859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 859

chapter: 32

>> Inflation, Disinflation, and Deflation

BRINGING A SUITCASE TO THE BANK

By the summer of 2008, the African nation of Zimbabwe had achieved an unenviable distinction: in June 2008 it had the world's highest inflation rate, 11 million percent a year. Although the government kept introducing ever-larger denominations of its currency, the Zimbabwe dollar—for example, in May 2008 it introduced a half-billion dollar bill—it still took a lot of currency to pay for the necessities of life: a stack of Zimbabwean cash worth $100 U.S. dollars weighed about 40 pounds. Zimbabwean currency was worth so little that some people withdrawing funds from banks brought suitcases along, in order to be able to walk away with enough cash to pay for ordinary living expenses.

Phillimon Bulawayo/epa/Corbis

In 2008, the Zimbabwe dollar was so devalued by extreme inflation that this much currency was needed to pay for a single loaf of bread.

Zimbabwe's experience was shocking, but not unprecedented. In 1994 the inflation rate in Armenia hit 27,000%. In 1991 Nicaraguan inflation exceeded 60,000%. And even Zimbabwe's inflation was mild compared with history's most famous example of extreme inflation, which took place in Germany in 1922–1923. Toward the end of the German hyperinflation, prices were rising 16% a *day,* which—through compounding—meant an increase of approximately 500 billion percent over the course of five months. People became so reluctant to hold paper money, which lost value by the hour, that eggs and lumps of coal began to circulate as currency. German firms would pay their workers several times a day so that they could spend their earnings before they lost value (lending new meaning to the term *hourly wage*). Legend has it that men sitting down at a bar would order two beers at a time, out of fear that the price of a beer would rise before they could order a second round!

The United States has never experienced that kind of inflation. The worst inflation the U.S. has seen in modern times took place at the end of the 1970s, when consumer prices were rising at an annual rate of 13%. Yet inflation at even that rate was profoundly troubling to the American public, and the policies the Federal Reserve pursued in order to get U.S. inflation back down to an acceptable rate led to the deepest recession since the Great Depression.

What causes inflation to rise and fall? In this chapter, we'll look at the underlying reasons for inflation. We'll see that the underlying causes of very high inflation, the type of inflation suffered by Zimbabwe, are quite different from the causes of more moderate inflation. We'll also learn why *disinflation,* a reduction in the inflation rate, is often very difficult. Finally, we'll discuss the special problems associated with a falling price level, or deflation.

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 860

WHAT YOU WILL LEARN IN THIS CHAPTER:

- Why efforts to collect an **inflation tax** by printing money can lead to high rates of inflation and hyperinflation
- What the **Phillips curve** is and the nature of the short-run trade-off between inflation and unemployment
- Why there is no long-run trade-off between inflation and unemployment
- Why expansionary policies are limited due to the effects of expected inflation
- Why even moderate levels of inflation can be hard to end
- Why deflation is a problem for economic policy and leads policy makers to prefer a low but positive inflation rate
- Why the nominal interest rate cannot go below the **zero bound** and the danger this poses of the economy falling into a **liquidity trap,** making conventional monetary policy ineffective

Money and Inflation

As we'll see later in this chapter, moderate levels of inflation such as those experienced in the United States—even the double-digit inflation of the late 1970s—can have complex causes. But very high inflation is always associated with rapid increases in the money supply.

To understand why, we need to revisit the effect of changes in the money supply on the overall price level. Then we'll turn to the reasons governments sometimes increase the money supply very rapidly.

The Classical Model of Money and Prices

In Chapter 31, we learned that in the short run an increase in the money supply increases real GDP by lowering the interest rate and stimulating investment spending and consumer spending. However, in the long run, as nominal wages and other sticky prices rise, real GDP falls back to its original level. So in the long run, an increase in the money supply does not change real GDP. Instead, other things equal, it leads to an equal percent rise in the overall price level; that is, the prices of all goods and services in the economy, including nominal wages and the prices of intermediate goods, rise by the same percentage as the money supply. And when the overall price level rises, the aggregate price level—the prices of all final goods and services—rises as well. As a result, a change in the *nominal* money supply, *M,* leads in the long run to a change in the aggregate price level that leaves the *real* quantity of money, *M/P,* at its original level. As a result, there is no long-run effect on aggregate demand or real GDP. For example, when Turkey dropped six zeros from its currency, the Turkish lira, in January 2005, Turkish real GDP did not change. The only thing that changed was the number of zeros in prices: instead of something costing 2,000,000 lira, it cost 2 lira.

This is, to repeat, what happens in the long run. When analyzing large changes in the aggregate price level, however, macroeconomists often find it useful to ignore the distinction between the short run and the long run. Instead, they work with a simplified model in which the effect of a change in the money supply on the aggregate price level takes place instantaneously rather than over a long period of time. You might be concerned about this assumption given that in previous chapters we've emphasized the difference between the short run and the long run. However, for reasons we'll explain shortly, this is a reasonable assumption to make in the case of high inflation.

A simplified model in which the real quantity of money, *M/P,* is always at its long-run equilibrium level is known as the **classical model of the price level,** because it was commonly used by "classical" economists who wrote before the work of John Maynard Keynes. To understand the classical model and why it is useful in the context of high inflation, let's revisit the *AD-AS* model and what it says about the effects of an increase in the money supply. (Unless otherwise noted, we will always be referring to changes in the *nominal* supply of money.)

According to the **classical model of the price level,** the real quantity of money is always at its long-run equilibrium level.

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 861

Figure 32-1 reviews the effects of an increase in the money supply according to the *AD–AS* model. The economy starts at E_1, a point of short-run and long-run macroeconomic equilibrium. It lies at the intersection of the aggregate demand curve, AD_1, and the short-run aggregate supply curve, $SRAS_1$. It also lies on the long-run aggregate supply curve, *LRAS*. At E_1, the equilibrium aggregate price level is P_1.

Now suppose there is an increase in the money supply. This is an expansionary monetary policy, which shifts the aggregate demand curve to the right, to AD_2, and moves the economy to a new short-run macroeconomic equilibrium at E_2. Over time, however, nominal wages adjust upward in response to the rise in the aggregate price level, and the *SRAS* curve shifts to the left, to $SRAS_2$. The new long-run macroeconomic equilibrium is at E_3, and real GDP returns to its initial level. As we learned in Chapter 31, the long-run increase in the aggregate price level from P_1 to P_3 is proportional to the increase in the money supply. As a result, in the long run changes in the money supply have no effect on the real quantity of money, M/P, or on real GDP. In the long run, money—as we learned—is *neutral*.

The classical model of the price level ignores the short-run movement from E_1 to E_2, assuming that the economy moves directly from one long-run equilibrium to another long-run equilibrium. In other words, it assumes that the economy moves directly from E_1 to E_3 and that real GDP never changes in response to a change in the money supply. In effect, in the classical model the effects of money supply changes are analyzed as if the short-run as well as the long-run aggregate supply curves were vertical.

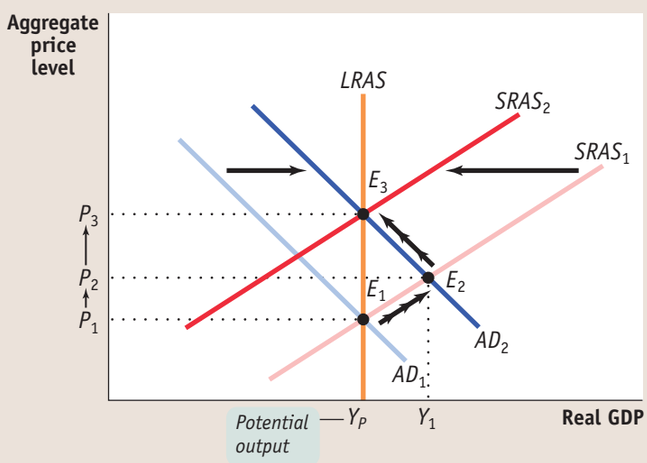
In reality, this is a poor assumption during periods of low inflation. With a low inflation rate, it may take a while for workers and firms to react to a monetary expansion by raising wages and prices. In this scenario, some nominal wages and the prices of some goods are sticky in the short run. As a result, under low inflation there is an upward-sloping *SRAS* curve, and changes in the money supply can indeed change real GDP in the short run.

But what about periods of high inflation? In the face of high inflation, economists have observed that the short-run stickiness of nominal wages and prices tends to vanish. Workers and businesses, sensitized to inflation, are quick to raise their wages and prices in response to changes in the money supply. This implies that under high inflation there is a quicker adjustment of wages and prices of intermediate goods than occurs in the case of low inflation. So the short-run aggregate supply curve shifts leftward more quickly and there is a more rapid return to long-run equilibrium

FIGURE 32-1

The Classical Model of the Price Level

Starting at E_1, an increase in the money supply shifts the aggregate demand curve rightward, as shown by the movement from AD_1 to AD_2. There is a new short-run macroeconomic equilibrium at E_2 and a higher price level at P_2. In the long run, nominal wages adjust upward and push the *SRAS* curve leftward to $SRAS_2$. The total percent increase in the price level from P_1 to P_3 is equal to the percent increase in the money supply. In the *classical model of the price level,* we ignore the transition period and think of the price level as rising to P_3 immediately. This is a good approximation under conditions of high inflation.



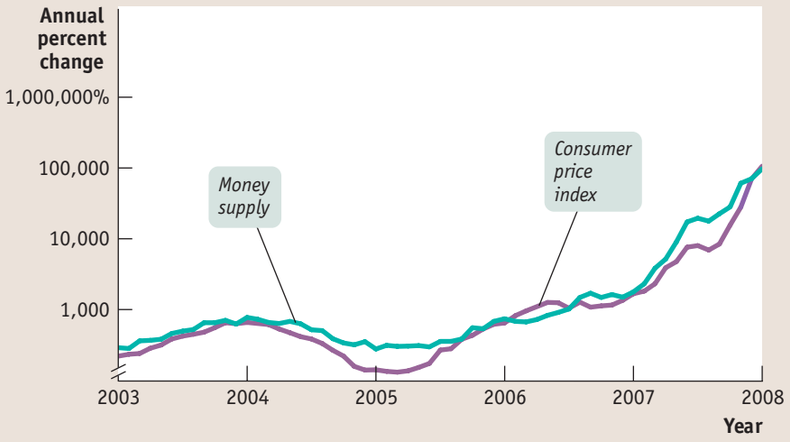
859-884_Krugman2e_Econ_Ch32.qxp 1/29/09 2:53 PM Page 862

FIGURE 32-2

Money Supply Growth and Inflation in Zimbabwe

This figure, drawn on a logarithmic scale, shows the annual rates of change of the money supply and the price level in Zimbabwe from 2003 through January 2008. The surges in the money supply were quickly reflected in a roughly equal surge in the price level.

Source: Reserve Bank of Zimbabwe.



under high inflation. As a result, the classical model of the price level is much more likely to be a good approximation of reality for economies experiencing persistently high inflation. The following For Inquiring Minds explains this point further.

The consequence of this rapid adjustment of all prices in the economy is that in countries with persistently high inflation, changes in the money supply are quickly translated into changes in the inflation rate. Let's look at Zimbabwe. Figure 32-2 shows the annual rate of growth in the money supply and the annual rate of change of consumer prices from 2003 through January 2008. As you can see, the surge in the growth rate of the money supply coincided closely with a roughly equal surge in the inflation rate. Note that to fit these very large percentage increases—several thousands of percent—onto the figure, we have drawn the vertical axis using a logarithmic scale.

What leads a country to increase its money supply so much that the result is an inflation rate in the millions of percent?

The Inflation Tax

Modern economies use fiat money—pieces of paper that have no intrinsic value but are accepted as a medium of exchange. In the United States and most other wealthy countries, the decision about how many pieces of paper to issue is placed in the hands of a central bank that is somewhat independent of the political process. However, this independence can always be taken away if politicians decide to seize control of monetary policy.

