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FIRST PAGES

CHAPTER

28

INFLATION, AGGREGATE SUPPLY, AND AGGREGATE DEMAND

During the summer and fall of 1996, Federal Reserve chairman Alan Greenspan was under increasing pressure by many economists to increase interest rates. The unemployment rate was falling and stood below 5.5 percent, generally considered to be the natural unemployment rate at that time. The rapid pace of economic growth suggested that an expansionary gap would soon appear, which meant that inflation would not be far behind. These economists urged Greenspan to increase the federal funds rate to slow the economy and prevent a possible surge in inflation.

Yet Greenspan was unconvinced. He thought he saw evidence of new economic developments that would permit the rapid growth to continue without increased inflation. If he was right, an aggressive increase in interest rates was not only unnecessary but could damage the economy. What did Greenspan see? Did the Fed raise interest rates in 1996? What happened to output and inflation? We will discuss Greenspan's decision later in this chapter (in Economic Naturalist 28.3), but first we need to introduce the basic framework for understanding inflation and the policies used to control it.

In the previous two chapters we made the assumption that firms are willing to meet the demand for their products at preset prices. When firms simply produce what is demanded, the level of planned aggregate expenditure determines the nation's real GDP. If the resulting level of short-run equilibrium output is lower than potential output, a recessionary output gap develops, and if the resulting level of output exceeds potential output, the economy experiences an expansionary gap. As we saw in the previous two chapters, policymakers can attempt to eliminate output gaps by taking actions that affect the level of autonomous expenditure, such as changing the level of government spending or taxes (fiscal policy) or using the Fed's control of the money supply to change the real interest rate (monetary policy).

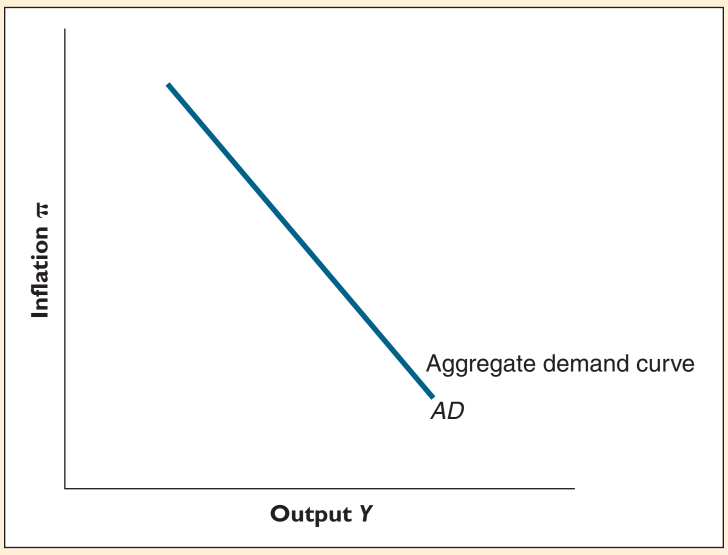
The basic Keynesian model is useful for understanding the role of spending in the short-run determination of output, but it is too simplified to provide a fully realistic description of the economy. The main shortcoming of the basic Keynesian model is that it does not explain the behavior of *inflation*. Indeed, the model represents a special case in which prices are constant and inflation is zero. Although firms may meet demand at preset prices for a time, as assumed in the basic Keynesian model, prices do *not* remain fixed indefinitely. Indeed, sometimes they may rise quite rapidly—the phenomenon of high inflation—imposing significant costs on the economy in the process. In this chapter, we will extend the basic Keynesian model to allow for ongoing inflation. As we will show, the extended model can be conveniently represented by a new diagram, called the *aggregate demand–aggregate supply diagram*. Using this extended analysis, we will be able to show how macroeconomic policies affect inflation as well as output, illustrating in the process the difficult trade-offs policymakers sometimes face. We will emphasize numerical and graphical analysis of output and inflation in the body of the chapter. The appendix at the end of the next chapter presents an algebraic treatment.

