c. A retired person who moved to Florida and answers advertisements for part-time positions

d. A parent who works part-time, wants a full-time job, but doesn't have time to look

e. A teacher who has a job but is too ill to work

6. In explaining its procedures, the Department of Labor gives the following examples:

a. "Joan Howard told the interviewer that she has filed applications with three companies for summer jobs. However, it is only April and she doesn't wish to start work until at least June 15, because she is attending school. Although she has taken specific steps to find a job, Joan is classified as not in the labor force because she is not currently available for work."

b. "James Kelly and Elyse Martin attend Jefferson High School. James works after school at the North Star Café, and Elyse is seeking a part-time job at the same establishment (also after school). James' job takes precedence over his non-labor force activity of going to school, as does Elyse's search for work; therefore, James is counted as employed and Elyse is counted as unemployed."

Explain each of these examples. Take a survey of your classmates. Using the examples above, have people classify themselves in terms of their labor-force status as employed, unemployed, or not in the labor force.

7. Assume that Congress is considering a law that would set the minimum wage above the market-clearing wage for teenagers but below that for adult workers. Using supply-and-demand diagrams, show the impact of the minimum wage on the employment, unemployment, and incomes of both sets of workers. Is the unemployment voluntary or involuntary? What would you recommend to Congress if you were called to testify about the wisdom of this measure?

8. Do you think that the economic costs and personal stress of a teenager unemployed for 1 month of the summer might be less or more than those of a head-of-household unemployed for 1 year? Do you think that this suggests that public policy should have a different stance with respect to these two groups?

9. Make a list of reasons why unemployment looks so different in the United States as compared to Europe. Using the framework in Figure 31-6, show how a decrease in the demand for labor would lead to unchanged unemployment but lower wages in flexible-wage America, shown in (*a*), but to lower employment, higher unemployment, and unchanged wages in rigid-wage Europe, in (*b*).

CHAPTER

32

Ensuring Price Stability

Lenin is said to have declared that the best way to destroy the capitalist system was to debauch the currency. By a continuing process of inflation, governments can confiscate, secretly and unobserved, an important part of the wealth of their citizens.

J. M. Keynes

The United States recently experienced low and stable inflation that was unprecedented in the nation's history and unique among high-income countries. This experience was primarily due to the success of monetary policy in keeping output in a narrow corridor between inflationary excesses and depressionary downturns. In part, the low inflation was found in the restrained wage growth due to a decline in labor-union membership, a graying workforce, and greater worker docility in the face of aggressive management cost containment.

Additionally, inflation was restrained because of phenomenal price declines in computers and other new-economy products as well as relative quiet in oil and commodity markets.

One new factor in the inflation equation was the growing "globalization" of production. As the United States became more integrated in world markets, domestic firms found that their prices were constrained by the prices of international competitors. Even when domestic sales of automobiles were booming, domestic automakers could not raise their prices too much for fear of losing market share to Japanese and other foreign producers.

These were the forces at work in the American economy that kept inflation in check over the last two decades. Other countries were not so lucky, however. The present chapter will examine the meaning and determinants of inflation and describe the important public-policy issues that arise in this area. Figure 32-1 provides an overview of this chapter.

A. DEFINITION AND IMPACT OF INFLATION

WHAT IS INFLATION?

We described the major price indexes and defined inflation in Chapter 21, but it will be useful to reiterate the basic definitions here:

Inflation occurs when the general level of prices is rising. Today, we calculate inflation by using price indexes—weighted averages of the prices of thousands of individual products. The consumer price index (CPI) measures the cost of a market basket of consumer goods and services relative to the cost of that bundle during a particular base year. The GDP deflator is the price of GDP.

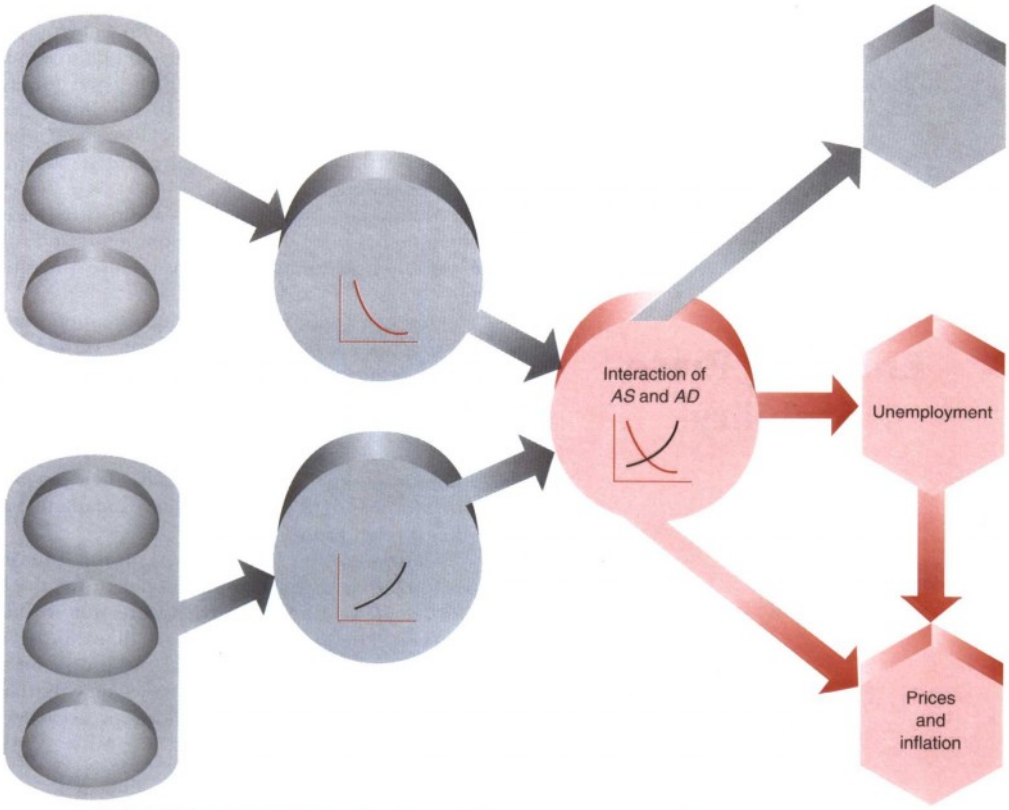

FIGURE 32-1. Inflation Is a Fundamental Constraint on Economic Policy

What are inflation's economic impacts? What forces lead to persistent inflation? How can governments slow inflation? These questions are central to macroeconomic theory and policy today.

The rate of inflation is the percentage change in the price level:

$$\text{Rate of inflation (year } t) = \frac{\text{price level (year } t) - \text{price level (year } t-1)}{\text{price level (year } t-1)} \times 100$$

If you are unclear on the definitions, refresh your memory by reviewing Chapter 21.