So what is to prevent a government from paying for some of its expenses not by raising taxes or borrowing but simply by printing money? Nothing. In fact, governments, including the U.S. government, do it all the time. How can the U.S. government do this, given that the Federal Reserve issues money, not the U.S. Treasury? The answer is that the Treasury and the Federal Reserve work in concert. The Treasury issues debt to finance the government's purchases of goods and services, and the Fed *monetizes* the debt by creating money and buying the debt back from the public through open-market purchases of Treasury bills. In effect, the U.S. government can and does raise revenue by printing money.

For example, in August 2007 the U.S. monetary base—bank reserves plus currency in circulation—was $20 billion larger than it had been a year earlier. This occurred because, over the course of that year, the Federal Reserve had issued $20 billion in money or its electronic equivalent and put it into circulation through open-market operations. To put it another way, the Fed created money out of thin air and used it to

859-884_Krugman2e_Econ_Ch32.qxp 1/29/09 2:53 PM Page 863

FOR INQUIRING MINDS

Indexing to Inflation

When an economy experiences high inflation year after year, people try to protect themselves from future inflation. The most common way of achieving such protection is through *indexation*—contracts are written so that the terms of the contract automatically adjust for inflation. When indexation spreads through the economy, prices become much more highly sensitive to changes in the money supply, even in the short run. Even in an economy without indexation, an increase in the money supply quickly pushes up the prices of some types of goods, such as raw materials. In a highly indexed economy, these higher prices feed rapidly into changes in the consumer price index. That, in turn, quickly leads to increases in wages, further leading to increases in other prices, which feed back into wages, and so on. The result is that the long run, the period in which an increase in the money supply raises the overall price level by the same percentage, arrives very quickly—typically in a matter of months. Under indexation, the prospect that a one-time increase in prices can spark a persistent rise in inflation poses a much greater risk.

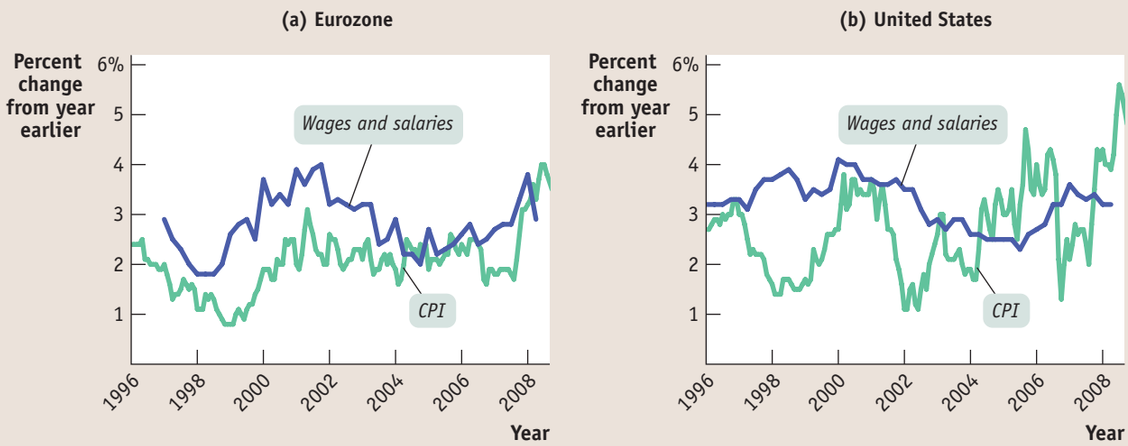
To evaluate the effects of indexation on wage contracts, we can compare the recent history of U.S. wages versus wages in the eurozone, the set of European countries that use the euro as their common currency. Nearly one-third of eurozone firms index their workers' wages to inflation, either formally or informally. In Spain, for example, the wages of nearly 70% of private-sector employees rise with the inflation rate. In contrast, less than 1% of American workers have wages indexed to inflation. Most economists believe the reason behind this disparity lies in the fact that organized labor plays a much greater role in the eurozone than in the United States. With powerful unions, eurozone workers are able to negotiate inflation-indexed wage contracts, with contracts for non-unionized workers often following the same pattern.

Figure 32-3 shows the recent history of the inflation rate and percentage changes in wages in the eurozone and in the United States. As you can see, inflation and wage growth in the eurozone tend to track one another; in contrast, the U.S. shows little linkage between inflation and wage growth. In fact, except for a brief period in 2007, since 2004 U.S. wage growth has lagged behind the inflation rate, leading to a lower real standard of living for many American workers.

So although both Spain and the United States saw their economies sharply slow in 2007 and 2008 in response to bursting housing bubbles, Spanish real wages rose but American real wages fell.

Because indexation tends to magnify price increases, transforming them into sustained inflation, the European Central Bank generally keeps a tighter leash on its economy and maintains a more hawkish stance toward inflation than the Federal Reserve. Indeed, during mid-2008, with both the U.S. and the eurozone clearly moving into recession, the European short-term interest rate stood at 4.25%, but the Fed funds rate stood at only 2%.

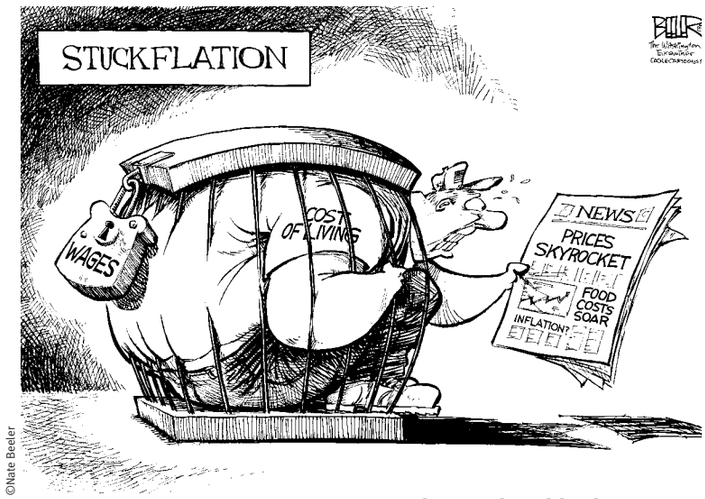
FIGURE 32-3 Inflation and Wages in Europe and in the United States



In the eurozone, wages and salaries are indexed to inflation to a much greater degree than in the United States. As a result, as panel (a) shows, eurozone wages and salaries track inflation closely. By contrast, as shown in panel (b), there is little correlation between U.S. wages and salaries and inflation. Since 2004, in most years the growth in U.S. wages has lagged behind the inflation rate.

Sources: European Central Bank; Eurostat; Bureau of Labor Statistics.

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 864



©Nate Beeler

buy valuable government securities from the private sector. It's true that the U.S. government pays interest on debt owned by the Federal Reserve—but the Fed, by law, hands the interest payments it receives on government debt back to the Treasury, keeping only enough to fund its own operations. In effect, then, the Federal Reserve's actions enabled the government to pay off $20 billion in outstanding government debt by printing money.

An alternative way to look at this is to say that the right to print money is itself a source of revenue. Economists refer to the revenue generated by the government's right to print money as *seignorage,* an archaic term that goes back to the Middle Ages. It refers to the right to stamp gold and silver into coins, and charge a fee for doing so, that medieval lords—seigneurs, in France—reserved for themselves.

Seignorage accounts for only a tiny fraction (less than 1%) of the U.S. government's budget. Furthermore, concerns about seignorage don't have any influence on the Federal Reserve's decisions about how much money to print; the Fed is worried about inflation and unemployment, not revenue. But this hasn't always been true, even in America: both sides relied on seignorage to help cover budget deficits during the Civil War. And there have been many occasions in history when governments turned to their printing presses as a crucial source of revenue. According to the usual scenario, a government finds itself running a large budget deficit—and lacks either the competence or the political will to eliminate this deficit by raising taxes or cutting spending. Furthermore, the government can't borrow to cover the gap because potential lenders won't extend loans given the fear that the government's weakness will continue and leave it unable to repay its debts.

In such a situation, governments end up printing money to cover the budget deficit. But by printing money to pay its bills, a government increases the quantity of money in circulation. And as we've just seen, increases in the money supply translate into equally large increases in the aggregate price level. So printing money to cover a budget deficit leads to inflation.

Who ends up paying for the goods and services the government purchases with newly printed money? The people who currently hold money pay. They pay because inflation erodes the purchasing power of their money holdings. In other words, a government imposes an **inflation tax,** the reduction in the value of the money held by the public, by printing money to cover its budget deficit and creating inflation.

It's helpful to think about what this tax represents. If the inflation rate is 5%, then a year from now $1 will buy goods and services worth only $0.95 today. So a 5% inflation rate in effect imposes a tax rate of 5% on the value of all money held by the public.

But why would any government push the inflation tax to rates of hundreds or thousands of percent? We turn next to the logic of hyperinflation.

The Logic of Hyperinflation

Inflation imposes a tax on individuals who hold money. And, like most taxes, it will lead people to change their behavior. In particular, when inflation is high, people will try to avoid holding money and will instead substitute real goods as well as interest-bearing assets for money. In this chapter's opening story, we described how, during the German hyperinflation, people began using eggs or lumps of coal as a medium of exchange. They did this because lumps of coal maintained their real value over time but money didn't. Indeed, during the peak of German hyperinflation, people often burned paper money, which was less valuable than wood. Moreover, people don't just

The **inflation tax** is the reduction in the value of money held by the public caused by inflation.

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 865

reduce their nominal money holdings—they reduce their *real* money holdings, cutting the amount of money they hold so much that it actually has less purchasing power than the amount of money they would hold if inflation were low. Why? Because the more real money holdings they have, the greater the real amount of resources the government captures from them through the inflation tax.

We are now prepared to understand how countries can get themselves into situations of extreme inflation. High inflation arises when the government must print a large quantity of money, imposing a large inflation tax, to cover a large budget deficit.

Now, the seignorage collected by the government over a short period—say, one month—is equal to the change in the money supply over that period. Let's use M to represent the money supply and use the symbol Δ to mean "monthly change in." Then:

(32-1) Seignorage = ΔM

The money value of seignorage, however, isn't very informative by itself. After all, the whole point of inflation is that a given amount of money buys less and less over time. So it's more useful to look at *real* seignorage, the revenue created by printing money divided by the price level, P:

(32-2) Real seignorage = $\Delta M/P$

Equation 32-2 can be rewritten by dividing and multiplying by the current level of the money supply, M, giving us:

(32-3) Real seignorage = $(\Delta M/M) \times (M/P)$

or

Real seignorage = Rate of growth of the money supply × Real money supply

But as we've just explained, in the face of high inflation the public reduces the real amount of money it holds, so that the far right-hand term in Equation 32-3, M/P, gets smaller. Suppose that the government needs to print enough money to pay for a given quantity of goods and services—that is, it needs to collect a given *real* amount of seignorage. Then, as the real money supply, M/P, falls as people hold smaller amounts of real money, the government has to respond by accelerating the rate of growth of the money supply, $\Delta M/M$. This will lead to an even higher rate of inflation. And people will respond to this new higher rate of inflation by reducing their real money holdings, M/P, yet again. As the process becomes self-reinforcing, it can easily spiral out of control. Although the amount of real seignorage that the government must ultimately collect to pay off its deficit does not change, the inflation rate the government needs to impose to collect that amount rises. So the government is forced to increase the money supply more rapidly, leading to an even higher rate of inflation, and so on.

Here's an analogy: imagine a city government that tries to raise a lot of money with a special fee on taxi rides. The fee will raise the cost of taxi rides, and this will cause people to turn to easily available substitutes, such as walking or taking the bus. As taxi use declines, the government finds that its tax revenue declines and it must impose a higher fee to raise the same amount of revenue as before. You can imagine the ensuing vicious circle: the government imposes fees on taxi rides, which leads to less taxi use, which causes the government to raise the fee on taxi rides, which leads to even less taxi use, and so on.