aggregate demand (AD) curve shows the relationship between short-run equilibrium output Y and the rate of inflation π, the name of the curve reflects the fact that short-run equilibrium output is determined by, and equals, total planned spending in the economy; increases in inflation reduce planned spending and short-run equilibrium output, so the aggregate demand curve is downward-sloping

INFLATION, SPENDING, AND OUTPUT: THE AGGREGATE DEMAND CURVE

To begin incorporating inflation into the model, our first step is to introduce a new relationship, called the *aggregate demand curve,* which is shown graphically in Figure 28.1. The **aggregate demand (*AD*) curve** shows the relationship between short-run equilibrium output Y and the rate of inflation, denoted π. The name of the curve reflects the fact that, as we have seen, short-run equilibrium output is determined by total planned spending, or demand, in the economy. Indeed, by definition, short-run equilibrium output *equals* planned aggregate expenditure, so

FIGURE 28.1
The Aggregate Demand Curve.
The aggregate demand curve *AD* shows the relationship between short-run equilibrium output Y and the rate of inflation π. Because short-run equilibrium output equals planned spending, the *AD* curve also shows the relationship between inflation and planned spending. The downward slope of the *AD* curve implies that an increase in inflation reduces short-run equilibrium output.



that we could just as well say that the *AD* curve shows the relationship between inflation and spending.[1]

We will see shortly that, all else being equal, *an increase in the rate of inflation tends to reduce short-run equilibrium output.* Therefore, in a diagram showing inflation π on the vertical axis and output Y on the horizontal axis (Figure 28.1), the aggregate demand curve is downward-sloping.[2] Note that we refer to the *AD* "curve," even though the relationship is drawn as a straight line in Figure 28.1. In general, the *AD* curve can be either straight or curving.

Why does higher inflation lead to a lower level of planned spending and short-run equilibrium output? As we will see next, one important reason is the Fed's response to increases in inflation.

INFLATION, THE FED, AND THE *AD* CURVE

One of the primary responsibilities of the Fed, or any central bank, is to maintain a low and stable rate of inflation. For example, in recent years, the Fed has tried to keep inflation in the United States in the range of 2 to 3 percent. By keeping inflation low, the central bank tries to avoid the costs high inflation imposes on the economy.

What can the Fed do to keep inflation low and stable? As we have already mentioned, one situation that is likely to lead to increased inflation is an expansionary output gap, in which short-run equilibrium output exceeds potential output. When output is above potential output, firms must produce at above-normal capacity to meet the demands of their customers. Like Al's ice cream store, described in the chapter "Short-Term Economic Fluctuations," firms may be willing to do this for a time. But eventually they will adjust to the high level of demand by raising prices, contributing to inflation. To control inflation, then, the Fed needs to dampen planned spending and output when they threaten to exceed potential output.

How can the Fed avoid a situation of economic "overheating," in which spending and output exceed potential output? As we saw in the previous chapter, the Fed can act to reduce autonomous expenditure, and hence short-run equilibrium output, by raising the real interest rate. This behavior by the Fed is a key factor that underlies the link between inflation and output that is summarized by the aggregate demand curve. When inflation is high—that is, when inflation is above the Fed's target inflation rate—the Fed responds by raising the real interest rate (as implied by the Fed's monetary *policy reaction function,* introduced in the last chapter).[3] The increase in the real interest rate reduces consumption and investment spending (autonomous expenditure) and hence reduces short-run equilibrium output. Because higher inflation leads, through the Fed's actions, to a reduction in output, the aggregate demand (*AD*) curve is downward-sloping, as Figure 28.1 shows. We can summarize this chain of reasoning symbolically as follows:

$$\pi\uparrow \Rightarrow r\uparrow \Rightarrow \text{autonomous expenditure}\downarrow \Rightarrow Y\downarrow \qquad (AD \text{ curve})$$

where, recall, π is inflation, r is the real interest rate, and Y is output.