The History of Inflation

Inflation is as old as market economies. Figure 32-2 depicts the history of prices in England since the thirteenth century. Over the long haul, prices have generally risen, as the rust line reveals. But examine also the black line, which plots the path of *real wages* (the wage rate divided by consumer prices). Real wages meandered along until the Industrial Revolution. Comparing the two lines shows that inflation is not necessarily accompanied by a decline in real income.

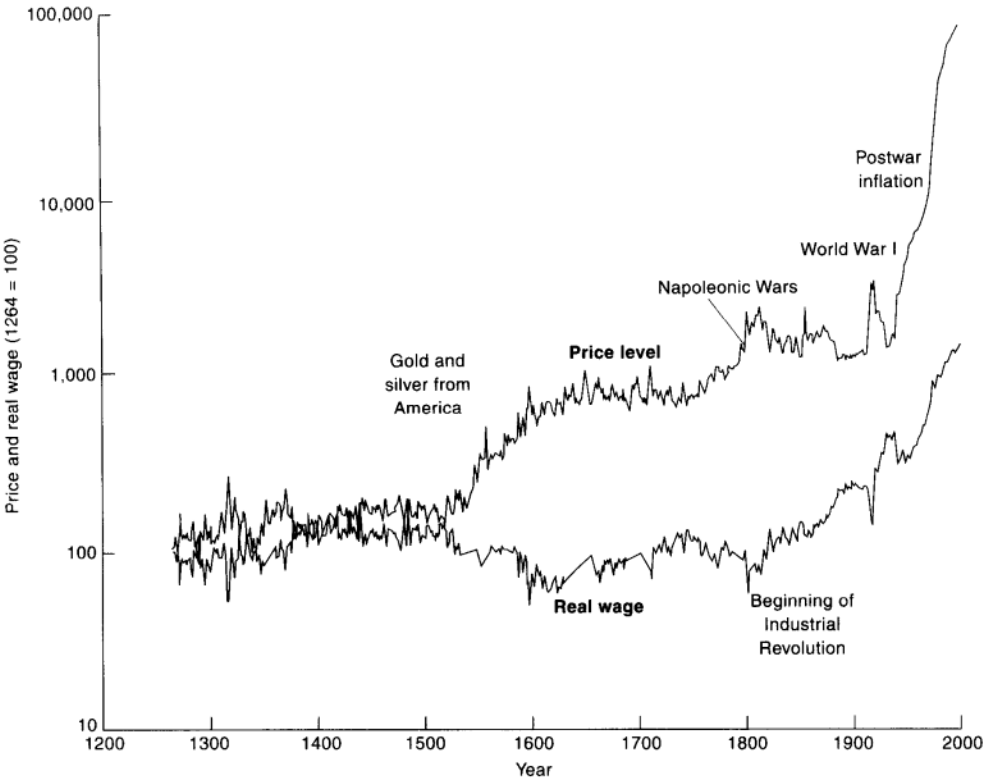

FIGURE 32-2. English Price Level and Real Wage, 1264–2002 (1270 = 100)

The graph shows England's history of prices and real wages since the Middle Ages. In early years, price increases were associated with increases in the money supply, such as from discoveries of New World treasure and the printing of money during the Napoleonic Wars. Note the meandering of the real wage prior to the Industrial Revolution. Since then, real wages have risen sharply and steadily.

Source: E. H. Phelps Brown and S. V. Hopkins, *Economica*, 1956, updated by the authors.

You can see, too, that real wages have climbed steadily since around 1800, rising more than tenfold.

Figure 32-3 on page 670 focuses on the behavior of consumer prices in the United States since the Revolutionary War. Until World War II, the United States was generally on a combination of gold and silver standards, and the pattern of price changes was regular: prices would soar during wartime and then fall back during the postwar slump. But the pattern changed dramatically after World War II. Prices and wages now travel on a one-way street that goes only upward. They rise rapidly in periods of economic expansion and slow down in periods of slack.

Figure 32-4 on page 670 shows CPI inflation over the last half-century. You can see that the last few years, with low and stable inflation, were an unusually tranquil period.

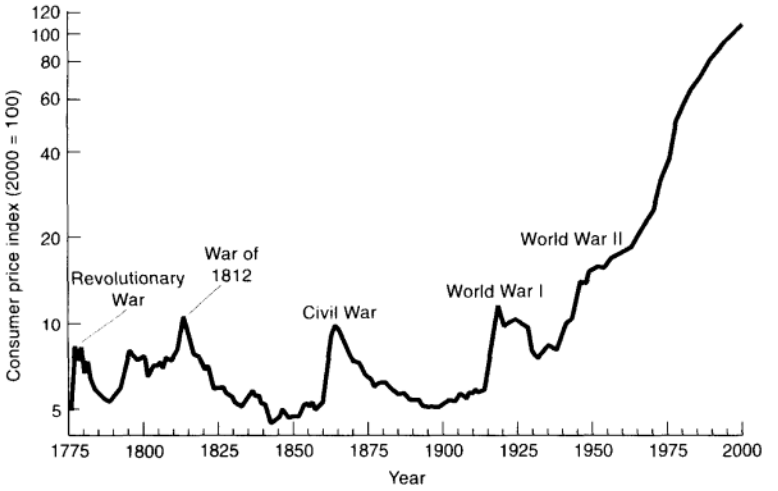

FIGURE 32-3. Consumer Prices in the United States, 1776–2003

Until World War II, prices fluctuated trendlessly—rising rapidly with each war and then drifting down afterward. But since then, the trend has been upward, both here and abroad.

Source: U.S. Department of Labor, Bureau of Labor Statistics for data since 1919.

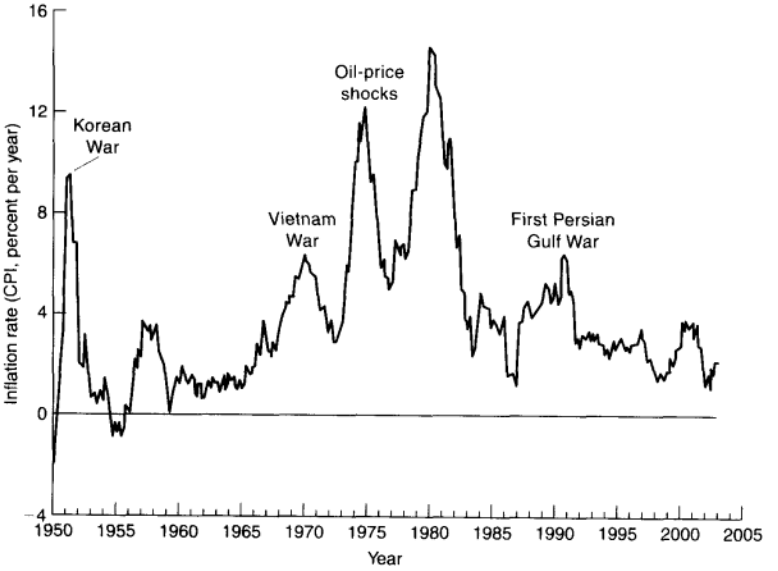

FIGURE 32-4. Inflation Has Remained Low and Stable in Recent Years

Historically, inflation in the United States was variable, and it reached unacceptably high rates in the early 1980s. In the last decade, skillful monetary management by the Federal Reserve along with favorable supply shocks led to low and stable inflation.