Substitute the real money supply for taxi rides and the inflation rate for the increase in the fee on taxi rides, and you have the story of hyperinflation. A race develops between the government printing presses and the public: the presses churn out money at a faster and faster rate, to try to compensate for the fact that the public is reducing its real money holdings. At some point the inflation rate explodes into hyperinflation, and people are unwilling to hold any money at all (and resort to trading in eggs and lumps of coal). The government is then forced to abandon its use of the inflation tax and shut down the printing presses.

Keystone/Getty Images

In the 1920s, hyperinflation made German currency worth so little that children made kites from banknotes.

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 866

➤ECONOMICS IN ACTION

Zimbabwe's Inflation

As we noted in this chapter's opening story, Zimbabwe offers a recent example of a country experiencing very high inflation. Figure 32-2 showed that surges in Zimbabwe's money supply growth were matched by almost simultaneous surges in its inflation rate. But looking at rates of change doesn't give a true feel for just how much prices went up.

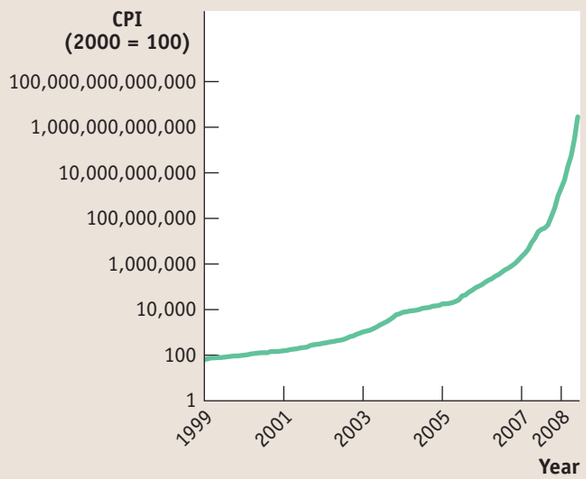
Figure 32-4 shows Zimbabwe's consumer price index from 1999 to June 2008, with the 2000 level set equal to 100. As in Figure 32-2, we also use a logarithmic scale, which lets us draw equal-sized percent changes as the same size. Over the course of just over nine years, consumer prices rose by approximately 4.5 trillion percent.

FIGURE 32-4

Consumer Prices in Zimbabwe, 1999–2008

Using a logarithmic scale, this figure plots Zimbabwe's consumer price index from 1999 to June 2008, with the 2000 level set equal to 100. By June 2008, when Zimbabwe's high inflation had turned into hyperinflation, consumer prices had risen by 4.5 trillion percent since January 1999.

Source: Reserve Bank of Zimbabwe.



Why did Zimbabwe's government pursue policies that led to runaway inflation? The reason boils down to political instability, which in turn had its roots in Zimbabwe's history. Until the 1970s, Zimbabwe had been ruled by its small white minority; even after the shift to majority rule, many of the country's farms remained in the hands of whites. Eventually Robert Mugabe, Zimbabwe's president, tried to solidify his position by seizing these farms and turning them over to his political supporters. But because this seizure disrupted production, the result was to undermine the country's economy and its tax base. It became impossible for the country's government to balance its budget either by raising taxes or by cutting spending. At the same time, the regime's instability left Zimbabwe unable to borrow money in world markets. Like many others before it, Zimbabwe's government turned to the printing press to cover the gap—leading to massive inflation. ▲

➤➤QUICK REVIEW

- The **classical model of the price level** does not distinguish between the short and the long run. It explains how increases in the money supply feed directly into inflation. It is a good description of reality only for countries with persistently high inflation or hyperinflation.
- Governments sometimes print money to cover a budget deficit. The resulting loss in the value of money is called the **inflation tax.**
- A high inflation rate causes people to reduce their real money holdings, leading to the printing of more money and higher inflation in order to collect the inflation tax. This can cause a self-reinforcing spiral into hyperinflation.

➤ CHECK YOUR UNDERSTANDING 32-1

1. Suppose there is a large increase in the money supply in an economy that previously had low inflation. As a consequence, aggregate output expands in the short run. What does this say about situations in which the classical model of the price level applies?
2. Suppose that all wages and prices in an economy are indexed to inflation. Can there still be an inflation tax?

Solutions appear at back of book.

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 867

Moderate Inflation and Disinflation

The governments of wealthy, politically stable countries like the United States and Britain don't find themselves forced to print money to pay their bills. Yet over the past 40 years both countries, along with a number of other nations, have experienced uncomfortable episodes of inflation. In the United States, the inflation rate peaked at 13% at the beginning of the 1980s. In Britain, the inflation rate reached 26% in 1975. Why did policy makers allow this to happen?

The answer, in brief, is that in the short run, policies that produce a booming economy also tend to lead to higher inflation, and policies that reduce inflation tend to depress the economy. This creates both temptations and dilemmas for governments.

First, imagine yourself as a politician facing an election in a year or two, and suppose that inflation is fairly low at the moment. You might well be tempted to pursue expansionary policies that will push the unemployment rate down, as a way to please voters, even if your economic advisers warn that this will eventually lead to higher inflation. You might also be tempted to find different economic advisers, who tell you not to worry: in politics, as in ordinary life, wishful thinking often prevails over realistic analysis.

Conversely, imagine yourself as a politician in an economy suffering from inflation. Your economic advisers will probably tell you that the only way to bring inflation down is to push the economy into a recession, which will lead to temporarily higher unemployment. Are you willing to pay that price? Maybe not.

This political asymmetry—inflationary policies often produce short-term political gains, but policies to bring inflation down carry short-term political costs—explains how countries with no need to impose an inflation tax sometimes end up with serious inflation problems. For example, that 26% rate of inflation in Britain was largely the result of the British government's decision in 1971 to pursue highly expansionary monetary and fiscal policies. Politicians disregarded warnings that these policies would be inflationary and were extremely reluctant to reverse course even when it became clear that the warnings had been correct.

But why do expansionary policies lead to inflation? To answer that question, we need to look first at the relationship between output and unemployment.

The Output Gap and the Unemployment Rate

In Chapter 28 we introduced the concept of *potential output,* the level of real GDP that the economy would produce once all prices had fully adjusted. Potential output typically grows steadily over time, reflecting long-run growth. However, as we learned from the aggregate demand–aggregate supply model, actual aggregate output fluctuates around potential output in the short run: a recessionary gap arises when actual aggregate output falls short of potential output; an inflationary gap arises when actual aggregate output exceeds potential output. Recall from Chapter 28 that the percentage difference between the actual level of real GDP and potential output is called the *output gap.* A positive or negative output gap occurs when an economy is producing more than or less than what would be "expected" because all prices have not yet adjusted. And wages, as we've learned, are the prices in the labor market.

Meanwhile, we learned in Chapter 24 that the unemployment rate is composed of cyclical unemployment and natural unemployment, the portion of the unemployment rate unaffected by the business cycle. So there is a relationship between the unemployment rate and the output gap. This relationship is defined by two rules:

- When actual aggregate output is equal to potential output, the actual unemployment rate is equal to the natural rate of unemployment.
- When the output gap is positive (an inflationary gap), the unemployment rate is *below* the natural rate. When the output gap is negative (a recessionary gap), the unemployment rate is *above* the natural rate.

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 868

In other words, fluctuations of aggregate output around the long-run trend of potential output correspond to fluctuations of the unemployment rate around the natural rate.

This makes sense. When the economy is producing less than potential output—when the output gap is negative—it is not making full use of its productive resources. Among the resources that are not fully utilized is labor, the economy's most important resource. So we would expect a negative output gap to be associated with unusually high unemployment. Conversely, when the economy is producing more than potential output, it is temporarily using resources at higher-than-normal rates. With this positive output gap, we would expect to see lower-than-normal unemployment.

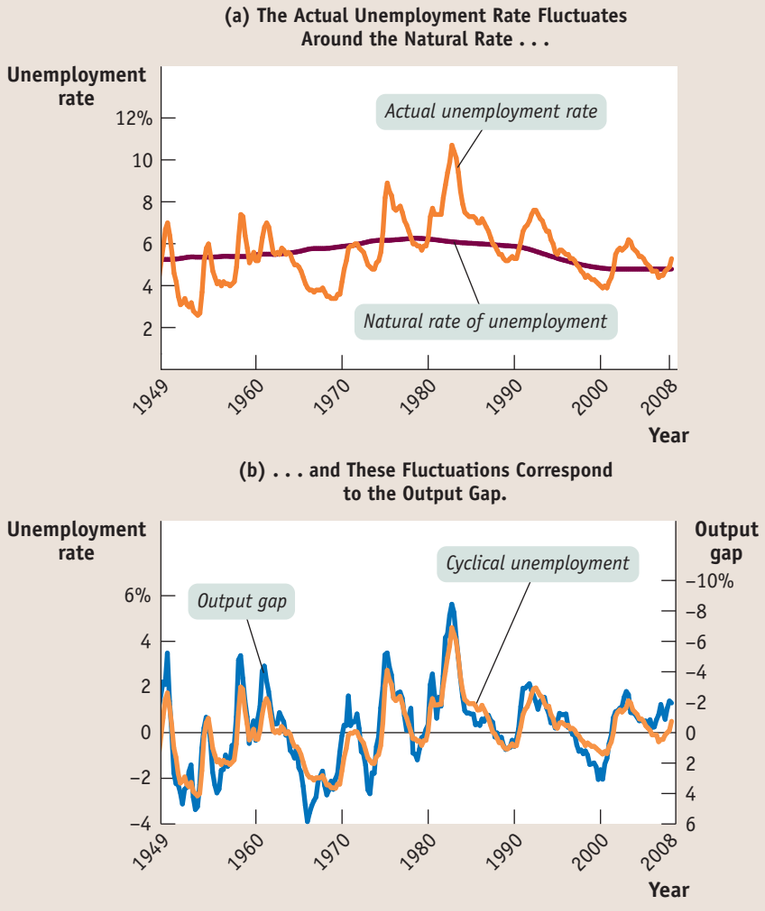
Figure 32-5 confirms this rule. Panel (a) shows the actual and natural rates of unemployment, as estimated by the Congressional Budget Office (CBO). Panel (b) shows two series. One is cyclical unemployment: the difference between the actual unemployment rate and the CBO estimate of the natural rate of unemployment, measured on the left. The other is the CBO estimate of the output gap, measured on the right. To make the relationship clearer, the output gap series is inverted—shown upside down—so that the line goes down if actual output rises above potential output and up if actual output falls below potential output. As you can see, the two series move together quite closely, showing the strong relationship between the output gap

FIGURE 32-5

Cyclical Unemployment and the Output Gap

Panel (a) shows the actual U.S. unemployment rate from 1949 to 2008, together with the Congressional Budget Office estimate of the natural rate of unemployment. The actual rate fluctuates around the natural rate, often for extended periods. Panel (b) shows cyclical unemployment—the difference between the actual unemployment rate and the natural rate of unemployment—and the output gap, also estimated by the CBO. The unemployment rate is measured on the left vertical axis, and the output gap is measured with an inverted scale on the right vertical axis. With an inverted scale, it moves in the same direction as the unemployment rate: when the output gap is positive, the actual unemployment rate is below its natural rate; when the output gap is negative, the actual unemployment rate is above its natural rate. The two series track one another closely, showing the strong relationship between the output gap and cyclical unemployment.

Source: Congressional Budget Office; Bureau of Labor Statistics; Bureau of Economic Analysis.



859-884_Krugman2e_Econ_Ch32.qxp 1/29/09 2:53 PM Page 869

FOR INQUIRING MINDS

Okun's Law

Although cyclical unemployment and the output gap move together, cyclical unemployment seems to move *less* than the output gap. For example, the output gap reached –8% in 1982, but the cyclical unemployment rate reached only 4%. This observation is the basis of an important relationship originally discovered by Arthur Okun, John F. Kennedy's chief economic adviser.