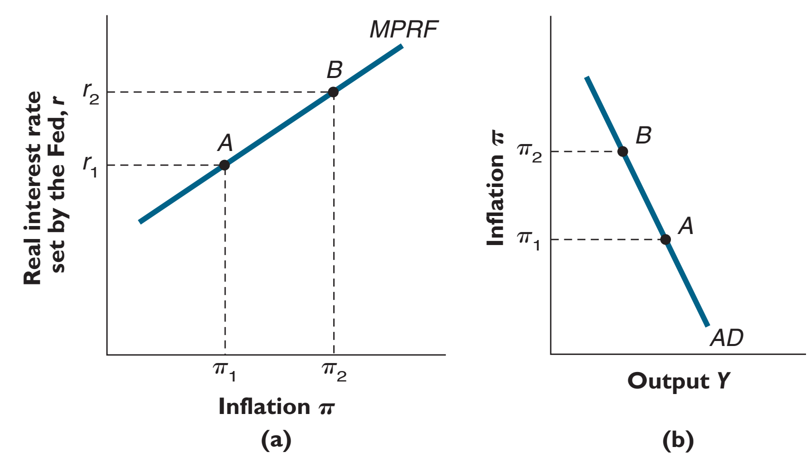
[1]It is important to distinguish the aggregate demand curve from the expenditure line, introduced as part of the Keynesian cross diagram in the chapter "Spending and Output in the Short Run." The upward-sloping expenditure line shows the relationship between planned aggregate expenditure and output. Again, the aggregate demand (*AD*) curve shows the relationship between short-run equilibrium output (which equals planned spending) and inflation.

[2]Economists sometimes define the aggregate demand curve as the relationship between aggregate demand and the *price level,* rather than inflation, which is the *rate of change* of the price level. The definition used here both simplifies the analysis and yields results more consistent with real-world data. For a comparison of the two approaches, see David Romer, "Keynesian Macroeconomics without the LM Curve," *Journal of Economic Perspectives,* Spring 2000, pp. 149–170. The graphical analysis used in this chapter follows closely the approach recommended by Romer.

[3]Recall from our earlier discussion that the Fed uses a nominal interest rate to announce its intentions. According to the policy reaction function, the Fed increases the real interest rate when inflation rises. It does this by acting to increase the nominal interest rate by more than the increase in inflation.

FIGURE 28.2

The Aggregate Demand Curve and the Monetary Policy Reaction Function. (a) With the Fed's target real interest rate r^* and target inflation rate π^* held fixed, the Fed will respond to an increase in inflation from π_1 to π_2 by increasing the real interest rate from r_1 to r_2. This increase in r will create a movement along the monetary policy reaction function, from point *A* to point *B.* (b) The increase in the real interest rate will reduce the equilibrium level of output, leading to a movement along the aggregate demand curve, from point *A* to point *B.* Thus, higher inflation causes the Fed to increase *r,* which reduces output.



These changes are illustrated in Figure 28.2. In Figure 28.2(a), we have redrawn the Fed's monetary policy reaction function from Figure 27.9. With the Fed's target real interest rate r^* and target inflation rate π^* held fixed, an increase in inflation from π_1 to π_2 will cause the Fed to raise the real interest rate from r_1 to r_2. The increase in the real interest rate will create a movement along the monetary policy reaction function, from point *A* to point *B*. In Figure 28.2(b), the increase in the real interest rate will create a similar movement along the aggregate demand curve, again from point *A* to point *B*.

OTHER REASONS FOR THE DOWNWARD SLOPE OF THE *AD* CURVE

Although we focus here on the behavior of the Fed as the source of the *AD* curve's downward slope, there are other channels through which higher inflation reduces planned spending and thus short-run equilibrium output. Hence, the downward slope of the *AD* curve does not depend on the Fed behaving in the particular way just described.

One additional reason for the downward slope of the *AD* curve is the effect of inflation on the *real value of money* held by households and businesses. At high levels of inflation, the purchasing power of money held by the public declines rapidly. This reduction in the public's real wealth may cause households to restrain consumption spending, reducing short-run equilibrium output.

