize-winning economist James Tobin. It states that efficiency generally requires that a decline in the demand for labour in a particular industry results in a reduction in real wages for workers in the industry. Labour demand and supply are discussed in detail in *Principles of Microeconomics*. If the inflation rate is a few percentage points or higher, then the appropriate real wage cuts can typically be achieved without nominal wage cuts. For example, if nominal wages go up by 1 percent, and inflation is 4 percent, then real wages will have fallen by 3 percent. If the inflation rate is zero, however, then a 3 percent cut in real wages requires a 3 percent cut in nominal wages. But people tend to regard nominal wage cuts as unfair in most situations, so zero or low inflation tends to impair real wage flexibility and hence economic efficiency.

downward nominal wage rigidity hypothesis the claim that low levels of inflation will reduce efficiency because real wage cuts will then typically require nominal wage cuts, which will be resisted

A second argument for moderate inflation is that in fighting past recessions central banks have sometimes had to cut their official interest rates, or key policy rates, by several percentage points. (Details about how central banks use their official interest rates are provided in Chapters 9 and 13). If the official rate is already very low in line with low inflation (recall the Fisher effect), then macroeconomic policy will be deprived of a key policy lever. In the economics literature, this is known as the **zero bound on nominal interest rates hypothesis**, and it is often credited to Lawrence Summers, an academic economist who served as U.S. Treasury Secretary in the Clinton Administration. One illustration is provided by Japan, where the inflation rate was approximately zero and the official rate of the central

zero bound on nominal interest rates hypothesis the claim that because interest rates cannot go below zero, a central bank may be unable to stimulate the economy with rate cuts if the official interest rate is low to begin with

[8]Critics of zero or low inflation dominate, for example, among the contributors to Lars Osberg and Pierre Fortin, eds., *Hard Money, Hard Times* (Toronto: Lorimer, 1998).

bank was only half a percentage point when the economy slipped into recession in 1997. A nominal interest rate cannot be negative, so Japan's official interest rate could not be reduced by even half a percentage point to offset the slump.

A third argument for moderate inflation is that a rapidly growing economy will naturally tend to produce moderate (not just low) inflation from time to time, such as when the inflation rate picks up because of oil price increases or sales tax increases. If the government tolerates moderate inflation, as the government of Ireland did in 2000, then the economy may continue to grow at a healthy pace. If the government tries to keep the inflation rate more strictly under control, as was the case in Canada and the United States in 2000, then the growth rate will slow, and the economy may even be thrown into recession.

DISINFLATION AND ECONOMIC GROWTH

Economists generally agree that the process of getting from high or moderate inflation to low inflation can be very costly in terms of economic growth. In principle, a transition to a lower rate of inflation could be brought about in various ways, such as through an *incomes policy* (a government-initiated attempt to curb inflation by controlling the growth of labour and capital income).[9] But in recent times, disinflation has typically been the product of central bank policy. A central bank tries to produce disinflation by raising its official interest rate. In later chapters we will explain the process by which an increase in the official interest rate can increase interest rates in general and ultimately reduce the growth of overall spending and reduce both economic growth and the rate of inflation. Here it is perhaps sufficient to mention that the two biggest recessions in postwar Canadian economic history, the recessions of the early 1980s and the early 1990s, were both associated with attempts by the Bank of Canada to produce disinflation.

DEFLATION AND ECONOMIC GROWTH

Some columnists for the business sections of newspapers write about the importance of the central bank preserving the purchasing power of the currency. They can make it sound almost like the typical family keeps its life savings in a piggybank and that the value of the money in the piggybank will just go down and down if prices are allowed to rise.

Well, suppose families really did keep their life savings in the form of cash in piggybanks, and that the value of those life savings was the only proper concern of central bankers. Why should central bankers just aim for price stability to preserve the value of money? Why not increase the value of money by bringing about deflation (falling prices)?

To illustrate, suppose that you had $12 706 of Canadian money in a piggybank in 1929. Between 1929 and 1933 the level of the Canadian CPI (1992 base) actually fell from 10.8 to 8.5, a fall of about 21 percent or 5.8 percent per year. To buy a basket of goods that cost $12 706 in 1929 would cost only $10 000 in 1933. The extra $2706 is a windfall for the piggybank owner corresponding to a real rate of interest of 5.8 percent per year.