Modern estimates of **Okun's law**—the negative relationship between the output gap and the unemployment rate—typically find that a rise in the output gap of 1 percentage point reduces the unemployment rate by about ½ of a percentage point.

For example, suppose that the natural rate of unemployment is 5.2% and that the economy is currently producing at only 98% of potential output. In that case, the output gap is –2%, and Okun's law predicts an unemployment rate of $5.2\% - \frac{1}{2} \times (-2\%) = 6.2\%$.

The fact that a 1% rise in output reduces the unemployment rate by only ½ of 1% may seem puzzling: you might have expected to see a one-to-one relationship between the output gap and unemployment. Doesn't a 1% rise in aggregate output require a 1% increase in employment? And shouldn't that take 1% off the unemployment rate?

The answer is no: there are several well-understood reasons why the relationship isn't one-to-one. For one thing, companies often meet changes in demand in part by changing the number of hours their existing employees work. For example, a company that experiences a sudden increase in demand for its products may cope by asking (or requiring) its workers to put in longer hours, rather than by hiring more workers. Conversely, a company that sees sales drop will often reduce workers' hours rather than lay off employees. This behavior dampens the effect of output fluctuations on the number of workers employed.

Also, the number of workers looking for jobs is affected by the availability of jobs. Suppose that the number of jobs falls by 1 million. Measured unemployment will rise by less than 1 million because some unemployed workers become discouraged and give up actively looking for work. (Recall from Chapter 24 that workers aren't counted as unemployed unless they are actively seeking work.) Conversely, if the economy adds 1 million jobs, some people who haven't been actively looking for work will begin doing so. As a result, measured unemployment will fall by less than 1 million.

Finally, the rate of growth of labor productivity generally accelerates during booms and slows down or even turns negative during busts. The reasons for this phenomenon are the subject of some dispute among economists. The consequence, however, is that the effects of booms and busts on the unemployment rate are dampened.

and cyclical unemployment. Years of high cyclical unemployment, like 1982 or 1992, were also years of a strongly negative output gap. Years of low cyclical unemployment, like the late 1960s or 2000, were also years of a strongly positive output gap.

The Short-Run Phillips Curve

We've just seen that expansionary policies lead to a lower unemployment rate. Our next step in understanding the temptations and dilemmas facing governments is to show that there is a short-run trade-off between unemployment and inflation—lower unemployment tends to lead to higher inflation, and vice versa. The key concept is that of the *Phillips curve.*

The origins of this concept lie in a famous 1958 paper by the New Zealand–born economist A.W.H. Phillips. Looking at historical data for Britain, he found that when the unemployment rate was high, the wage rate tended to fall, and when the unemployment rate was low, the wage rate tended to rise. Using data from Britain, the United States, and elsewhere, other economists soon found a similar apparent relationship between the unemployment rate and the rate of inflation—that is, the rate of change in the aggregate price level. For example, Figure 32-6 on the next page shows the U.S. unemployment rate and the rate of consumer price inflation over each subsequent year from 1955 to 1968, with each dot representing one year's data.

Looking at evidence like Figure 32-6, many economists concluded that there is a negative short-run relationship between the unemployment rate and the inflation rate, which is called the **short-run Phillips curve,** or *SRPC.* (We'll explain the difference between the short-run and the long-run Phillips curve soon.) Figure 32-7 on the next page shows a hypothetical short-run Phillips curve.

Early estimates of the short-run Phillips curve for the United States were very simple: they showed a negative relationship between the unemployment rate and

Okun's law is the negative relationship between the output gap and cyclical unemployment.

The **short-run Phillips curve** is the negative short-run relationship between the unemployment rate and the inflation rate.

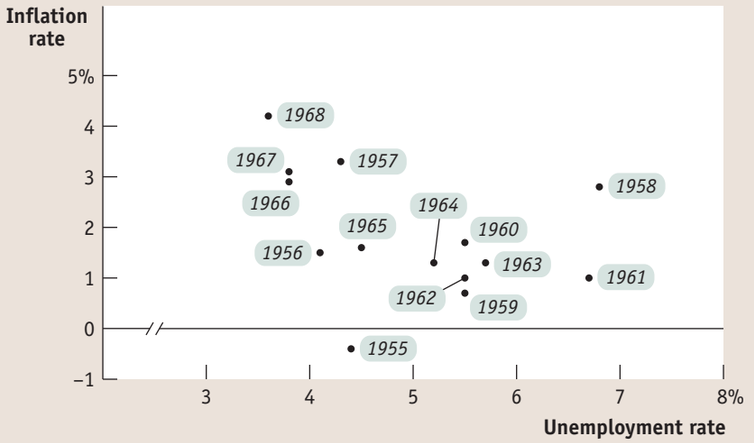
859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 870

FIGURE 32-6

Unemployment and Inflation, 1955–1968

Each dot shows the average U.S. unemployment rate for one year and the percentage increase in the consumer price index over the subsequent year. Data like this lay behind the initial concept of the Phillips curve.

Source: Bureau of Labor Statistics.



the inflation rate, without taking account of any other variables. During the 1950s and 1960s this simple approach seemed, for a while, to be adequate. And this simple relationship is clear in the data in Figure 32-6.

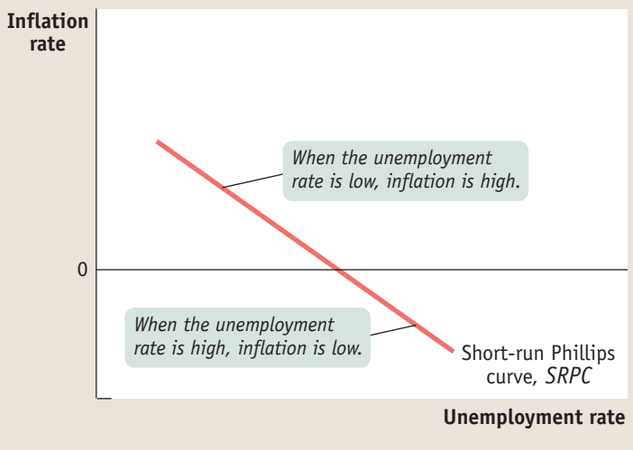
Even at the time, however, some economists argued that a more accurate short-run Phillips curve would include other factors. In Chapter 28 we discussed the effect of *supply shocks,* such as sudden changes in the price of oil, which shift the short-run aggregate supply curve. Such shocks also shift the short-run Phillips curve: surging oil prices were an important factor in the inflation of the 1970s and also played an important role in the acceleration of inflation in 2007–2008. In general, a negative supply shock shifts *SRPC* up, as the inflation rate increases for every level of the unemployment rate, and a positive supply shock shifts it down as the inflation rate falls for every level of the unemployment rate. Both outcomes are shown in Figure 32-9.

But supply shocks are not the only factors that can change the inflation rate. In the early 1960s, Americans had little experience with inflation as inflation rates had been low for decades. But by the late 1960s, after inflation had been steadily increasing for a

FIGURE 32-7

The Short-Run Phillips Curve

The short-run Phillips curve, *SRPC,* slopes downward because the relationship between the unemployment rate and the inflation rate is negative.



859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 871

FOR INQUIRING MINDS

The Aggregate Supply Curve and the Short-Run Phillips Curve

In earlier chapters we made extensive use of the *AD–AS* model, in which the short-run aggregate supply curve—a relationship between real GDP and the aggregate price level—plays a central role. Now we've introduced the concept of the short-run Phillips curve, a relationship between the unemployment rate and the rate of inflation. How do these two concepts fit together?

We can get a partial answer to this question by looking at panel (a) of Figure 32-8, which shows how changes in the aggregate price level and the output gap depend on changes in aggregate demand. Assume that in year 1 the aggregate demand curve is AD_1, the long-run aggregate supply curve is *LRAS,* and the short-run aggregate supply curve is *SRAS*. The initial macroeconomic equilibrium is at E_1, where the price level is 100 and real GDP is $10 trillion. Notice that at E_1 real GDP is equal to potential output, so the output gap is zero.

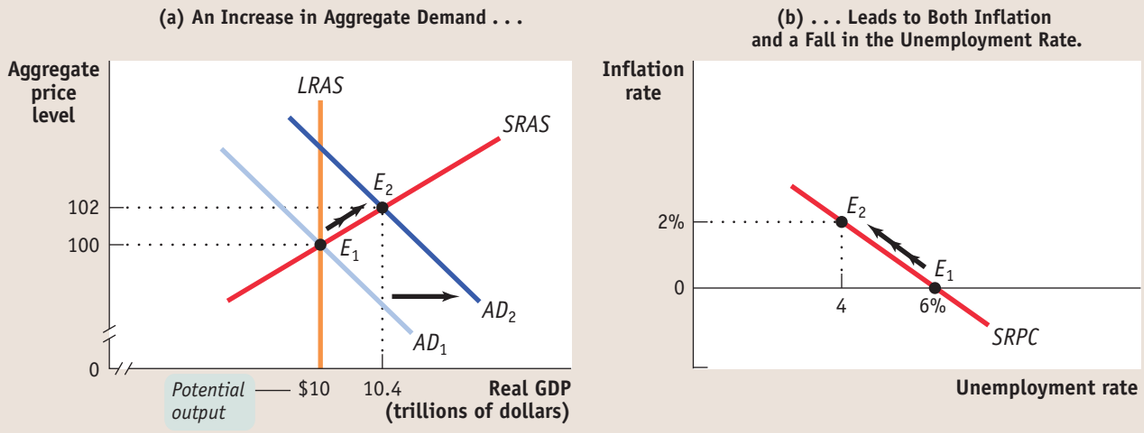
Now consider two possible paths for the economy over the next year. One is that aggregate demand remains unchanged and the economy stays at E_1. The other is that aggregate demand shifts rightward to AD_2 and the economy moves to E_2.

At E_2, real GDP is $10.4 trillion, $0.4 trillion more than potential output—a 4% output gap. Meanwhile, at E_2 the aggregate price level is 102—a 2% increase. So panel (a) tells us that in this example a zero output gap is associated with zero inflation and a 4% output gap is associated with 2% inflation.

Panel (b) shows what this implies for the relationship between unemployment and inflation. Assume that the natural rate of unemployment is 6% and that a rise of 1 percentage point in the output gap causes a fall of ½ percentage point in the unemployment rate per Okun's law, described in the previous For Inquiring Minds. In that case, the two cases shown in panel (a)—aggregate demand either staying put or rising—correspond to the two points in panel (b). At E_1, the unemployment rate is 6% and the inflation rate is 0%. At E_2, the unemployment rate is 4%, because an output gap of 4% reduces the unemployment rate by 4% × 0.5 = 2% below its natural rate of 6%—and the inflation rate is 2%. So there is a negative relationship between unemployment and inflation.

So does the short-run aggregate supply curve say exactly the same thing as the short-run Phillips curve? Not quite. The short-run aggregate supply curve seems to imply a relationship between the *change* in the unemployment rate and the inflation rate, but the short-run Phillips curve shows a relationship between the *level* of the unemployment rate and the inflation rate. Reconciling these views completely would go beyond the scope of this book. The important point is that the short-run Phillips curve is a concept that is closely related, though not identical, to the short-run aggregate supply curve.