Source: Bureau of Labor Statistics, www.bls.gov. This graph shows inflation of the consumer price index.

Three Strains of Inflation

Like diseases, inflations exhibit different levels of severity. It is useful to classify them into three categories: low inflation, galloping inflation, and hyperinflation.

Low Inflation. Low inflation is characterized by prices that rise slowly and predictably. We might define this as single-digit annual inflation rates. When prices are relatively stable, *people trust money* because it retains its value from month to month and year to year. People are willing to write long-term contracts in money terms because they are confident that the relative prices of goods they buy and sell will not get too far out of line. Most industrial countries have experienced low inflation over the last decade.

Galloping Inflation. Inflation in the double-digit or triple-digit range of 20, 100, or 200 percent a year is called **galloping inflation** or "very high inflation." Galloping inflation is relatively common, particularly in countries suffering from weak governments, war, or revolution. Many Latin American countries, such as Argentina, Chile, and Brazil, had inflation rates of 50 to 700 percent per year in the 1970s and 1980s.

Once galloping inflation becomes entrenched, serious economic distortions arise. Generally, most contracts get indexed to a price index or to a foreign currency like the dollar. In these conditions, money loses its value very quickly, so people hold only the bare-minimum amount of money needed for daily transactions. Financial markets wither away, as capital flees abroad. People hoard goods, buy houses, and never, never lend money at low nominal interest rates.

Hyperinflation. While economies seem to survive under galloping inflation, a third and deadly strain takes hold when the cancer of **hyperinflation** strikes. Nothing good can be said about a market economy in which prices are rising a million or even a trillion percent per year.

Hyperinflations are particularly interesting to students of inflation because they highlight its disastrous impacts. Consider this description of hyperinflation in the Confederacy during the Civil War:

> We used to go to the stores with money in our pockets and come back with food in our baskets. Now we go with money in baskets and return with food in our pockets. Everything is scarce except money! Prices are chaotic and production disorganized. A meal that used to cost the same amount as an opera ticket now costs twenty times as much. Everybody tends to hoard "things" and to try to get rid of the "bad" paper money, which drives the "good" metal money out of circulation. A partial return to barter inconvenience is the result.

The most thoroughly documented case of hyperinflation took place in the Weimar Republic of Germany in the 1920s. Figure 32-5 shows how the government unleashed the monetary printing presses, driving both money and prices to astronomical levels. From January 1922 to November 1923, the price index rose from 1 to 10,000,000,000. If a person had owned 300 million marks worth of German bonds in early 1922, this amount would not have bought a piece of candy 2 years later.

Studies have found several common features in hyperinflations. First, the real money stock (measured by the money stock divided by the price level)

The German Hyperinflation

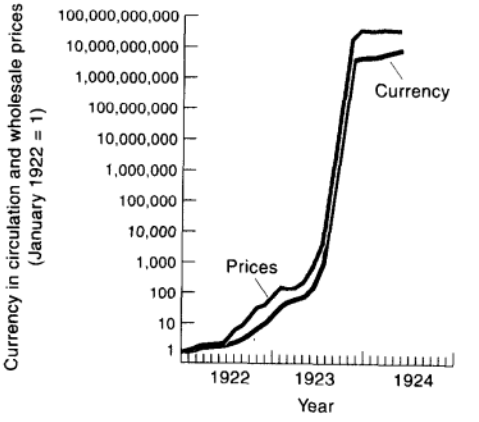

FIGURE 32-5. Money and Hyperinflation in Germany, 1922–1924

In the early 1920s, Germany could not raise enough taxes, so it used the monetary printing press to pay the government's bills. The stock of currency rose astronomically from early 1922 to December 1923, and prices spiraled upward as people frantically tried to spend their money before it lost all value.

falls drastically. By the end of the German hyperinflation, real money demand was only one-thirtieth of its level 2 years earlier. People are in effect rushing around, dumping their money like hot potatoes before they get burned by money's loss of value. Second, relative prices become highly unstable. Under normal conditions, a person's real wages move only a percent or less from month to month. During 1923, German real wages changed on average one-third (up or down) each month. This huge variation in relative prices and real wages—and the inequities and distortions caused by these fluctuations—took an enormous toll on workers and businesses, highlighting one of the major costs of inflation.

The impact of inflation was beautifully expressed by J. M. Keynes:

> As inflation proceeds and the real value of the currency fluctuates wildly from month to month, all permanent relations between debtors and creditors, which form the ultimate foundation of capitalism, become so utterly disordered as to be almost meaningless; and the process of wealth-getting degenerates into a game and a lottery.

Anticipated vs. Unanticipated Inflation

An important distinction in the analysis of inflation is whether the price increases are anticipated or unanticipated. Suppose that all prices are rising at 3 percent each year and everyone expects this trend to continue. Would there be any reason to get excited about inflation? Would it make any difference if both the actual and the expected inflation rates were 1 or 3 or 5 percent each year? Economists generally believe that anticipated inflation at low rates has little effect on economic efficiency or on the distribution of income and wealth. People would simply be adapting their behavior to a changing monetary yardstick.

But the reality is that inflation is usually unanticipated. For example, the Russian people had become accustomed to stable prices for many decades. When prices were freed from controls of central planning in 1992, no one, not even the professional economists, guessed that prices would rise by 400,000 percent over the next 5 years. People who were unlucky enough to hold their wealth in ruble assets saw their savings become worthless.

In more stable countries like the United States, the impact of unanticipated inflation is less dramatic, but the same general point applies. An unexpected jump in prices will impoverish some and enrich others. How costly is this redistribution? Perhaps "cost" does not describe the problem. The effects may be more social than economic. An epidemic of burglaries may not lower GDP, but it causes great distress. Similarly, randomly redistributing wealth by inflation is like forcing people to play a lottery they would prefer to avoid.

The Quagmire of Deflation

If inflation is so bad, should societies instead strive for *deflation*—a situation where prices are actually falling rather than rising? Historical experience and macroeconomic analysis suggest that deflation combined with low interest rates can produce serious macroeconomic difficulties.

A gentle deflation by itself is not particularly harmful. Rather, deflations generally trigger economic problems because they may lead to a situation where monetary policy becomes impotent.

Normally, if prices begin to fall because of a recession, the central bank can stimulate the economy by increasing bank reserves and lowering interest rates. But if prices are falling rapidly, then real interest rates may be relatively high. For example, if the nominal interest rate is ¼ percent and prices are falling at 3¾ percent per year, then the real interest rate is 4 percent per year. At such a high real interest rate, investment may be choked off, with recessionary consequences.