While the years 1929–1933 might have been great years for anyone whose standard of living was based upon Canadian money stored in a piggybank, they were the worst years of the Great Depression, as discussed in Chapter 4. Canadian GDP dropped sharply from 1930 to 1933 and the unemployment rate reached a level never approached before or since.

[9]Incomes policies can be compulsory or voluntary and they may involve controls on prices as well as on income. Canada had a compulsory incomes policy (wage-and-price controls) during the 1975–1978 period when the *Anti-Inflation Act* was in effect.

Deflation has been associated with weak or negative economic growth for some of the same reasons disinflation has, but there are other reasons as well. One of them is suggested by the piggybank example—investors who can earn, say, a tax-free annual return of 5.8 percent just by holding cash may be reluctant to make their money available for the private-sector investment (in plant and equipment, office buildings, shopping malls, and so on) that would spur employment and productivity increases in the economy. For this and other reasons, very few economists would view deflation as a sensible goal for economic policy.

HYPERINFLATION AND ECONOMIC GROWTH

One of the most widely accepted findings of research on inflation is that hyperinflation impairs the efficiency of an economy, often severely. Hence, countries experiencing hyperinflation tend to experience lower growth than economies that are comparable on other dimensions.

One reason that hyperinflation is associated with lower economic growth is that it greatly increases the costs of making economic transactions. As an extreme case, think of a shopper needing a wheelbarrow just to transport to the grocery store the cash needed to buy a loaf of bread.[10] Two of these *transactions costs* are known as *shoe-leather costs* and *menu costs*.

Shoe-leather costs become an issue because of the time and resources used up as people attempt to minimize the losses they incur from the rapidly falling value of money. The shoe leather worn out in the extra running around symbolizes this category of transactions costs although few people still wear shoes with leather soles. Businesses may have to issue paycheques by the day rather than by the week or month. People may visit the bank two or three times a day so as to keep as much of their money as possible in inflation-indexed accounts, if they are available, and as little as possible in rapidly depreciating cash. Or, as soon as they are paid, people may rush off to exchange the local currency for a stable, widely used international currency like the U.S. dollar.

Menu costs become an issue because of the frequency with which prices must be changed. The cost to a restaurant of printing up a new set of menus with new prices symbolizes this category of transactions costs. Under hyperinflation, annual or quarterly price adjustment is impractical—businesses must change their prices by the day, perhaps even by the hour. Sellers must devote extra resources to conveying price information to buyers.

Incidentally, while shoe-leather and menu costs become a serious issue with hyperinflations, they also exist in other situations. Shoe-leather costs would be minimized in a state of rapidly falling prices, but rapidly falling prices have negative side effects of a more serious nature, as noted above. Menu costs are increased, not just by rising prices, but by falling prices as well. In any case, most economists interpret the evidence as suggesting that these transaction costs are trivial at the rates of inflation observed throughout most of Canadian history.[11] Annual inflation rates in Canada, it is important to remember, have never reached 20 percent, let alone the 5000 percent or more observed in several hyperinflations.

[10]You may wonder how countries could ever allow themselves to fall into a state of hyperinflation. One common path is for a country to experience economic collapse as a result of war. The government needs revenue but is reluctant or unable to raise the funds through taxation. So it issues extra currency to pay for its purchases. With too much currency chasing too few goods and services, prices soar. People try to hoard goods and this contributes to accelerating inflation. The government then needs even more currency to pay for its purchases so it issues even more currency, and eventually the process spins out of control.

[11]Furthermore, technological improvements such as Internet banking, computerized cash registers, and Web-based price lists have worked to reduce the shoe-leather and menu costs of any given rate of inflation.

HIGH, ACCELERATING INFLATION AND ECONOMIC GROWTH

Canadian advocates of high and accelerating inflation are few and far between. On the face of it, this might seem odd because Canada's years of high and accelerating inflation in the 1970s were characterized by relatively strong economic growth. Canadian inflation during the period 1971–1981 averaged over 8 percent, with two phases of accelerating inflation, from 1971 to 1975 and from 1976 to 1981. But the annual real per capita GDP growth rate for the whole period averaged a healthy 2.7 percent.