FIGURE 32-8 The *AD–AS* Model and the Short-Run Phillips Curve



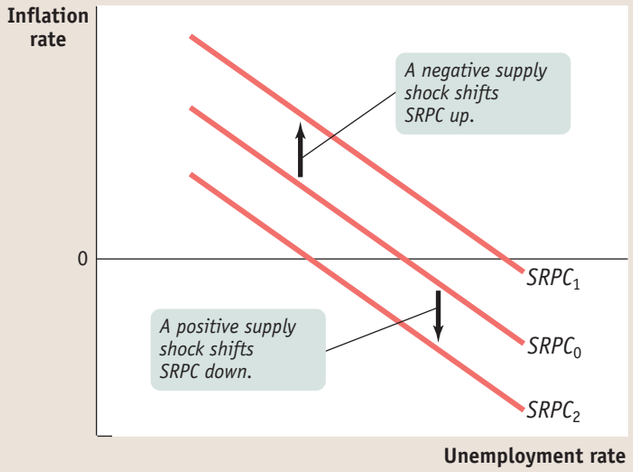
The short-run Phillips curve is closely related to the short-run aggregate supply curve. In panel (a), the economy is initially in equilibrium at E_1, with the aggregate price level at 100 and aggregate output at $10 trillion, which we assume is potential output. Now consider two possibilities. If the aggregate demand curve remains at AD_1, there is an output gap of zero and 0% inflation. If the aggregate demand curve shifts out to AD_2, there is an output gap of 4%—reducing unemployment to 4%—and 2% inflation. Assuming that the natural rate of unemployment is 6%, the implications for unemployment and inflation are as follows, shown in panel (b): if aggregate demand does not increase, 6% unemployment and 0% inflation will result; if aggregate demand does increase, 4% unemployment and 2% inflation will result.

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 872

FIGURE 32-9

The Short-Run Phillips Curve and Supply Shocks

A negative supply shock shifts the *SRPC* up, and a positive supply shock shifts the *SRPC* down.



number of years, Americans had come to expect future inflation. In 1968 two economists—Milton Friedman of the University of Chicago and Edmund Phelps of Columbia University—independently set forth a crucial hypothesis: that expectations about future inflation directly affect the present inflation rate. Today most economists accept that the *expected inflation rate*—the rate of inflation that employers and workers expect in the near future—is the most important factor, other than the unemployment rate, affecting inflation.

Inflation Expectations and the Short-Run Phillips Curve

The expected rate of inflation is the rate of inflation that employers and workers expect in the near future. One of the crucial discoveries of modern macroeconomics is that changes in the expected rate of inflation affect the short-run trade-off between unemployment and inflation and shift the short-run Phillips curve.

Why do changes in expected inflation affect the short-run Phillips curve? Put yourself in the position of a worker or employer about to sign a contract setting the worker's wages over the next year. For a number of reasons, the wage rate they agree to will be higher if everyone expects high inflation (including rising wages) than if everyone expects prices to be stable. The worker will want a wage rate that takes into account future declines in the purchasing power of earnings. He or she will also want a wage rate that won't fall behind the wages of other workers. And the employer will be more willing to agree to a wage increase now if hiring workers later will be even more expensive. Also, rising prices will make paying a higher wage rate more affordable for the employer because the employer's output will sell for more.

For these reasons, an increase in expected inflation shifts the short-run Phillips curve upward: the actual rate of inflation at any given unemployment rate is higher when the expected inflation rate is higher. In fact, macroeconomists believe that the relationship between changes in expected inflation and changes in actual inflation is one-to-one. That is, when the expected inflation rate increases, the actual inflation rate at any given unemployment rate will increase by the same amount. When the expected inflation rate falls, the actual inflation rate at any given level of unemployment will fall by the same amount.

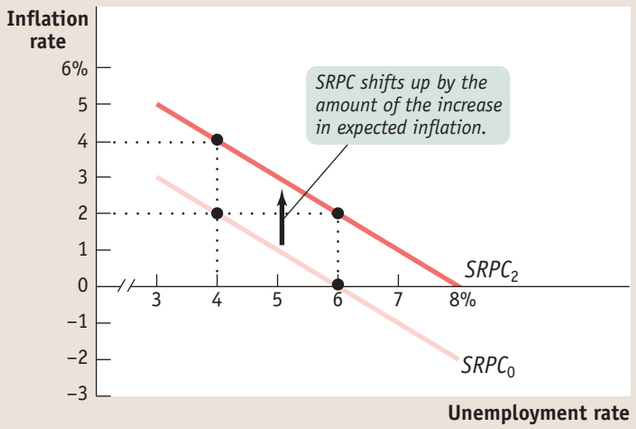
Figure 32-10 shows how the expected rate of inflation affects the short-run Phillips curve. First, suppose that the expected rate of inflation is 0%. $SRPC_0$ is the short-run Phillips curve when the public expects 0% inflation. According to $SRPC_0$,

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 873

FIGURE 32-10

Expected Inflation and the Short-Run Phillips Curve

An increase in expected inflation shifts the short-run Phillips curve up. $SRPC_0$ is the initial short-run Phillips curve with an expected inflation rate of 0%; $SRPC_2$ is the short-run Phillips curve with an expected inflation rate of 2%. Each additional percentage point of expected inflation raises the actual inflation rate at any given unemployment rate by 1 percentage point.



the actual inflation rate will be 0% if the unemployment rate is 6%; it will be 2% if the unemployment rate is 4%.

Alternatively, suppose the expected rate of inflation is 2%. In that case, employers and workers will build this expectation into wages and prices: at any given unemployment rate, the actual inflation rate will be 2 percentage points higher than it would be if people expected 0% inflation. $SRPC_2$, which shows the Phillips curve when the expected inflation rate is 2%, is $SRPC_0$ shifted upward by 2 percentage points at every level of unemployment. According to $SRPC_2$, the actual inflation rate will be 2% if the unemployment rate is 6%; it will be 4% if the unemployment rate is 4%.

What determines the expected rate of inflation? In general, people base their expectations about inflation on experience. If the inflation rate has hovered around 0% in the last few years, people will expect it to be around 0% in the near future. But if the inflation rate has averaged around 5% lately, people will expect inflation to be around 5% in the near future.

Since expected inflation is an important part of the modern discussion about the short-run Phillips curve, you might wonder why it was not in the original formulation of the Phillips curve. The answer lies in history. Think back to what we said about the early 1960s: at that time, people were accustomed to low inflation rates and reasonably expected that future inflation rates would also be low. It was only after 1965 that persistent inflation became a fact of life. So only then did it become clear that expected inflation would play an important role in price-setting.

➤ECONOMICS IN ACTION

From the Scary Seventies to the Nifty Nineties

Figure 32-6 showed that the American experience during the 1950s and 1960s supported the belief in the existence of a short-run Phillips curve for the U.S. economy, with a short-run trade-off between unemployment and inflation.

After 1969, however, that relationship appeared to fall apart according to the data. Figure 32-11 on the next page plots the track of U.S. unemployment and inflation rates from 1961 to 1990. As you can see, the track looks more like a tangled piece of yarn than like a smooth curve.

Through much of the 1970s and early 1980s, the economy suffered from a combination of above-average unemployment rates coupled with inflation rates unprecedented

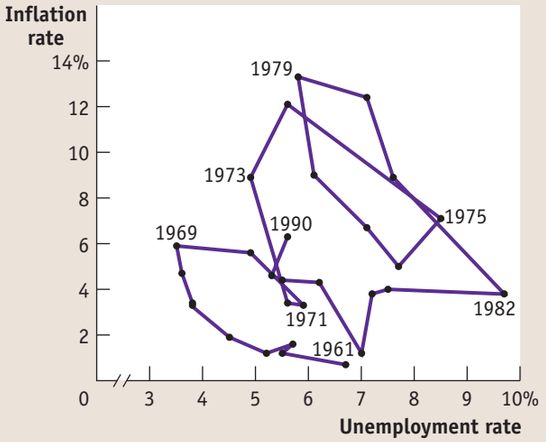
859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 874

FIGURE 32-11

Unemployment and Inflation, 1961–1990

During the 1970s, the short-run Phillips curve relationship that seemed to hold during the 1950s and 1960s broke down as the U.S. economy experienced a combination of high unemployment and high inflation. Economists believe this was the result both of negative supply shocks and the cumulative effect of several years of higher expected inflation. Inflation came down during the 1980s, and the 1990s were a time of both low unemployment and low inflation.

Source: Bureau of Labor Statistics.



in modern American history. This condition came to be known as *stagflation*—for stagnation combined with high inflation. In the late 1990s, by contrast, the economy was experiencing a blissful combination of low unemployment and low inflation. What explains these developments?

Part of the answer can be attributed to a series of negative supply shocks that the U.S. economy suffered during the 1970s. The price of oil, in particular, soared as wars and revolutions in the Middle East led to a reduction in oil supplies and as oil-exporting countries deliberately curbed production to drive up prices. Compounding the oil price shocks, there was also a slowdown in labor productivity growth. Both of these factors shifted the short-run Phillips curve upward. During the 1990s, by contrast, supply shocks were positive. Prices of oil and other raw materials were generally falling, and productivity growth accelerated. As a result, the short-run Phillips curve shifted downward.

Equally important, however, was the role of expected inflation. As mentioned earlier in the chapter, inflation accelerated during the 1960s. During the 1970s the public came to expect high inflation, and this also shifted the short-run Phillips curve up. It took a sustained and costly effort during the 1980s to get inflation back down. The result, however, was that expected inflation was very low by the late 1990s, allowing actual inflation to be low even with low rates of unemployment. ▲

>> QUICK REVIEW

- **Okun's law** describes the relationship between the output gap and cyclical unemployment.
- The **short-run Phillips curve** illustrates the negative relationship between unemployment and inflation.
- A negative supply shock shifts the short-run Phillips curve upward, but a positive supply shock shifts it downward.
- An increase in the expected rate of inflation pushes the short-run Phillips curve upward: each additional percentage point of expected inflation pushes the actual inflation rate at any given unemployment rate up by 1 percentage point.

CHECK YOUR UNDERSTANDING 32-2

1. Explain how the short-run Phillips curve illustrates the negative relationship between cyclical unemployment and the actual inflation rate for a given level of the expected inflation rate.
2. Which way does the short-run Phillips curve move in response to a fall in commodities prices? To a surge in commodities prices? Explain.

Solutions appear at back of book.

Inflation and Unemployment in the Long Run

The short-run Phillips curve says that at any given point in time there is a trade-off between unemployment and inflation. According to this view, policy makers have a choice: they can choose to accept the price of high inflation in order to achieve low unemployment. In fact, during the 1960s many economists believed that this trade-off represented a real choice.

However, this view was greatly altered by the later recognition that expected inflation affects the short-run Phillips curve. In the short run, expectations often diverge

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:06 PM Page 875

from reality. In the long run, however, any consistent rate of inflation will be reflected in expectations. If inflation is consistently high, as it was in the 1970s, people will come to expect more of the same; if inflation is consistently low, as it has been in recent years, that, too, will become part of expectations.

So what does the trade-off between inflation and unemployment look like in the long run, when actual inflation is incorporated into expectations? Most macroeconomists believe that there is, in fact, no long-run trade-off. That is, it is not possible to achieve lower unemployment in the long run by accepting higher inflation. To see why, we need to introduce another concept: the *long-run Phillips curve*.

The Long-Run Phillips Curve

Figure 32-12 reproduces the two short-run Phillips curves from Figure 32-10, $SRPC_0$ and $SRPC_2$. It also adds an additional short-run Phillips curve, $SRPC_4$, representing a 4% expected rate of inflation. In a moment, we'll explain the significance of the vertical long-run Phillips curve, *LRPC*.

Suppose that the economy has, in the past, had a 0% inflation rate. In that case, the current short-run Phillips curve will be $SRPC_0$, reflecting a 0% expected inflation rate. If the unemployment rate is 6%, the actual inflation rate will be 0%.

Also suppose that policy makers decide to trade off lower unemployment for a higher rate of inflation. They use monetary policy, fiscal policy, or both to drive the unemployment rate down to 4%. This puts the economy at point *A* on $SRPC_0$, leading to an actual inflation rate of 2%.