A second channel by which inflation may affect planned spending is through *distributional effects*. Studies have found that people who are less well off are often hurt more by inflation than wealthier people are. For example, retirees on fixed incomes and workers receiving the minimum wage (which is set in dollar terms) lose buying power when prices are rising rapidly. Less affluent people are also likely to be relatively unsophisticated in making financial investments and hence less able than wealthier citizens to protect their savings against inflation.

People at the lower end of the income distribution tend to spend a greater percentage of their disposable income than do wealthier individuals. Thus, if a burst of inflation redistributes resources from relatively high-spending, less affluent households toward relatively high-saving, more affluent households, overall spending may decline.

A third connection between inflation and aggregate demand arises because higher rates of inflation generate *uncertainty* for households and businesses. When inflation is high, people become less certain about what things will cost in the future, and uncertainty makes planning more difficult. In an uncertain economic environment, both households and firms may become more cautious, reducing their spending as a result.

A final link between inflation and total spending operates through the *prices of domestic goods and services sold abroad.* As we will see in the chapter "Exchange Rates and the Open Economy," the foreign price of domestic goods depends in part on the rate at which the domestic currency, such as the dollar, exchanges for foreign currencies, such as the British pound. However, for constant rates of exchange between currencies, a rise in domestic inflation causes the prices of domestic goods in foreign markets to rise more quickly. As domestic goods become relatively more expensive to prospective foreign purchasers, export sales decline. Net exports are part of aggregate expenditure, and so once more we find that increased inflation is likely to reduce spending. All these factors contribute to the downward slope of the *AD* curve, together with the behavior of the Fed.

SHIFTS OF THE AGGREGATE DEMAND CURVE

The downward slope of the aggregate demand, or *AD,* curve shown in Figure 28.1 reflects the fact that *all other factors held constant,* a higher level of inflation will lead to lower planned spending and thus lower short-run equilibrium output. Again, a principal reason higher inflation reduces planned spending and output is that the Fed tends to react to increases in inflation by raising the real interest rate, which in turn reduces consumption and planned investment, two important components of planned aggregate expenditure.

However, even if inflation is held constant, various factors can affect planned spending and short-run equilibrium output. Graphically, as we will see in this section, these factors will cause the *AD* curve to shift. Specifically, for a given level of inflation, if there is a change in the economy that *increases* short-run equilibrium output, the *AD* curve will shift to the *right.* If, on the other hand, the change *reduces* short-run equilibrium output at each level of inflation, the *AD* curve will shift to the *left.* We will focus on two sorts of changes in the economy that shift the aggregate demand curve: (1) *exogenous* changes in spending, which are changes in spending caused by factors other than output or interest rates, and (2) changes in the Fed's monetary policy, as reflected in a shift in the Fed's monetary policy reaction function.

Changes in Spending

We have seen that planned aggregate expenditure depends both on output (through the consumption function) and on the real interest rate (which affects both consumption and planned investment). However, many factors other than output or the real interest rate can affect planned spending. For example, at given levels of output and the real interest rate, fiscal policy affects the level of government purchases, and changes in consumer confidence can affect consumption spending. Likewise, new technological opportunities may lead firms to increase their planned investment, and an increased willingness of foreigners to purchases domestic goods will raise net exports. We will refer to changes in planned spending that are not caused by changes in output or the real interest rate as *exogenous* changes in spending.