The central bank may decide to lower interest rates. *But the lower limit on nominal interest rates is zero.* Why so? Because when interest rates are zero, then bonds are essentially money, and people will hardly want to hold a bond paying negative interest when money has a zero interest rate. Now, when the central bank has lowered interest rates to zero, in our example, real interest rates would still be 3¾ percent per year, which might still be too high to stimulate the economy. The central bank is trapped in a quagmire—a quagmire called the *liquidity trap*—in which it can lower short-term interest rates no further. The central bank has run out of ammunition.

Deflation was frequently observed in the nineteenth and early twentieth centuries but largely disappeared in the late twentieth century. However, at the end of the 1990s, Japan entered a period of sustained deflation. This was in part caused by a tremendous fall in asset prices, particularly land and stocks, but also by a long recession. Short-term interest rates were essentially zero after 2000. For example, the yield on 1 year bank deposits was 0.032 percent per

year in mid-2003. The Bank of Japan appeared helpless in the face of deflation and zero interest rates.

The United States also had a brief skirmish with deflation and the liquidity trap in late 2002 and early 2003, as short-term interest rates fell to their lowest point in half a century.

Are there any remedies for deflation and the liquidity trap? One clear solution is to use fiscal policy. A fiscal stimulus will increase aggregate demand, and it will do so without any crowding out from higher interest rates. Some monetary specialists argue that the central bank could buy long-term bonds, inflation-protected bonds, or even stocks—for these are not in a liquidity trap. But most economists believe that the best defense is a good offense: make sure that the economy stays safely away from deflation by maintaining full employment and a gradually rising price level.

THE ECONOMIC IMPACTS OF INFLATION

Central bankers are united in their determination to contain inflation. During periods of high inflation, opinion polls often find that inflation is economic enemy number one. What is so dangerous and costly about inflation? We noted above that during periods of inflation all prices and wages do not move at the same rate; that is, changes in *relative prices* occur. As a result of the diverging relative prices, two definite effects of inflation are:

- A *redistribution* of income and wealth among different groups
- *Distortions* in the relative prices and outputs of different goods, or sometimes in output and employment for the economy as a whole

Impacts on Income and Wealth Distribution

Inflation affects the distribution of income and wealth primarily because of differences in the assets and liabilities that people hold.[1] When people owe money, a sharp rise in prices is a windfall gain for them. Suppose you borrow $100,000 to buy a house and your annual fixed-interest-rate mortgage payments are $10,000. Suddenly, a great inflation doubles all wages and incomes. Your *nominal* mortgage payment is still $10,000 per year, but its real cost is halved. You will need to work only half as long as before to make your mortgage payment. The great inflation has increased your wealth by cutting in half the real value of your mortgage debt.

If you are a lender and have assets in fixed-interest-rate mortgages or long-term bonds, the shoe is on the other foot. An unexpected rise in prices will leave you the poorer because the dollars repaid to you are worth much less than the dollars you lent.

If an inflation persists for a long time, people come to anticipate it and markets begin to adapt. An allowance for inflation will gradually be built into the market interest rate. Say the economy starts out with interest rates of 3 percent and stable prices. Once people expect prices to rise at 9 percent per year, bonds and mortgages will tend to pay 12 percent rather than 3 percent. The 12 percent nominal interest rate reflects a 3 percent real interest rate plus a 9 percent inflation premium. There are no further major redistributions of income and wealth once interest rates have adapted to the new inflation rate. The adjustment of interest rates to chronic inflation has been observed in all countries with a long history of rising prices.[2]

Because of institutional changes, some old myths no longer apply. It used to be thought that common stocks were a good inflation hedge, but stocks generally move inversely with inflation today. A common saying was that inflation hurts widows and orphans; today, they are insulated from inflation because social security benefits are indexed to consumer prices. Also, unanticipated inflation benefits debtors and hurts lenders less than before because many kinds of debt (like "floating-rate" mortgages) have interest rates that move up and down with market interest rates.

The major redistributive impact of inflation comes through its effect on the real value of people's wealth. In general, unanticipated inflation redistributes wealth from creditors to debtors, helping borrowers and hurting lenders. An unanticipated decline in inflation has the opposite effect. But inflation mostly churns income and assets, randomly redistributing wealth among the population with little significant impact on any single group.

[1] The important elements of balance sheets were described in Chapters 7 and 25.

[2] Fig. 25-3 shows movements in nominal and real interest rates for the United States in recent years.

Impacts on Economic Efficiency

In addition to redistributing incomes, inflation affects the real economy in two specific areas: It can harm economic efficiency, and it can affect total output. We begin with the efficiency impacts.

Inflation impairs economic efficiency because it *distorts prices and price signals.* In a low-inflation economy, if the market price of a good rises, both buyers and sellers know that there has been an actual change in the supply and/or demand conditions for that good, and they can react appropriately. For example, if the neighborhood supermarkets all boost their beef prices by 50 percent, perceptive consumers know that it's time to start eating more chicken. Similarly, if the prices of new computers fall by 90 percent, you may decide it's time to turn in your old model.

By contrast, in a high-inflation economy it's much harder to distinguish between changes in relative prices and changes in the overall price level. If inflation is running at 20 or 30 percent per month, price changes are so frequent that changes in relative prices get missed in the confusion.

Inflation also *distorts the use of money.* Currency is money that bears a zero nominal interest rate. If the inflation rate rises from 0 to 10 percent annually, the real interest rate on currency falls from 0 to −10 percent per year. There is no way to correct this distortion.

As a result of the negative real interest rate on money, people devote real resources to reducing their money holdings during inflationary times. They go to the bank more often—using up "shoe leather" and valuable time. Corporations set up elaborate cash-management schemes. Real resources are thereby consumed simply to adapt to a changing monetary yardstick rather than to make productive investments.

Many economists point to the *distortion of inflation on taxes.* Certain parts of the tax code are written in dollar terms. When prices rise, the real value of those provisions tends to decline. For example, you might be able to subtract a fixed-dollar "standard deduction" from your income in calculating your taxable income. With inflation, the real value of that standard deduction would decline and the real value of your taxes would rise. Such "taxation without legislation" has led many countries to index their tax laws to prevent inflation-induced tax increases. Parts of the U.S. tax code were indexed during the 1980s.

Indexing of tax brackets alone will not purge the tax system of the impacts of inflation because inflation distorts measures of income. For example, if you earned an interest rate of 6 percent on your funds in 2003, half of this return simply replaced your loss in the purchasing power of your funds from a 3 percent inflation rate. Yet the tax code does not distinguish between real return and the interest that just compensates for inflation. Many similar distortions of income and taxes are present in the tax code today.

But these are not the only costs; some economists point to *menu costs* of inflation. The idea is that when prices are changed, firms must spend real resources adjusting their prices. For instance, restaurants reprint their menus, mail-order firms reprint their catalogs, taxi companies remeter their cabs, cities adjust parking meters, and stores change the price tags of goods. Sometimes, the costs are intangible, such as those involved in gathering people to make new pricing decisions.

Macroeconomic Impacts

What are the macroeconomic effects of inflation? This question is addressed in the next section, so we merely highlight the major points here. Until the 1970s, high inflation in the United States usually went hand in hand with economic expansions; inflation tended to increase when investment was brisk and jobs were plentiful. Periods of deflation or declining inflation—the 1890s, the 1930s, some of the 1950s—were times of high unemployment of labor and capital.