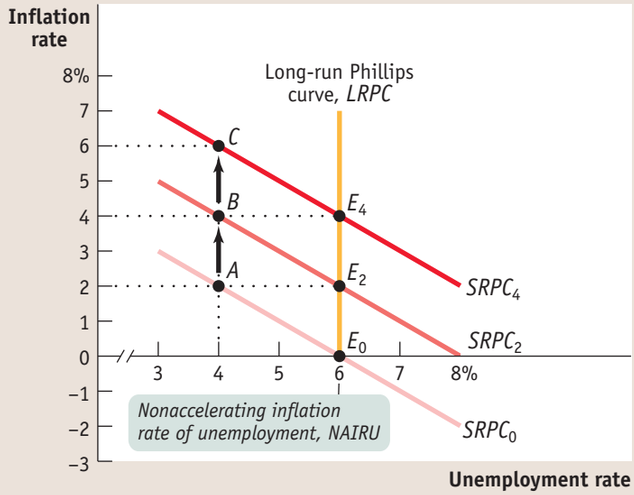
Over time, the public will come to expect a 2% inflation rate. *This increase in inflationary expectations will shift the short-run Phillips curve upward* to $SRPC_2$. Now, when the unemployment rate is 6%, the actual inflation rate will be 2%. Given this new short-run Phillips curve, policies adopted to keep the unemployment rate at 4% will lead to a 4% actual inflation rate—point *B* on $SRPC_2$—rather than point *A* with a 2% actual inflation rate.

Eventually, the 4% actual inflation rate gets built into expectations about the future inflation rate, and the short-run Phillips curve shifts upward yet again to $SRPC_4$. To keep the unemployment rate at 4% would now require accepting a 6% actual inflation rate, point *C* on $SRPC_4$, and so on. In short, a persistent attempt to trade off lower unemployment for higher inflation leads to *accelerating* inflation over time.

FIGURE 32-12

The NAIRU and the Long-Run Phillips Curve

$SRPC_0$ is the short-run Phillips curve when the expected inflation rate is 0%. At a 4% unemployment rate, the economy is at point *A* with an actual inflation rate of 2%. The higher inflation rate will be incorporated into expectations, and the *SRPC* will shift upward to $SRPC_2$. If policy makers act to keep the unemployment rate at 4%, the economy will be at *B* and the actual inflation rate will rise to 4%. Inflationary expectations will be revised upward again, and *SRPC* will shift to $SRPC_4$. At a 4% unemployment rate, the economy will be at *C* and the actual inflation rate will rise to 6%. Here, an unemployment rate of 6% is the NAIRU, or nonaccelerating inflation rate of unemployment. As long as unemployment is at the NAIRU, the actual inflation rate will match expectations and remain constant. An unemployment rate below 6% requires ever-accelerating inflation. The long-run Phillips curve, *LRPC*, which passes through E_0, E_2, and E_4, is vertical: no long-run trade-off between unemployment and inflation exists.



859-884_Krugman2e_Econ_Ch32.qxp 1/29/09 2:53 PM Page 876

The **nonaccelerating inflation rate of unemployment,** or **NAIRU,** is the unemployment rate at which inflation does not change over time.

The **long-run Phillips curve** shows the relationship between unemployment and inflation after expectations of inflation have had time to adjust to experience.

Disinflation is the process of bringing down inflation that is embedded in expectations.

To avoid accelerating inflation over time, the unemployment rate must be high enough that the actual rate of inflation matches the expected rate of inflation. This is the situation at E_0 on $SRPC_0$: when the expected inflation rate is 0% and the unemployment rate is 6%, the actual inflation rate is 0%. It is also the situation at E_2 on $SRPC_2$: when the expected inflation rate is 2% and the unemployment rate is 6%, the actual inflation rate is 2%. And it is the situation at E_4 on $SRPC_4$: when the expected inflation rate is 4% and the unemployment rate is 6%, the actual inflation rate is 4%. As we'll learn in the next chapter, this relationship between accelerating inflation and the unemployment rate is known as the *natural rate hypothesis.*

The unemployment rate at which inflation does not change over time—6% in Figure 32-12—is known as the **nonaccelerating inflation rate of unemployment,** or **NAIRU** for short. Keeping the unemployment rate below the NAIRU leads to ever-accelerating inflation and cannot be maintained. Most macroeconomists believe that there is a NAIRU and that there is no long-run trade-off between unemployment and inflation.

We can now explain the significance of the vertical line *LRPC.* It is the **long-run Phillips curve,** the relationship between unemployment and inflation in the long run, after expectations of inflation have had time to adjust to experience. It is vertical because any unemployment rate below the NAIRU leads to ever-accelerating inflation. In other words, the long-run Phillips curve shows that there are limits to expansionary policies because an unemployment rate below the NAIRU cannot be maintained in the long run. Moreover there is a corresponding point we have not yet emphasized: any unemployment rate above the NAIRU leads to decelerating inflation.

The Natural Rate of Unemployment, Revisited

Recall the concept of the natural rate of unemployment, the portion of the unemployment rate unaffected by the swings of the business cycle. Now we have introduced the concept of the *NAIRU.* How do these two concepts relate to each other?

The answer is that the NAIRU is another name for the natural rate. The level of unemployment the economy "needs" in order to avoid accelerating inflation is equal to the natural rate of unemployment.

In fact, economists estimate the natural rate of unemployment by looking for evidence about the NAIRU from the behavior of the inflation rate and the unemployment rate over the course of the business cycle. For example, the way major European countries learned, to their dismay, that their natural rates of unemployment were 9% or more was through unpleasant experience. In the late 1980s, and again in the late 1990s, European inflation began to accelerate as European unemployment rates, which had been above 9%, began to fall, approaching 8%.

In Figure 32-5 we cited Congressional Budget Office estimates of the U.S. natural rate of unemployment. The CBO has a model that predicts changes in the inflation rate based on the deviation of the actual unemployment rate from the natural rate. Given data on actual unemployment and inflation, this model can be used to deduce estimates of the natural rate—and that's where the CBO numbers come from.

The Costs of Disinflation

Through experience, policy makers have found that bringing inflation down is a much harder task than increasing it. The reason is that once the public has come to expect continuing inflation, bringing inflation down is painful.

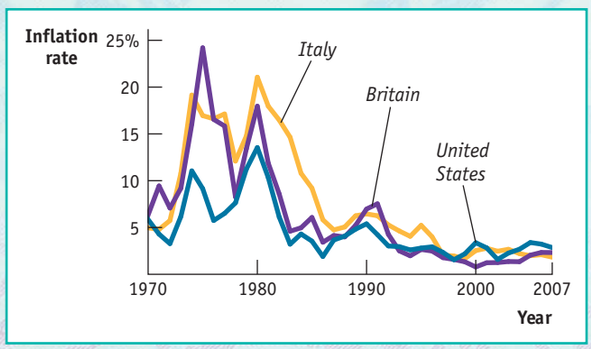
A persistent attempt to keep unemployment below the natural rate leads to accelerating inflation that becomes incorporated into expectations. To reduce inflationary expectations, policy makers need to run the process in reverse, adopting contractionary policies that keep the unemployment rate above the natural rate for an extended period of time. The process of bringing down inflation that has become embedded in expectations is known as **disinflation.**

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:07 PM Page 877

GLOBAL COMPARISON

DISINFLATION AROUND THE WORLD

The great disinflation of the 1980s wasn't unique to the United States. A number of other advanced countries also experienced high inflation during the 1970s, then brought inflation down during the 1980s at the cost of a severe recession. This figure shows the annual rate of inflation in Britain, Italy, and the United States from 1970 to 2007. All three nations experienced high inflation rates following the two oil shocks of 1973 and 1979, with the U.S. inflation rate the least severe of the three. All three nations then weathered severe recessions in order to bring inflation down. Since the 1980s, inflation has remained low and stable in all wealthy nations.



Source: OECD.

Disinflation can be very expensive. As the following Economics in Action documents, the U.S. retreat from high inflation at the beginning of the 1980s appears to have cost the equivalent of about 18% of a year's real GDP, the equivalent of roughly $2.6 trillion today. The justification for paying these costs is that they lead to a permanent gain. Although the economy does not recover the short-term production losses caused by disinflation, it no longer suffers from the costs associated with persistently high inflation. In fact, the United States, Britain, and other wealthy countries that experienced inflation in the 1970s eventually decided that the benefit of bringing inflation down was worth the required suffering—the large reduction in real GDP in the short term.

Some economists argue that the costs of disinflation can be reduced if policy makers explicitly state their determination to reduce inflation. A clearly announced, credible policy of disinflation, they contend, can reduce expectations of future inflation and so shift the short-run Phillips curve downward. Some economists believe that the clear determination of the Federal Reserve to combat the inflation of the 1970s was credible enough that the costs of disinflation, huge though they were, were lower than they might otherwise have been.

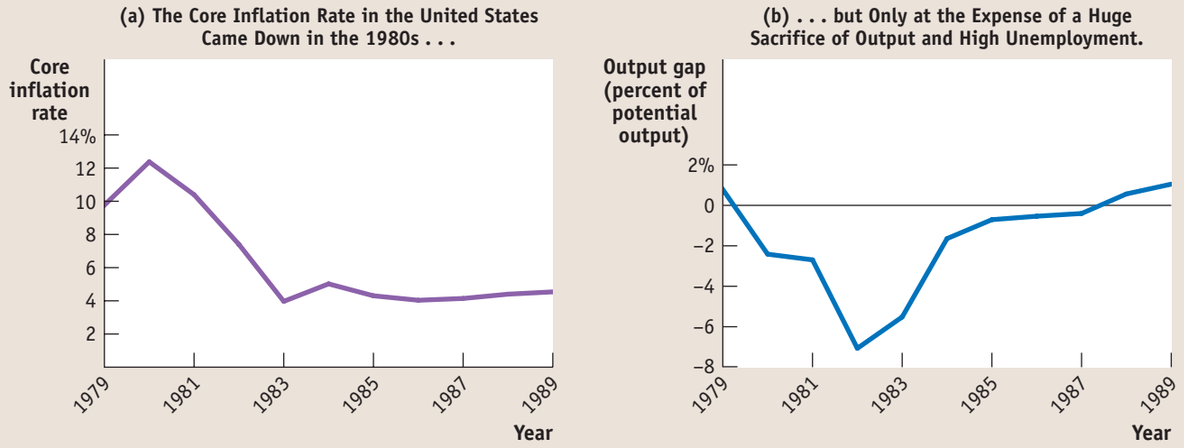
➤ECONOMICS IN ACTION

The Great Disinflation of the 1980s

As we've mentioned several times in this chapter, the United States ended the 1970s with a high rate of inflation, at least by its own peacetime historical standards—13% in 1980. Part of this inflation was the result of one-time events, especially a world oil crisis. But expectations of future inflation at 10% or more per year appeared to be firmly embedded in the economy.

859-884_Krugman2e_Econ_Ch32.qxp 1/29/09 2:53 PM Page 878

FIGURE 32-13 The Great Disinflation



Panel (a) shows the U.S. *core inflation rate,* which excludes food and energy. It shows the sharp fall in inflation during the 1980s. Panel (b) shows that disinflation came at a heavy cost: the economy developed a huge output gap, and actual aggregate output didn't return to potential output until 1987. If you add up the output gaps over the period, you find that the economy sacrificed about 18% of a year's real GDP. If we had to do that today, it would mean giving up roughly $2.6 trillion in goods and services.

Sources: Bureau of Labor Statistics; Congressional Budget Office.

By the mid-1980s, however, inflation was running at about 4% per year. Panel (a) of Figure 32-13 shows the annual rate of change in the "core" consumer price index (CPI)—also called the *core inflation rate.* This index, which excludes volatile energy and food prices, is widely regarded as a better indicator of underlying inflation trends than the overall CPI. By this measure, inflation fell from about 12% at the end of the 1970s to about 4% by the mid-1980s.

How was this disinflation achieved? At great cost. Beginning in late 1979, the Federal Reserve imposed strongly contractionary monetary policies, which pushed the economy into its worst recession since the Great Depression. Panel (b) shows the Congressional Budget Office estimate of the U.S. output gap from 1979 to 1989: by 1982, actual output was 7% below potential output, corresponding to an unemployment rate of more than 9%. Aggregate output didn't get back to potential output until 1987.