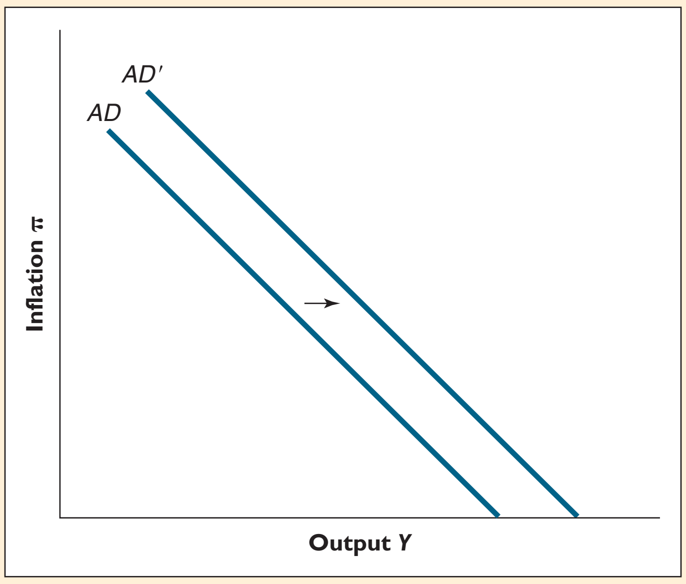


FIGURE 28.3
Effect of an Increase in Exogenous Spending.
The *AD* curve is seen both *before* (*AD*) and *after* (*AD'*) an increase in exogenous spending—specifically, an increase in consumption spending resulting from a rise in the stock market. If the inflation rate and the real interest rate set by the Fed are held constant, an increase in exogenous spending raises short-run equilibrium output. As a result, the *AD* curve will shift to the right, from *AD* to *AD'*.

For a given inflation rate (and thus for a given real interest rate set by the Fed), an exogenous increase in spending raises short-run equilibrium output, for the reasons we have discussed in the past two chapters. Because it increases output at each level of inflation, *an exogenous increase in spending shifts the AD curve to the right*. This result is illustrated graphically in Figure 28.3. Imagine, for example, that a rise in the stock market makes consumers more willing to spend (the wealth effect). Then, for each level of inflation, aggregate spending and short-run equilibrium output will be higher, a change that is shown as a shift of the *AD* curve to the right, from *AD* to *AD'*.

Similarly, at a given inflation rate, an exogenous decline in spending—for example, a fall in government purchases resulting from a more restrictive fiscal policy—causes short-run equilibrium output to fall. We conclude that *an exogenous decrease in spending shifts the AD curve to the left*.

EXERCISE 28.1

Determine how the following events will affect the *AD* curve:

a. Due to widespread concerns about future weakness in the economy, businesses reduce their spending on new capital.

b. The federal government reduces income taxes.

Changes in the Fed's Target Inflation Rate

Recall that the Fed's monetary policy reaction function describes how the Fed sets the real interest rate at each level of inflation. The monetary policy reaction function is determined from Equation 27.2 as

$$r = r^* + g(\pi - \pi^*)$$

Suppose for now that the Fed's target real interest rate r^* and its target inflation rate π^* are held constant. This equation for the Fed's monetary policy reaction function then implies that the Fed will raise the actual real interest rate r in response to an increase in inflation π. Furthermore, the parameter g implies that every time inflation rises by an additional percentage point, the Fed will raise the real interest rate