But a more careful examination of the historical record reveals an interesting fact: The positive association between output and inflation appears to be only a temporary relationship. Over the longer run, there seems to be an inverse-U-shaped relationship between inflation and output growth. Table 32-1 shows the results of a recent multicountry study of the association between inflation and growth. It indicates that economic growth is strongest in countries with low inflation, while countries with high inflation or deflation tend to grow more slowly. (But beware the *ex post* fallacy here, as explored in question 7 at the end of the chapter.)

What Is the Optimal Rate of Inflation?

Most nations seek rapid economic growth, full employment, and price stability. But just what is meant

Inflation rate (% per year)	Growth of per capita GDP (% per year)
−20–0	0.7
0–10	2.4
10–20	1.8
20–40	0.4
100–200	−1.7
1,000+	−6.5

TABLE 32-1. Inflation and Economic Growth

The pooled experience of 127 countries shows that the most rapid growth is associated with low inflation rates. Deflation and moderate inflation accompany slow growth, while hyperinflations are associated with sharp downturns.

Source: Michael Bruno and William Easterly, "Inflation Crises and Long-Run Growth," World Bank Policy Research Working Paper 1517, September 1995.

by "price stability"? Exactly zero inflation? Over what period? Or is it perhaps low inflation?

One school of thought holds that policy should aim for absolutely stable prices or zero inflation. If we are confident that the price level in 20 years will be very close to the price level today, we can make better long-term investment and saving decisions.

Many macroeconomists believe, however, that, while a zero-inflation target might be sensible in an ideal economy, we do not live in a frictionless system. Perhaps the most important friction is the resistance of workers to declines in money wages. If the average wage level were stable, this would be the average of some wages that are rising and some that are falling. But workers and firms are extremely reluctant to cut money wages. Evidence for the downward rigidity of wages is found in a comprehensive government survey of wage changes in manufacturing over the period 1958–1978. During this period, on average less than 0.1 percent of workers received wage cuts, even in years when inflation was extremely low.

From a macroeconomic point of view, this suggests that zero inflation would be associated with a higher sustainable level of unemployment and a lower level of output than would be the case at an inflation rate of 2 to 4 percent. A recent study estimates that targeting stable prices would cost the United States between 1 and 3 percent lower output and employment *permanently* as compared with an inflation target of around 3 percent. The authors conclude:

> Downward rigidity [of wages] interferes with the ability of some firms to make adjustments in real wages, leading to inefficient reductions in employment. . . . The main implication for policymakers is that targeting zero inflation will lead to a large inefficiency in the allocation of resources, as reflected in an unemployment rate that is unnecessarily high.[3]

We can summarize our discussion in the following way:

While economists may disagree on the exact target for inflation, most agree that a predictable and gently rising price level provides the best climate for healthy economic growth. A careful sifting of the evidence suggests that low inflation like that seen recently in the United States has little impact on productivity or real output. By contrast, galloping inflation or hyperinflation can cause serious harm to productivity and to individuals through the redistribution of income and wealth.

B. MODERN INFLATION THEORY

Can market economies simultaneously enjoy the blessings of full employment and price stability? Is there no way to control inflation other than by economic slowdowns that keep unemployment undesirably high? If recessions are too high a price to pay for the control of inflation, do we need "incomes policies" that can lower inflation without raising unemployment?

Questions, questions, questions. Yet answers to these are critical to the economic health of modern mixed economies. In the balance of this chapter we explore modern inflation theory and analyze the costs of lowering inflation.

[3] See the reference to Akerlof, Dickens, and Perry in this chapter's Further Reading section.

PRICES IN THE *AS-AD* FRAMEWORK

There is no single source of inflation. Like illnesses, inflations occur for many reasons. Some inflations come from the demand side; others, from the supply side. But one key fact about modern inflations is that they develop an internal momentum and are costly to stop once under way.

Inertial Inflation

In modern industrial economies like the United States, inflation has great momentum and tends to persist at the same rate. Inertial inflation is like a lazy old dog. If the dog is not "shocked" by the push of a foot or the pull of a cat, it will stay put. Once disturbed, the dog may chase the cat, but then it eventually lies down in a new spot where it stays until the next shock.

During the 1990s, prices in the United States rose steadily at around 3 percent annually, and most people came to expect that inflation rate. This expected rate of inflation was built into the economy's institutions. Wage agreements between labor and management were designed around a 3 percent inflation rate; government monetary and fiscal plans assumed a 3 percent rate. During this period, the *inertial rate of inflation* was 3 percent per year. Other names sometimes heard for this concept are the *core, underlying,* or *expected* inflation rate.

While inflation can persist at the same rate for a while, history shows that shocks to the economy tend to push inflation up or down. The economy is constantly subject to changes in aggregate demand, sharp oil- and commodity-price changes, poor harvests, movements in the foreign exchange rate, productivity changes, and countless other economic events that push inflation away from its inertial rate.

The economy has an ongoing **inertial rate of inflation** to which people's expectations have adapted. This built-in inertial inflation rate tends to persist until a shock causes it to move up or down.

Demand-Pull Inflation

One of the major shocks to inflation is a change in aggregate demand. In earlier chapters we saw that changes in investment, government spending, or net exports can change aggregate demand and propel output beyond its potential. We also saw how a nation's central bank can affect economic activity. Whatever the reason, **demand-pull inflation** occurs when aggregate demand rises more rapidly than the economy's productive potential, pulling prices up to equilibrate aggregate supply and demand. In effect, demand dollars are competing for the limited supply of commodities and bid up their prices. As unemployment falls and workers become scarce, wages are bid up and the inflationary process accelerates.

One important factor behind demand inflation is rapid *money-supply growth.* Increases in the money supply increase aggregate demand, which in turn increases the price level. Thus, when the German central bank printed billions and billions of paper marks in 1922–1923 and they came into the marketplace in search of bread or housing, it was no wonder that the German price level rose a billionfold. This was demand-pull inflation with a vengeance. This scene was replayed when the Russian government financed its budget deficit by printing rubles in the early 1990s. The result was an inflation rate that averaged 25 percent *per month* [or $100 \times (1.25^{12} - 1) = 1355$ percent per year].[4]

Figure 32-6 illustrates the process of demand-pull inflation in terms of aggregate supply and demand. Starting from an initial equilibrium at point *E*,

[4] The next chapter's review of alternative approaches to macroeconomics examines "monetarist" theories, which hold that price changes depend principally on changes in the money supply.