By contrast, for the period 1982–1992 inflation averaged under 5 percent through years of disinflation followed by stable inflation and then disinflation again. Real per capita GDP growth for the 1982–1992 period averaged under 1 percent.

Although various costs of inflation are thought to increase with the inflation rate, the explanation for widespread aversion to high and accelerating inflation in the range that Canada experienced in the 1970s is probably not primarily because of a belief about it being directly associated with poor economic performance.[12] One reason for the aversion is that high and accelerating inflation, like disinflation, typically means that the future inflation rate is difficult to predict and income is thereby arbitrarily redistributed between employers and employees, borrowers and lenders, and so on. Another reason is the concern that if high and accelerating inflation persists it will eventually transform into hyperinflation.

But perhaps the most serious problem with high and accelerating inflation is political. Because of widely held concerns about redistribution and the risk of hyperinflation, many economists have concluded that high and accelerating inflation will likely create a political consensus in favour of clamping down on inflation, typically through disinflation induced by central bank policies.[13] In turn, such disinflation will mean a recession, a sharp drop in economic growth.

It is true that political pressure could take the form of dealing with high and accelerating inflation by means other than a costly disinflation. The upsurge in Canadian inflation during the early 1970s, for example, led at first not to a costly disinflation but to a brief experiment with wage-and-price controls (which helped to reduce inflation, at least temporarily, but had other problems). And costly disinflations have been imposed in the absence of either high and accelerating inflation or a political consensus, as in the disinflation of the early 1990s. Still, the conclusion holds that in many societies, high and accelerating inflation carries the substantial risk of creating a political consensus in favour of costly disinflation.

EXERCISE 6.9

***The Economist* article quoted in Exercise 6.8 also contained the following paragraph:**

> **First, it swells the real burden of debt, causing bankruptcies and bank failures. Second, expectations that prices will be lower tomorrow may encourage households to postpone their spending. Weaker demand may then push prices even lower. Third, workers are often reluctant to accept a pay cut in nominal terms, so that when prices are falling the real wage bill goes up. The only way to cut costs is to lay off more workers, which may deepen a recession. Last, but by no means least,**

[12]On the lack of solid international evidence for the view that high inflation harms economic growth, see Jonathan Temple, "The New Growth Evidence," *Journal of Economic Literature*, March 1999, pp. 112–156.

[13]For international evidence that the public dislikes high inflation, see Rafael Di Tella, Robert MacCulloch, and Andrew Oswald, "Preferences over Inflation and Unemployment: Evidence from Surveys of Happiness," *American Economic Review*, March 2001, pp. 335–341.

interest rates cannot go below zero, so [it] makes real interest rates painfully high—as Japan has discovered.[14]

What is "it"—zero inflation, deflation, or accelerating inflation? Explain.

RECAP

THE ECONOMIC CONSEQUENCES OF VARIOUS TYPES OF INFLATION

Changes in relative prices (such as the price of bread) should be distinguished from inflation, which is a change in the overall level of prices. The distinction is important because remedies for undesired changes in relative prices and for inflation are different.

It is difficult to draw conclusions about the consequences of anything so general as "inflation." Instead we have examined the consequences of various types of inflation for income distribution and economic growth.

- If inflation is anticipated, it will generally not have major impacts on income distribution, even if indexing is uncommon.
- If inflation is unanticipated (as is often the case for disinflation or accelerating inflation), then it can have major impacts on income distribution, but only in the absence of indexing.
- Deflation has been associated with slow or negative economic growth.
- There is controversy over whether a policy of aiming for low inflation is superior to a policy of tolerating moderate inflation as a means of supporting economic growth.
- High, accelerating inflation can generate political support for a costly disinflation to get inflation back under control.
- Hyperinflation has typically been associated with low or negative economic growth and has often led to economic collapse.

SUMMARY

- The basic tool for measuring inflation is the *consumer price index*, or CPI. The CPI measures the cost of purchasing a fixed basket of goods and services in any period relative to the cost of the same basket of goods and services in a base year. The *inflation rate* is the annual percentage rate of change in the price level as measured by a *price index* such as the CPI.

- The accuracy of inflation measurement based on the CPI has been debated in both Canada and the United States. In Canada, debate about the accuracy of inflation measurement has raised questions about the level of the Bank of Canada's inflation control target. In the United States, the debate has focused more on whether changes should be made in how the CPI is calculated, with important implications for the value of indexed incomes and measured economic growth.