Our analysis of the Phillips curve tells us that a temporary rise in unemployment, like that of the 1980s, is needed to break the cycle of inflationary expectations. Once expectations of inflation are reduced, the economy can return to the natural rate of unemployment at a lower inflation rate. And that's just what happened.

But the cost was huge. If you add up the output gap over 1980–1987, you find that the economy sacrificed approximately 18% of an average year's output over the period. If we had to do the same thing today, that would mean giving up roughly $2.6 trillion worth of goods and services. ▲

QUICK REVIEW

- Policies that keep the unemployment rate below the **NAIRU,** the **nonaccelerating rate of inflation,** will lead to accelerating inflation as inflationary expectations adjust to higher levels of actual inflation. The NAIRU is equal to the natural rate of unemployment.
- The **long-run Phillips curve** is vertical and shows that an unemployment rate below the NAIRU cannot be maintained in the long run. As a result, there are limits to expansionary policies.
- **Disinflation** imposes high costs—unemployment and lost output—on an economy. Governments do it to avoid the costs of persistently high inflation.

CHECK YOUR UNDERSTANDING 32-3

1. Why is there no long-run trade-off between unemployment and inflation?
2. British economists believe that the natural rate of unemployment in that country rose sharply during the 1970s, from around 3% to as much as 10%. During that period, Britain experienced a sharp acceleration of inflation, which for a time went above 20%. How might these facts be related?
3. Why is disinflation so costly for an economy? Are there ways to reduce these costs?

Solutions appear at back of book.

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:07 PM Page 879

Deflation

Before World War II, *deflation*—a falling aggregate price level—was almost as common as inflation. In fact, the U.S. consumer price index on the eve of World War II was 30% lower than it had been in 1920. After World War II, inflation became the norm in all countries. But in the 1990s, deflation reappeared in Japan and proved difficult to reverse. Concerns about potential deflation played a crucial role in U.S. monetary policy in the early 2000s and again in late 2008.

Why is deflation a problem? And why is it hard to end?

Debt deflation is the reduction in aggregate demand arising from the increase in the real burden of outstanding debt caused by deflation.

There is a **zero bound** on the nominal interest rate: it cannot go below zero.

A **liquidity trap** is a situation in which conventional monetary policy is ineffective because nominal interest rates are up against the zero bound.

Debt Deflation

Deflation, like inflation, produces both winners and losers—but in the opposite direction. Due to the falling price level, a dollar in the future has a higher real value than a dollar today. So lenders, who are owed money, gain under deflation because the real value of borrowers' payments increases. Borrowers lose because the real burden of their debt rises.

In a famous analysis at the beginning of the Great Depression, Irving Fisher (who first analyzed the *Fisher effect* of expected inflation on interest rates, described in Chapter 26) claimed that the effects of deflation on borrowers and lenders can worsen an economic slump. Deflation, in effect, takes real resources away from borrowers and redistributes them to lenders. Fisher argued that borrowers, who lose from deflation, are typically short of cash and will be forced to cut their spending sharply when their debt burden rises. Lenders, however, are less likely to increase spending sharply when the values of the loans they own rise. The overall effect, said Fisher, is that deflation reduces aggregate demand, deepening an economic slump, which, in a vicious circle, may lead to further deflation. The effect of deflation in reducing aggregate demand, known as **debt deflation,** probably played a significant role in the Great Depression.

Effects of Expected Deflation

Like expected inflation, expected deflation affects the nominal interest rate. Look back at Figure 26-7, which demonstrated how expected inflation affects the equilibrium interest rate. In Figure 26-7, the equilibrium nominal interest rate is 4% if the expected inflation rate is 0%. Clearly, if the expected inflation rate is –3%—if the public expects deflation at 3% per year—the equilibrium nominal interest rate will be 1%.

But what would happen if the expected rate of inflation is –5%? Would the nominal interest rate fall to –1%, in which lenders are paying borrowers 1% on their debt? No. Nobody would lend money at a negative nominal rate of interest because they could do better by simply holding cash. This illustrates what economists call the **zero bound** on the nominal interest rate: it cannot go below zero.

This zero bound can limit the effectiveness of monetary policy. Suppose the economy is depressed, with output below potential output and the unemployment rate above the natural rate. Normally the central bank can respond by cutting interest rates so as to increase aggregate demand. If the nominal interest rate is already zero, however, the central bank cannot push it down any further. Banks refuse to lend and consumers and firms refuse to spend because, with a negative inflation rate and a 0% nominal interest rate, holding cash yields a positive real interest rate. Any further increases in the monetary base will either be held in bank vaults or held as cash by individuals and firms, without being spent.

A situation in which conventional monetary policy to fight a slump—cutting interest rates—can't be used because nominal interest rates are up against the zero bound is known as a **liquidity trap.** A liquidity trap can occur whenever there is a sharp reduction in demand for loanable funds—which is exactly what happened during the Great Depression. Figure 32-14 on the next page shows the interest rate on short-term U.S.

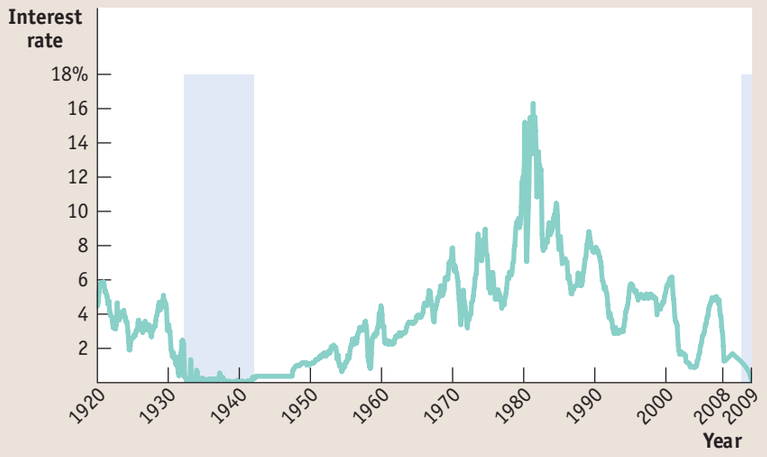
859-884_Krugman2e_Econ_Ch32.qxp 1/29/09 2:53 PM Page 880

FIGURE 32-14

The Zero Bound in U.S. History

This figure shows U.S. short-term interest rates, specifically the interest rate on three-month Treasury bills, since 1920. As shown by the shaded area at left, for much of the 1930s, interest rates were very close to zero, leaving little room for expansionary monetary policy. After World War II, persistent inflation generally kept rates well above zero. However, in late 2008, in the wake of the housing bubble bursting and the financial crisis, the interest rate on three-month Treasury bills was again virtually zero.

Source: Federal Reserve Bank of St. Louis.



government debt from 1920 to December 2008. As you can see, from 1933 until World War II brought a full economic recovery, the U.S. economy was either close to or up against the zero bound. After World War II, when inflation became the norm around the world, the zero bound largely vanished as a problem as the public came to expect inflation rather than deflation.

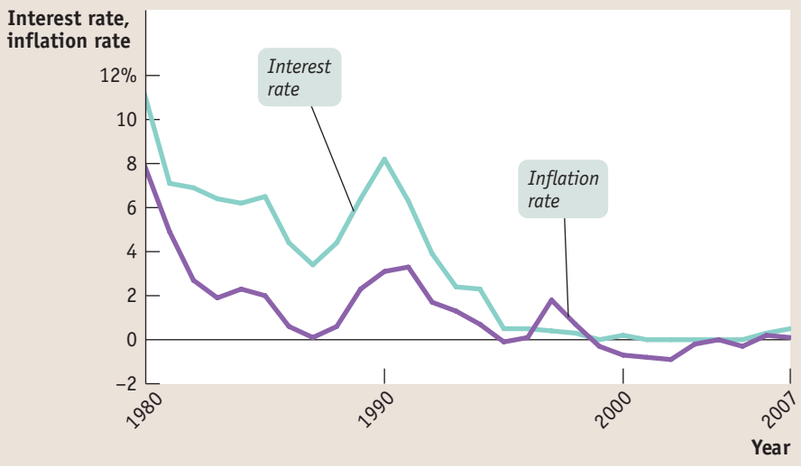
However, the recent history of the Japanese economy, shown in Figure 32-15, provides a modern illustration of the problem of deflation and the liquidity trap. Japan experienced a huge boom in the prices of both stocks and real estate in the late 1980s, then saw both bubbles burst. The result was a prolonged period of economic stagnation, the so-called Lost Decade, which gradually reduced the inflation rate and eventually led to persistent deflation. In an effort to fight the weakness of the economy, the Bank of Japan—the equivalent of the Federal

FIGURE 32-15

Japan's Lost Decade

A prolonged economic slump in Japan led to deflation from the late 1990s on. The Bank of Japan responded by cutting interest rates—but eventually ran up against the zero bound.

Source: OECD.



859-884_Krugman2e_Econ_Ch32.qxp 1/29/09 2:53 PM Page 881

Reserve—repeatedly cut interest rates. Eventually, it arrived at the ZIRP: the zero interest rate policy. The call money rate, the equivalent of the U.S. federal funds rate, was literally set equal to zero. Because the economy was still depressed, it would have been desirable to cut interest rates even further. But that wasn't possible: Japan was up against the zero bound.

As this book goes to press, the Federal Reserve also finds itself up against the zero bound. In the aftermath of the bursting of the housing bubble and the ensuing financial crisis, in late 2008 the interest on short-term U.S. government debt had fallen to virtually zero. As we discuss in the following Economics in Action, the Fed has turned to unconventional monetary policy as conventional policy has been rendered ineffective.

➤ECONOMICS IN ACTION

Turning Unconventional

In 2004, in response to fears of an overheating economy, the Federal Reserve began raising the target federal funds rate. As you can see in Figure 32-16, the rate went from 1% in mid-2004 to 5.25% by mid-2006. As intended, the increases slowed the economy and eventually pricked the housing bubble, the unsustainably high level of house prices that had developed when interest rates were low.

From mid-2006 to mid-2007, believing that troubles in the housing market would stay contained there, the Fed kept monetary policy unchanged. In mid-2007, however, a sharp increase in mortgage defaults led to massive losses in the banking industry and a financial meltdown. At first the Fed was slow to react; but by September 2007, stung by criticism that it was at risk of "getting behind the curve" in rescuing the economy, it began lowering the federal funds rate aggressively.

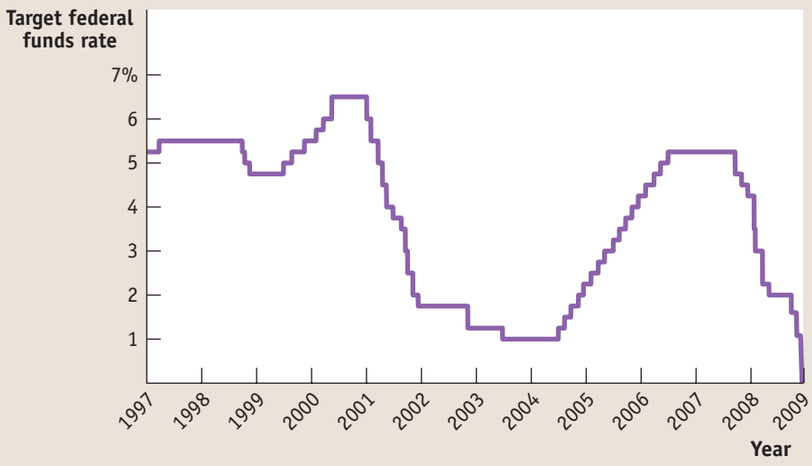
Why the sharp about-face by the Federal Reserve? Part of the answer lies in the background of Ben Bernanke, Chairman of the Fed. Bernanke, an authority on monetary policy and the Great Depression, understood the threat of deflation arising

FIGURE 32-16

Check Out Our Low, Low Rates

In late 2007, the Federal Reserve began aggressively cutting the target federal funds rate in an attempt to halt the economy's steep deterioration. But by late 2008, the federal funds rate had hit the zero bound, rendering conventional monetary policy ineffective. In response, the Federal Reserve has undertaken unconventional monetary policy, buying large amounts of corporate and other private-sector debt, such as securities backed by consumer credit card debt, to inject cash into the economy.