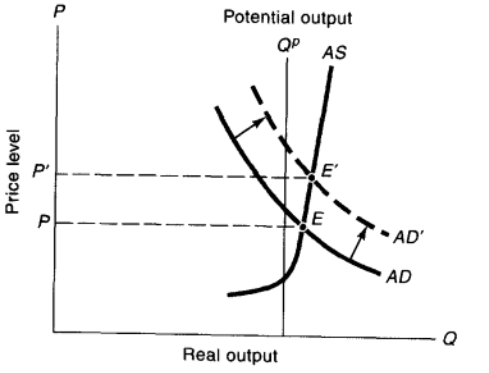

FIGURE 32-6. Demand-Pull Inflation Occurs When Too Much Spending Chases Too Few Goods

When aggregate demand increases, the rising spending is competing for limited goods. Prices rise from *P* to *P'* in demand-pull inflation. How would cost-push inflation be analyzed in this framework?

suppose there is an expansion of spending that pushes the *AD* curve up and to the right. The economy's equilibrium moves from E to E'. At this higher level of demand, prices have risen from P to P'. Demand-pull inflation has taken place.

Cost-Push Inflation

The rudiments of demand-pull inflation were understood by the classical economists and used by them to explain historical price movements. But a strange thing happened during the last half-century—the inflation process changed. Look back at the history of prices on page 670 and note that prices today travel a one-way street—up in recessions, up faster in booms. What differentiates modern inflation from the simple demand-pull variety is that prices and wages rise even in recessions when 30 percent of factory capacity lies idle and 10 percent of the labor force is unemployed. This phenomenon is known as *cost-push* or *supply-shock* inflation.

Inflation resulting from rising costs during periods of high unemployment and slack resource utilization is called **cost-push inflation.**

In looking for explanations of cost-push inflation, economists often start with wages. In 1982, for example, when the unemployment rate was almost 10 percent, wages rose 5 percent. Wages tend to rise even in recession because they are administered prices and because of the strong resistance to wage cuts.

Sometimes, cost-push shocks lead to an upward push to inflation. In 1973, in 1978, and again in late 1999 and early 2000, countries were minding their own macroeconomic business when severe shortages in oil markets occurred. Oil prices rose sharply, business costs of production increased, and a sharp burst of cost-push inflation followed. Sometimes, cost shocks are favorable. For example, during the 1990s, the United States enjoyed downward pressure on aggregate supply because of rapid productivity growth; falling energy, import, and commodity prices; and favorable trends in health costs.

Expectations and Inertial Inflation

Why, you might ask, does inflation have such strong inertia or momentum? The answer is that most prices and wages are set with an eye to future economic conditions. When prices and wages are rising rapidly and are expected to continue doing so, businesses and workers tend to build the rapid rate of inflation into their price and wage decisions. High or low inflation expectations tend to be self-fulfilling prophecies.

We can use a hypothetical example to illustrate the role of expectations in inertial inflation. Say that in 2004, Brass Mills Inc., a nonunionized light-manufacturing firm, was contemplating its annual wage and salary decisions for 2005. Its sales were growing well, and it was experiencing no major supply or demand shocks. Brass Mills' chief economist reported that no major inflationary or deflationary shocks were foreseen, and the major forecasting services were expecting national wage growth of 4 percent in 2005. Brass Mills had conducted a survey of local companies and found that most employers were planning on increases in compensation of 3 to 5 percent during the next year. All the signals, then, pointed to wage increases of around 4 percent for 2005 over 2004.

In examining its own internal labor market, Brass Mills determined that its wages were in line with the local labor market. Because the managers did not want to fall behind local wages, Brass Mills decided that it would try to match local wage increases. It therefore set wage increases at the expected market increase, an average 4 percent wage increase for 2005.

The process of setting wages and salaries with an eye to expected future economic conditions can be extended to virtually all employers. This kind of reasoning also applies to many product prices—such as college tuitions, automobile-model prices, and long-distance telephone rates—that cannot be easily changed after they have been set. Because of the length of time involved in modifying inflation expectations and in adjusting most wages and many prices, inertial inflation will yield only to major shocks or changes in economic policy.

Figure 32-7 illustrates the process of inertial inflation. Suppose that potential output is constant and that there are no supply or demand shocks. If everyone expects average costs and prices to rise at 3 percent each year, the *AS* curve will shift upward at 3 percent per year. If there are no demand shocks, the *AD* curve will also shift up at that rate. The intersection of the *AD* and *AS* curves will be 3 percent higher each year. Hence, the macroeconomic equilibrium moves from E to E' to E''. Prices are rising 3 percent from one year to the next; inertial inflation has set in at 3 percent.

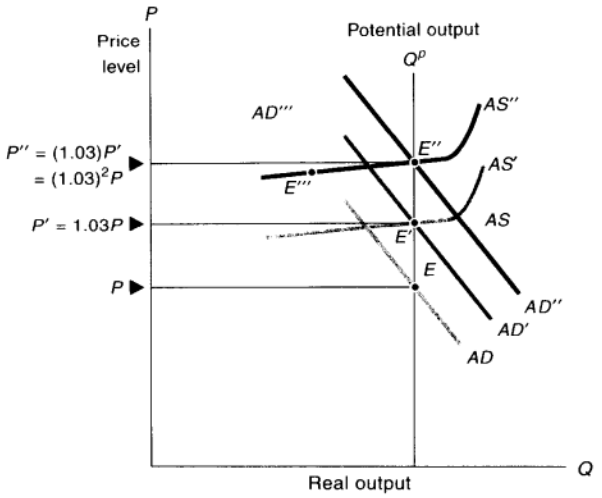

FIGURE 32-7. An Upward Spiral of Prices and Wages Occurs When Aggregate Supply and Demand Shift Up Together.

Suppose that production costs and *AD* rise by 3 percent each year. *AS* and *AD* curves would shift up 3 percent each year. As the equilibrium moves from *E* to *E'* to *E''*, prices march up steadily because of inertial inflation.

Inertial inflation occurs when the *AS* and *AD* curves are moving steadily upward at the same rate.

Price Levels vs. Inflation

Using Figure 32-7 above, we can make the useful distinction between movements in the price level and movements in inflation. In general, an increase in aggregate demand will raise prices, other things being equal. Similarly, an upward shift in the *AS* curve resulting from an increase in wages and other costs will raise prices, other things being equal.

But of course other things always change; in particular, *AD* and *AS* curves never sit still. Figure 32-7 shows, for example, the *AS* and *AD* curves marching up together.

What if there were an unexpected shift in the *AS* or *AD* curve during the third period? How would prices and inflation be affected? Suppose, for example, that the third period's *AD''* curve shifted to the left to *AD'''* because of a monetary contraction. This might cause a recession, with a new equilibrium at *E'''* on the *AS''* curve. At this point, output would have fallen below potential; prices and the inflation rate would be lower than at *E''*, but the economy would still be experiencing inflation because the price level at *E'''* is still above the previous period's equilibrium *E'* with price *P'*.

This example is a reminder that supply or demand shocks may reduce the price level below the level it would otherwise have attained. Nonetheless, because of inflation's momentum, the economy may continue to experience inflation.

THE PHILLIPS CURVE

A useful way of understanding inflation is the **Phillips curve.** This curve shows the relationship between unemployment and inflation. The basic idea is that when output is high and unemployment is low, wages and prices tend to rise more rapidly. This occurs because workers and unions press more strongly

for wage increases when jobs are plentiful, and firms can more easily raise prices when sales are brisk. The converse also holds—high unemployment tends to slow inflation.