- A *nominal quantity* is a quantity that is measured in terms of its current dollar value. Dividing a nominal quantity, such as a family's income or a worker's wage in dollars, by a price index such as the CPI expresses that quantity in terms of real purchasing power. This procedure is called *deflating* the nominal quantity. If nominal quantities from two different years are deflated by a common price index, the purchasing power of the two quantities can be compared. To ensure that a nominal payment, such as a Canada Pension Plan benefit, represents a constant level of real purchasing power, the nominal payment should be

[14] "The New Bogey," © 2001 *The Economist* Newspaper Ltd. All rights reserved. Reprinted with permission. Further reproduction prohibited. www.economist.com.

increased each year by a percentage equal to the inflation rate. This method of adjusting nominal payments to maintain their purchasing power is called *indexing*.

- The *real interest rate* is equal to the *nominal*, or *market, interest rate* minus the inflation rate. When inflation is unexpectedly high, the real interest rate is lower than anticipated, which hurts lenders but benefits borrowers. When inflation is unexpectedly low, lenders benefit and borrowers are hurt. To obtain a given real rate of return, lenders must charge a high nominal interest rate when inflation is high and a low nominal interest rate when inflation is low. The tendency for nominal interest rates to be high when inflation is high and low when inflation is low is called the *Fisher effect*.

- It is important to distinguish between increases in the *relative prices* for specific goods and services and increases in the general price level. The distinction is important because the appropriate response to a change in relative prices differs from the appropriate response to inflation.

- Economists employ precise terminology to describe the various types of inflation. Inflation can be *anticipated* or *unanticipated*. Distinctions are drawn between *zero inflation*, *stable inflation*, *accelerating inflation*, *disinflation*, and *deflation*. The intensity of inflation can be described by terms such as *low inflation*, *moderate inflation*, *high inflation*, and *hyperinflation*.

- The various types of inflation have different consequences for income distribution and economic growth. It is almost universally accepted that macroeconomic policy should aim at avoiding the extremes of hyperinflation (which Canada has never experienced) and deflation (which Canada experienced during the Great Depression). It is widely accepted that macroeconomic policy should avoid high and accelerating inflation.

KEY TERMS

accelerating inflation (152)
anticipated inflation (145)
consumer price index (CPI) (136)
deflating (a nominal quantity) (139)
deflation (139)
disinflation (152)
downward nominal wage rigidity hypothesis (156)
Fisher effect (145)
high inflation (152)
hyperinflation (152)
indexing (142)
low inflation (152)
moderate inflation (152)
nominal interest rate (143)
nominal quantity (139)
price index (137)
price level (149)
price signal distortion hypothesis (156)
rate of inflation (138)
real interest rate (143)
real quantity (139)
real wage (140)
relative price (149)
stable inflation (152)
unanticipated inflation (145)
zero bound on nominal interest rates hypothesis (156)
zero inflation (151)

REVIEW QUESTIONS

1. Explain why changes in the cost of living for any particular individual or family may differ from changes in the CPI.
2. What is the difference between the *price level* and the *rate of inflation* in an economy?
3. Why is it important to adjust for inflation when comparing nominal quantities (for example, workers' average wages) at different points in time? What is the basic method for adjusting for inflation?
4. Describe how indexation might be used to guarantee that the purchasing power of the wage agreed to in a multiyear collective agreement will not be eroded by inflation.
5. Give two arguments why the official CPI inflation rate might overstate the "true" rate of inflation. Also, give two counter-arguments in defense of the official CPI inflation rate.
6. "It's true that unanticipated inflation redistributes wealth from creditors to debtors, for example. But what one side of the bargain loses, the other side gains. So from the perspective of society as a whole, there is no real cost." Do you agree? Discuss.
7. How does deflation affect the real return on holding cash? How does positive inflation act as a tax on criminal gangs holding large quantities of cash to avoid detection by the authorities rather than keeping their money in interest-bearing bank accounts?
8. True or false, and explain: If both the potential lender and the potential borrower correctly anticipate the rate of inflation, inflation will not redistribute wealth from the creditor to the debtor.
9. Discuss the different consequences that deflation, high inflation, and hyperinflation have for economic growth.