Source: Federal Reserve Bank of St. Louis.



859-884_Krugman2e_Econ_Ch32.qxp 1/29/09 2:53 PM Page 882

from a severe slump and how it could lead to a liquidity trap. Through repeated interest rate cuts, the Fed attempted to get back "ahead of the curve" to stabilize the economy and prevent deflationary expectations that could lead to a liquidity trap.

By the time this book went to press in December 2008, the federal funds rate had been cut to 0%, reaching the zero bound. The economy continued to deteriorate, although it's not yet clear that the economy is experiencing deflation. Understanding the limits of conventional monetary policy, Bernanke has engaged in "unconventional" monetary policy, such as buying large amounts of corporate debt to inject more cash into the economy. Understanding the urgency of the situation, the Fed has turned from conventional central bank to unconventional lender of last resort.▲

QUICK REVIEW

- Unexpected deflation helps lenders and hurts borrowers. This can lead to **debt deflation,** which has a contractionary effect on aggregate demand.
- Deflation makes it more likely that interest rates will end up against the **zero bound.** When this happens, the economy is in a **liquidity trap,** and monetary policy is ineffective.

CHECK YOUR UNDERSTANDING 32-4

1. Why won't anyone lend money at a negative nominal rate of interest? How can this pose problems for monetary policy?

Solution appears at back of book.

A LOOK AHEAD•••

As we saw in this chapter, the breakdown of the simple Phillips curve in the 1970s led to a major change in economists' understanding of the relationship between inflation and unemployment. This was a prime example of how real-world experience combines with developments in theory to drive the evolution of macroeconomic thought. In the next chapter, we'll look at how events and ideas have interacted to drive the evolution of macroeconomics over the past 70 years.]

SUMMARY

1. In analyzing high inflation, economists use the **classical model of the price level,** which says that changes in the money supply lead to proportional changes in the aggregate price level even in the short run.
2. Governments sometimes print money in order to finance budget deficits. When they do, they impose an **inflation tax,** generating tax revenue equal to the inflation rate times the money supply, on those who hold money. Revenue from the real inflation tax, the inflation rate times the real money supply, is the real value of resources captured by the government. In order to avoid paying the inflation tax, people reduce their real money holdings and force the government to increase inflation to capture the same amount of real inflation tax revenue. In some cases, this leads to a vicious circle of a shrinking real money supply and a rising rate of inflation, leading to hyperinflation and a fiscal crisis.
3. The output gap is the percentage difference between the actual level of real GDP and potential output. A positive output gap is associated with lower-than-normal unemployment; a negative output gap is associated with higher-than-normal unemployment. The relationship between the output gap and cyclical unemployment is described by **Okun's law.**
4. Countries that don't need to print money to cover government deficits can still stumble into moderate inflation, either because of political opportunism or because of wishful thinking.
5. At a given point in time, there is a downward-sloping relationship between unemployment and inflation known as the **short-run Phillips curve.** This curve is shifted by changes in the expected rate of inflation. The **long-run Phillips curve,** which shows the relationship between unemployment and inflation once expectations have had time to adjust, is vertical. It defines the **nonaccelerating inflation rate of unemployment,** or **NAIRU,** which is equal to the natural rate of unemployment.
6. Once inflation has become embedded in expectations, getting inflation back down can be difficult because **disinflation** can be very costly, requiring the sacrifice of large amounts of aggregate output and imposing high levels of unemployment. However, policy makers in the United States and other wealthy countries were willing to pay that price of bringing down the high inflation of the 1970s.
7. Deflation poses several problems. It can lead to **debt deflation,** in which a rising real burden of outstanding debt intensifies an economic downturn. Also, interest rates are more likely to run up against the **zero bound** in an economy experiencing deflation. When this happens, the economy enters a **liquidity trap,** rendering conventional monetary policy ineffective.

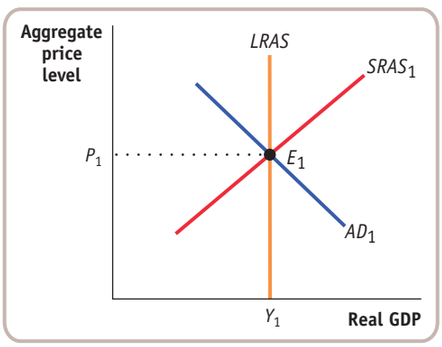
859-884_Krugman2e_Econ_Ch32.qxp 1/29/09 2:53 PM Page 883

KEY TERMS

Classical model of the price level, p. 860
Inflation tax, p. 864
Okun's law, p. 869
Short-run Phillips curve, p. 869
Nonaccelerating inflation rate of unemployment (NAIRU), p. 876
Long-run Phillips curve, p. 876
Disinflation, p. 876
Debt deflation, p. 879
Zero bound, p. 879
Liquidity trap, p. 879

PROBLEMS

1. In the economy of Scottopia, policy makers want to lower the unemployment rate and raise real GDP by using monetary policy. Using the accompanying diagram, show why this policy will ultimately result in a higher aggregate price level but no change in real GDP.



2. In the following examples, would the classical model of the price level be relevant?

a. There is a great deal of unemployment in the economy and no history of inflation.

b. The economy has just experienced five years of hyperinflation.

c. Although the economy experienced inflation in the 10% to 20% range three years ago, prices have recently been stable and the unemployment rate has approximated the natural rate of unemployment.

3. The Federal Reserve regularly releases data on the U.S. monetary base. You can access that data at various websites, including the website for the Federal Reserve Bank of St. Louis. Go to http://research.stlouisfed.org/fred2/ and click on "Reserves and Monetary Base," then on "Monetary Base," and then on "Board of Governors Monetary Base, Adjusted for Changes in Reserve Requirements" for the latest report. Use the Seasonally Adjusted (SA) series.

a. How much did the monetary base grow in the last month?

b. How did this help in the government's efforts to finance its deficit?

c. Why is it important for the central bank to be independent from the part of the government responsible for spending?

4. Answer the following questions about the (real) inflation tax, assuming that the price level starts at 1.

a. Maria Moneybags keeps $1,000 in her sock drawer for a year. Over the year, the inflation rate is 10%. What is the real inflation tax paid by Maria for this year?

b. Maria continues to keep the $1,000 in her drawer for a second year. What is the real value of this $1,000 at the beginning of the second year? Over the year, the inflation rate is again 10%. What is the real inflation tax paid by Maria for the second year?

c. For a third year, Maria keeps the $1,000 in the drawer. What is the real value of this $1,000 at the beginning of the third year? Over the year, the inflation rate is again 10%. What is the real inflation tax paid by Maria for the third year?

d. After three years, what is the cumulative real inflation tax paid?

e. Redo parts a through d with an inflation rate of 25%. Why is hyperinflation such a problem?

5. The inflation tax is often used as a significant source of revenue in developing countries where the tax collection and reporting system is not well developed and tax evasion may be high.

a. Use the numbers in the accompanying table to calculate the inflation tax in the United States and India (Rp = rupees).

	Inflation in 2006	Money supply in 2006 (billions)	Total government receipts in 2006 (billions)
India	5.79%	Rp8,070	Rp3,480
United States	3.23	$1,380	$2,200

Sources: IMF statistics and the budget offices of India and the United States.

b. How large is the inflation tax for the two countries when calculated as a percentage of government receipts?

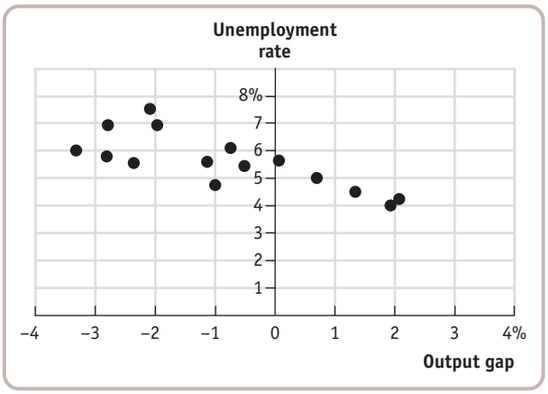
6. Concerned about the crowding-out effects of government borrowing on private investment spending, a candidate for president argues that the United States should just print money to cover the government's budget deficit. What are the advantages and disadvantages of such a plan?

7. The accompanying scatter diagram shows the relationship between the unemployment rate and the output gap in the United States from 1990 to 2004. Draw a straight line

859-884_Krugman2e_Econ_Ch32.qxp 1/26/09 3:07 PM Page 884

through the scatter of dots in the figure. Assume that this line represents Okun's law:

Unemployment rate = $b - (m \times$ Output gap)
where b is the vertical intercept and $-m$ is the slope



What is the unemployment rate when aggregate output equals potential output? What would the unemployment rate be if the output gap was 2%? What if the output gap was –3%? What do these results tell us about the coefficient m in Okun's law?

8. After experiencing a recession for the past two years, the residents of Albernia were looking forward to a decrease in the unemployment rate. Yet after six months of strong positive economic growth, the unemployment rate has fallen only slightly below what it was at the end of the recession. How can you explain why the unemployment rate did not fall as much although the economy was experiencing strong economic growth?

9. Due to historical differences, countries often differ in how quickly a change in actual inflation is incorporated into a change in expected inflation. In a country such as Japan, which has had very little inflation in recent memory, it will take longer for a change in the actual inflation rate to be reflected in a corresponding change in the expected inflation rate. In contrast, in a country such as Zimbabwe, which has recently had very high inflation, a change in the actual inflation rate will immediately be reflected in a corresponding change in the expected inflation rate. What does this imply about the short-run and long-run Phillips curves in these two types of countries? What does this imply about the effectiveness of monetary and fiscal policy to reduce the unemployment rate?

10. The accompanying table shows data for the average annual rates of unemployment and inflation for the economy of Britannia from 1998 to 2007. Use it to construct a scatter plot similar to Figure 32-6.

Year	Unemployment rate	Inflation rate
1998	4.0%	2.5%
1999	2.0	5.0
2000	10.0	1.0
2001	8.0	1.3
2002	5.0	2.0
2003	2.5	4.0
2004	6.0	1.7
2005	1.0	10.0
2006	3.0	3.0
2007	7.0	1.5

Are the data consistent with a short-run Phillips curve? If the government pursues expansionary monetary policies in the future to keep the unemployment rate below the natural rate of unemployment, how effective will such a policy be?

11. The accompanying table provides data from the United States on the average annual rates of unemployment and inflation. Use the numbers to construct a scatter plot similar to Figure 32-6. Discuss why, in the short run, the unemployment rate rises when inflation falls.

Year	Unemployment rate	Inflation rate
2000	4.0%	3.4%
2001	4.7	2.8
2002	5.8	1.6
2003	6.0	2.3
2004	5.5	2.7
2005	5.1	3.4
2006	4.6	3.2
2007	4.6	2.9

Source: IMF.

12. The economy of Brittania has been suffering from high inflation with an unemployment rate equal to its natural rate. Policy makers would like to disinflate the economy with the lowest economic cost possible. Assume that the state of the economy is not the result of a negative supply shock. How can they try to minimize the unemployment cost of disinflation? Is it possible for there to be no cost of disinflation?

13. Who are the winners and losers when a mortgage company lends $100,000 to the Miller family to buy a house worth $105,000 and during the first year prices unexpectedly fall by 10%? What would you expect to happen if the deflation continued over the next few years? How would continuing deflation affect borrowers and lenders throughout the economy as a whole?