Short-Run Phillips Curve

Macroeconomists distinguish between the short-run Phillips curve and the long-run Phillips curve. A typical short-run Phillips curve is shown in Figure 32-8. On the diagram's horizontal axis is the unemployment rate. On the black left-hand vertical scale is the annual rate of price inflation. The rust right-hand vertical scale shows the rate of money-wage inflation. As you move leftward on the Phillips curve by reducing unemployment, the rate of price and wage increase indicated by the curve becomes higher.

An important piece of inflation arithmetic underlies this curve. Say that labor productivity (output per worker) rises at a steady rate of 1 percent each year. Further, assume that firms set prices on the basis of average labor costs, so prices always change just as much as average labor costs per unit of output. If wages are rising at 4 percent, and productivity is rising at 1 percent, then average labor costs will rise at 3 percent. Consequently, prices will also rise at 3 percent.

Using this inflation arithmetic, we can see the relation between wage and price increases in Figure 32-8. These two scales in the figure differ only by the assumed rate of productivity growth (so the price change of 4 percent per year would correspond to a wage change of 5 percent per year if productivity grew by 1 percent per year and if prices always rose as fast as average labor costs).

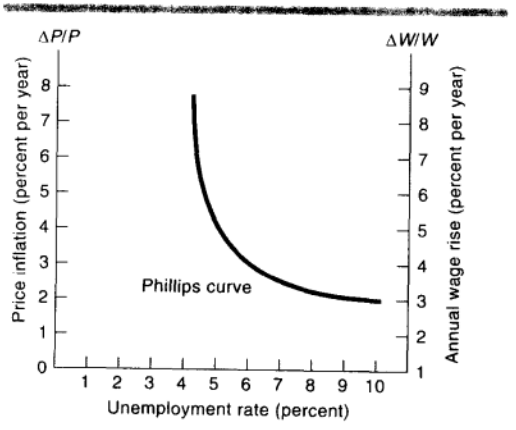

FIGURE 32-8. The Short-Run Phillips Curve Depicts the Tradeoff between Inflation and Unemployment

A short-run Phillips curve shows the inverse relationship between inflation and unemployment. The rust wage-change scale on the right-hand vertical axis is higher than the black left-hand inflation scale by the assumed 1 percent rate of growth of average labor productivity.

The Logic of Wage-Price Arithmetic

This relationship between prices, wages, and productivity can be formalized as follows: The fact that prices are based on average labor costs per unit of output implies that P is always proportional to WL/Q, where P is the price level, W is the wage rate, L is labor-hours, and Q is output. Assume that average labor productivity (Q/L) is growing smoothly at 1 percent per year. Hence, if wages are growing at 4 percent annually, prices will grow at 3 percent annually (= 4 percent growth in wages − 1 percent growth in productivity). More generally,

$$\text{Rate of inflation} = \text{rate of wage growth} - \text{rate of productivity growth}$$

This shows the relationship between price inflation and wage inflation.

We can illustrate how closely this relationship holds with actual numbers for a high-inflation period and for a low-inflation period. The following table shows the major long-run determinants of inflation to be wage growth and productivity change. From the first to the second period, inflation rose because wage growth increased slightly while productivity fell sharply. In the last 2 years, inflation was very low because wage growth was restrained while productivity growth rebounded.

	Rate of CPI inflation (%)	Rate of wage growth (%)	Rate of productivity growth (%)
1959–1973	3.1	5.8	3.2
1974–1997	6.0	6.3	1.5
1998–1999	2.4	3.9	2.5

Source: Bureau of Labor Statistics data on the business sector, at www.bls.gov.

The Nonaccelerating Inflation Rate of Unemployment

Economists who looked carefully at inflationary periods noticed that the Phillips curve drawn in Figure 32-8 was quite unstable. Based on theoretical work of Edmund Phelps and Milton Friedman, along with statistical tests of the actual history, macroeconomists developed the modern theory of inflation, which distinguishes between the long run and the short run. The downward-sloping Phillips curve of Figure 32-8 holds only in the short run. In the long run, the Phillips curve is *vertical*, not downward-sloping. This approach implies that in the long-run there is a minimum unemployment rate that is consistent with steady inflation. This is the *nonaccelerating inflation rate of unemployment* or *NAIRU* (pronounced "nay-rew").[5]

The **nonaccelerating inflation rate of unemployment** (or **NAIRU**) is that unemployment rate consistent with a constant inflation rate. At the NAIRU, upward and downward forces on price and wage inflation are in balance, so there is no tendency for inflation to change. The NAIRU is the lowest unemployment rate that can be sustained without upward pressure on inflation.

The idea behind the NAIRU is that the state of the economy can be divided into three situations:

- *Excess demand.* When markets are extremely tight, with low unemployment and high utilization of capacity, then prices and wages will be subject to demand-pull inflation and rising inflation.
- *Excess supply.* In recessionary situations, with high unemployment and idled factories, firms tend to sell at discounts and workers push less aggressively for wage increases. Wage and price inflation tend to moderate.
- *Neutral pressures.* Sometimes the economy is operating "in neutral." The upward wage pressures from job vacancies just match the downward wage pressures from unemployment. There are no supply shocks from oil or other exogenous sources. Here, the economy is at the NAIRU, and inflation neither rises nor falls.

[5] Other terms will sometimes be encountered. The original name for the NAIRU was the "natural rate of unemployment." This term is unsatisfactory because there is nothing natural about the NAIRU.

From Short Run to Long Run

How does the economy move from the short run to the long run? The basic idea is that when price changes are unanticipated, the short-run Phillips curve tends to shift up or down. This point is illustrated by a series of steps in a "boom cycle" here and in Figure 32-9:

- *Period 1.* In the first period, unemployment is at the NAIRU. There are no demand or supply surprises, and the economy is at point *A* on the lower short-run Phillips curve (*SRPC*) in Figure 32-9.
- *Period 2.* Next, suppose there is an economic expansion which lowers the unemployment rate. As unemployment declines, firms recruit workers more vigorously, giving larger wage increases than formerly. As output approaches capacity, price markups rise. Wages and prices begin to accelerate. In terms of our Phillips curve, the economy moves up and to the left to point *B* on its short-run Phillips curve (along *SRPC* in Figure 32-9). As shown in the figure, inflation expectations have not yet changed, so the economy stays on the original Phillips curve, on *SRPC*. The lower unemployment rate raises inflation during the second period.
- *Period 3.* Because inflation has risen, firms and workers are surprised, and they revise upward their inflationary expectations. They begin to incorporate the higher expected inflation into their wage and price decisions. The result is a *shift in the short-run Phillips curve.* We can see the new curve as *SRPC'* in Figure 32-9. The new short-run Phillips curve lies above the original Phillips curve, reflecting the higher expected rate of inflation. We have drawn the curve so that the new expected inflation rate for period 3 equals the actual inflation rate in period 2. If a slowdown in economic activity brings the unemployment rate back to the NAIRU in period 3, the economy moves to point *C*. Even though the unemployment rate is the same as it was in period 1, actual inflation will be higher, reflecting the upward shift in the short-run Phillips curve.