PROBLEMS

1. In the city of Pizzaville, government survey takers determine that typical family expenditures each month in the year designated as the base year are as follows:

   20 pizzas at $10 each
   Rent of apartment, $600 per month
   Gasoline and car maintenance, $100
   Phone service (basic service plus 10 long-distance calls), $50

   In the year following the base year, the survey takers determine that pizzas have risen to $11 each, apartment rent is $640, gasoline and maintenance has risen to $120, and phone service has dropped in price to $40.
   a. Find the CPI in the subsequent year and the rate of inflation between the base year and the subsequent year.
   b. The family's nominal income rose by 5 percent between the base year and the subsequent year. Is the family worse off or better off in terms of what its income is able to buy?

2. Here are values of the Canadian CPI for each year in the decade of the 1990s. For each year beginning with 1991, calculate the rate of inflation from the previous year. What happened to inflation rates over the 1990s?

1990	93.3
1991	98.5
1992	100.0
1993	101.8
1994	102.0
1995	104.2
1996	105.8
1997	107.6
1998	108.6
1999	110.5

3. According to the U.S. Census Bureau, nominal income for the typical family of four in the United States (median income) was $24 332 in 1980, $32 777 in 1985, $41 451 in 1990, and $53 350 in 1997. In purchasing power terms, how did family income compare in each of those 4 years? You will need to know that the CPI (1982–1984 = 100) was 82.4 in 1980, 107.6 in 1985, 130.7 in 1990, and 160.5 in 1997.

4. Suppose a study found that the real entry-level wage for graduates of a certain university declined by 8 percent between 1990 and 1997. The nominal entry-level wage in 1997 was $12.00 per hour. Assuming that the findings are correct, what was the nominal entry-level wage in 1990? Use the CPI data from Problem 2.

5. Here is the income tax schedule for a hypothetical country. It is expressed in nominal terms, for the year 2004:

Family income	Taxes due (percent of income)
≤$20 000	10
$20 001–$30 000	12
$30 001–$50 000	15
$50 001–$80 000	20
>$80 000	25

The legislature wants to ensure that families with a given real income are not pushed up into higher tax brackets by inflation. The CPI is 175 in 2004 and 185 in 2005. How should the income tax schedule above be adjusted for the year 2005 to meet the legislature's goal?

6. Here are the actual per-gallon prices in the United States for unleaded regular gasoline for June of each year between 1978 and 1986, together with the values of the U.S. CPIs for those years. For each year from 1979 to 1986, find the CPI inflation rate and the change in the relative price of gasoline, both from the previous year. Would it be fair to say that most of the changes in U.S. gas prices during this period were due to general inflation, or were factors specific to the oil market playing a role as well?

Year	Gasoline price ($/gallon)	CPI (1982–1984 = 100)
1978	0.663	65.2
1979	0.901	72.6
1980	1.269	82.4
1981	1.391	90.9
1982	1.309	96.5
1983	1.277	99.6
1984	1.229	103.9
1985	1.241	107.6
1986	0.955	113.6

7. On January 1, 2000, Albert invested $1000 at 6 percent interest per year for 3 years. The CPI on January 1, 2000, stood at 100. On January 1, 2001, the CPI was 105, on January 1, 2002, it was 110, and on January 1, 2003, the day Albert's investment matured, the CPI was 118. Find the real rate of interest earned by Albert in each of the 3 years and his total real return over the 3-year period. Assume that interest earnings are reinvested each year and themselves earn interest (that is, are compounded).

8. Frank is lending $1000 to Sarah for 2 years. Frank and Sarah agree that Frank should earn a 2 percent real return per year.
   a. The CPI is 100 at the time that Frank makes the loan. It is expected to be 110 in 1 year and 121 in 2 years. What nominal rate of interest should Frank charge Sarah?
   b. Suppose Frank and Sarah are unsure about what the CPI will be in two years. Show how Frank and Sarah could index Sarah's annual repayments to ensure that Frank gets an annual 2 percent real rate of return.