Note the surprising outcome. Because the expected inflation rate has increased, the rate of inflation is higher in period 3 than during period 1 even though the unemployment rate is the same. The economy in period 3 will have the same *real* GDP and unemployment rate as it did in period 1, even though

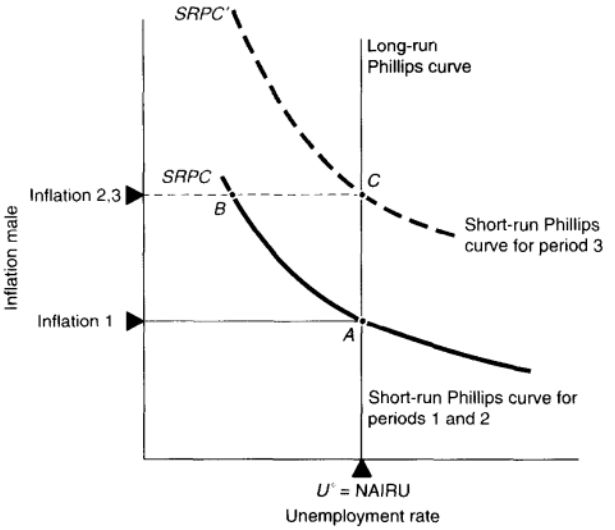

FIGURE 32-9. The Shifting Phillips Curve

This figure shows how economic expansion leads to an inflationary surprise and an upward shift in the short-run Phillips curve. The steps in the shift are explained by the bullets in the text. Note that if you connect points *A*, *B*, and *C*, the shifting curve produces a clockwise loop.

the *nominal* magnitudes (prices and nominal GDP) are now growing more rapidly than they did before the expansion raised the expected rate of inflation.

We can also track a "recession cycle" that occurs when unemployment rises and the actual inflation rate falls below its expected rate. The expected rate of inflation declines in recessions, and the economy enjoys a lower inflation rate when it returns to the NAIRU. This painful cycle of austerity occurred during the Carter-Volcker-Reagan wars against inflation during 1979–1984.

The Vertical Long-Run Phillips Curve

When the unemployment rate departs from the NAIRU, the inflation rate will tend to change. What happens if the gap between the actual unemployment rate and the NAIRU persists? For example, say that the NAIRU is 5 percent while the actual unemployment rate is 3 percent. Because of the gap, inflation will tend to rise from year to year. Inflation might be 3 percent in the first year, 4 percent in the second year, 5 percent in the third year—and might continue to move upward thereafter. When would this upward spiral stop? It stops only when unemployment moves back to the NAIRU. Put differently, as long as unemployment is below the NAIRU, wage inflation will tend to increase.

The opposite behavior will be seen at high unemployment. In that case, inflation will tend to fall as long as unemployment is above the NAIRU.

Only when unemployment is *at* the NAIRU will inflation stabilize; only then will the shifts of supply and demand in different labor markets be in balance; only then will inflation—at whatever is its inertial rate—tend neither to increase nor to decrease.

The modern theory of inflation has important implications for economic policy. It implies that there is a minimum level of unemployment that an economy can enjoy in the long run. If the economy is pushed to very high levels of output and employment, this will ignite an upward spiral of wage and price inflation. This theory also provides a formula for curbing inflation. When the inflation rate is too high, a country can tighten money, trigger a recession,

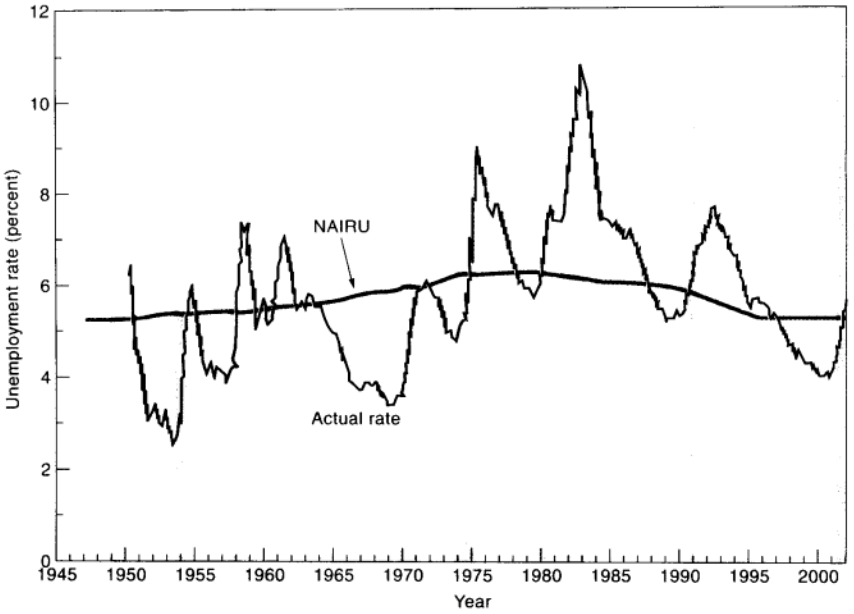

FIGURE 32-10. Actual Unemployment Rate and NAIRU

The NAIRU is the unemployment rate at which upward and downward forces acting on inflation are in balance.

Source: Actual unemployment rate from Bureau of Labor Statistics; NAIRU from estimates of the Congressional Budget Office.

raise the unemployment rate above the NAIRU, and thereby reduce inflation.

The NAIRU defines the neutral zone between excessive tightness/rising inflation and high unemployment/falling inflation. In the short run, inflation can be reduced by raising unemployment above the NAIRU, but in the long run, the NAIRU is the lowest sustainable rate of unemployment.

Quantitative Estimates

Although the NAIRU is a crucial macroeconomic concept, precise numerical estimates of the NAIRU have proved elusive. Many macroeconomists have used advanced techniques to estimate the NAIRU. For this text, we have adopted the estimates prepared by the Congressional Budget Office (CBO). According to the CBO, the NAIRU rose gradually from the 1950s, peaked at 6.3 percent of the labor force around 1980, and declined to 5.2 percent by 2002. CBO estimates, along with the actual unemployment rate through the end of 1999, are shown in Figure 32-10.

The Inflation Puzzle of the 1990s

The United States experienced a period of unusual macroeconomic stability and prosperity in the late 1990s. Output grew rapidly, unemployment fell sharply, and inflation was at its lowest rate for three decades.

While most Americans were satisfied with the robust economic growth, macroeconomists were puzzled about the unusual behavior of wages and prices. Economic studies from earlier periods suggested that wage and price inflation would begin to rise when unemployment fell below the NAIRU, which was generally thought to be around 5½ percent of the labor force. Unemployment fell below 5 percent for 3 years running, starting in 1997. Yet inflation fell over this period.