9. In 2003, based upon the Survey of Household Spending of 2001, Statistics Canada announced the following weights for the major spending categories tracked by the CPI:[15]

Food	16.3%
Shelter	28.5%
Household operations and furnishings	10.7%
Clothing and footwear	5.8%
Transportation	18.8%
Health and personal care	4.5%
Recreation, education, and reading	12.1%
Alcoholic beverages and tobacco products	3.2%

[15]Adapted from the Statistics Canada Web site, http://www.statcan.ca/english/sdds/document/2301_D12_T9_V1_B.pdf They do not add up to 100 percent because of rounding.

Employ the weights given above and suppose that 2001 is the base year with a CPI equal to 100. Suppose also that since 2001 the price of food has increased by 5 percent; the price of housing has increased by 10 percent, and the price of recreation, education, and reading has increased by 20 percent. All other prices are unchanged. Find the CPI for the current year.

ANSWERS TO IN-CHAPTER EXERCISES

6.1 The cost of the family's basket in 1992 remains at \$680, as in Table 6.1. If the rent on the apartment falls to \$400 in 2005, the cost of reproducing the 1992 basket of goods and services in 2005 is \$620 (\$400 for rent + \$150 for hamburgers + \$70 for movie tickets). The CPI for 2005 is accordingly \$620/\$680, or 0.912. So in this example, the cost of living has fallen nearly 9 percent between 1992 and 2005.

6.2 To construct a price index for university student expenditures, you would need to determine the basket of goods and services purchased in the base year. The university student price index in each period would then be defined as the cost of the basket in that period relative to the cost in the base year. To the extent that the mix of purchases of university students differs from that of average households, the university student price index would differ from the CPI. For example, if in the base year university students spent a higher share of their budgets than the average Canadian household on goods and services that have risen relatively rapidly in price (such as tuition fees for post-secondary education), then the inflation rate experienced by university students would be higher than the CPI inflation rate.

6.3 The percentage changes in the CPI in each year from the previous year are as follows:

1930	$-0.9 \text{ percent} = 100 \times \frac{(11 - 10.9)}{11}$
1931	−10.1 percent
1932	−9.2 percent
1933	−4.5 percent

Negative inflation is called deflation. The experience of the 1930s, when prices were falling, contrasts sharply with the 1970s, during which prices rose rapidly.

6.4 Deflating the unchanged \$6.85 minimum wage by the 1995 CPI value gives a real minimum wage for 1995 of \$6.57 in 1992 dollars. Deflating by the 2003 CPI gives a real minimum wage for 2003 of \$5.56. The decline in the real value of the minimum wage in the 1995–2003 period is therefore equal to approximately 15.4 percent.

Inflation affected all of the provinces more or less equally but other provinces adjusted their minimum wages upwards while Ontario did not. That other provincial governments raised their minimum wages two or more times during the 1995–2003 period when the Ontario government left the minimum wage unchanged would tend to suggest that the Ontario government wanted to lower the real value of the minimum wage. The Harris government apparently felt that the minimum wage had increased too rapidly under previous governments.

6.5 The nominal interest rate in 1980 is 12.7 percent. The after-tax return to the financial investor receiving that interest rate and paying a 40 percent tax rate is 7.6 percent. Subtracting inflation of 10.1 percent yields a negative after-tax real return of −2.5 percent. The nominal interest rate in 2000 is 5.5 percent. The after-tax return to the financial investor is 3.3 percent. Subtracting inflation of 2.7 percent yields an after-tax real return of 0.6 percent.

So although pre-tax real returns were very similar in 1980 and 2000, in our hypothetical example after-tax real returns in 1980 were 3.1 percentage points less

than after-tax real returns in 2000. All else being equal, then, a high rate of inflation can interact with the tax system to reduce the real after-tax returns available to financial investors.

6.6 The quotation indicates that Gordon believes that improvements in the memory size and processor speeds of computers overstate improvements in their quality. He believes that the official U.S. statistics over-adjust for improvements in the quality of computers.

6.7 No answer given.

6.8 The European Central Bank and the Bank of England aim for *low inflation*. Those who say economies work better with a "bit more inflation" are advocates of *moderate inflation*.

6.9 The paragraph is about *deflation*. The references to "when prices are falling" and to "expectations that prices will be lower tomorrow" are clearly references to deflation, which involves a falling price level. Zero inflation can cause some of the same economic problems that deflation causes. But zero inflation means the price level stays constant—it neither rises nor falls.