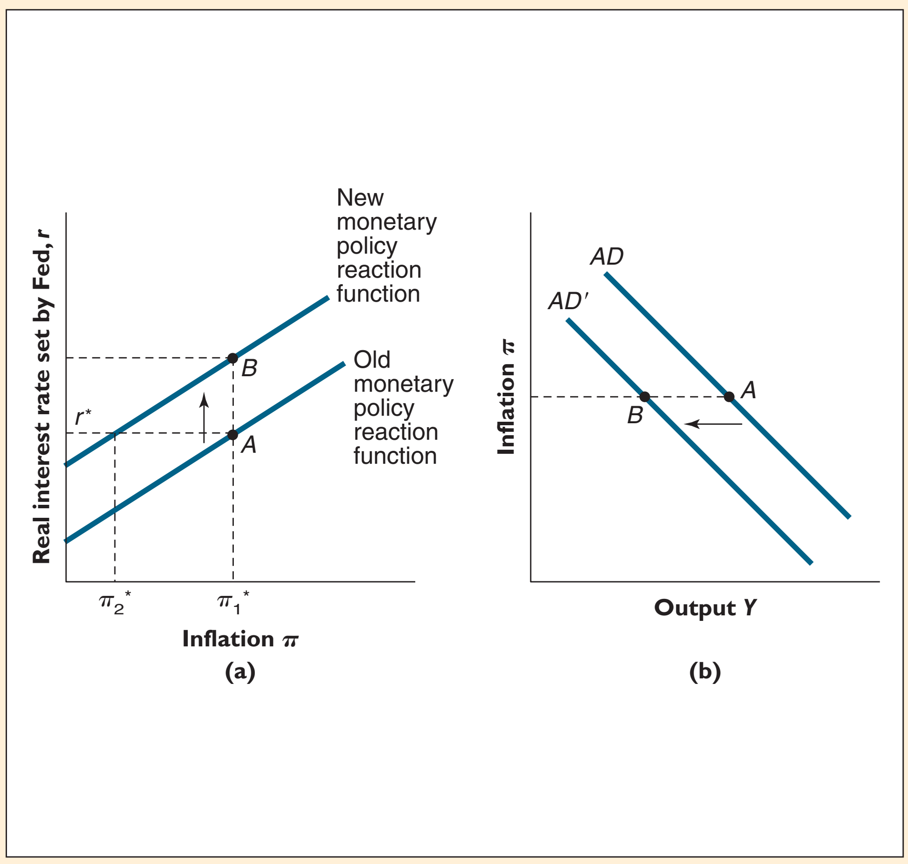


FIGURE 28.4

A Shift in the Fed's Monetary Policy Reaction Function.

The Fed chooses a "tighter" monetary policy by reducing its target inflation rate and setting the real interest rate at a higher level than usual for each given rate of inflation. Graphically, this change corresponds to an upward (or leftward) shift in the Fed's monetary policy reaction function (a). This change to a tighter monetary policy shifts the *AD* curve to the left (b). If a protracted recession led the Fed to increase its target inflation rate and set a lower real interest rate at each level of inflation, the Fed's monetary policy reaction function would shift downward (rightward) and the *AD* curve would shift to the right.

by g percentage points. The Fed's adjustment of the real interest rate in response to changes in inflation is an important reason that the *AD* curve is downward-sloping, as we already have seen. In particular, changes in the real interest rate r in response to changes in the inflation rate π result in movements along the *AD* curve, as in Figure 28.2, and not in a shift of the *AD* curve. Under normal circumstances, the Fed generally follows a stable monetary policy reaction function with constant values of r^* and π^*, implying that the Fed's normal actions do not shift the *AD* curve.

Sometimes, however, the Fed switches to a tighter or easier monetary policy than normal for a particular rate of inflation. In that event, the Fed changes its target inflation rate, and both the monetary policy reaction function and the aggregate demand curve will shift. For example, Figure 28.4 illustrates what happens when the Fed reduces its target inflation rate.

Suppose the economy is initially at point *A* in both graphs, and inflation π is initially equal to its target π_1^*. Thus, the Fed initially sets $r = r^*$ when $\pi = \pi_1^*$. If the Fed chooses a tighter monetary policy, it *reduces* its target inflation rate to π_2^*. The Fed will now set the real interest rate r equal to its target real interest rate r^* when (actual) inflation is equal to its new lower target inflation rate π_2^*. This changes in π^* will shift the monetary policy reaction function in Figure 28.4(a) upward (to the left). At the initial level of inflation, the Fed will raise the real interest rate r to point *B* on the new monetary policy reaction function even though r^* has not changed. The increase in r will reduce planned expenditure and the short-run equilibrium output at the initial rate of inflation. In summary, an upward (leftward) shift of the Fed's monetary policy reaction function leads the *AD* curve to shift to the left, to *AD′* in Figure 28.4(b).

Conversely, if the nation is experiencing an unusually severe and protracted recession, the Fed may choose a looser monetary policy by raising its target inflation rate. This change will shift the Fed's policy reaction downward or to the right. The reduction in the real interest rate at the initial rate of inflation would lead to higher levels of expenditure and short-run equilibrium output. Therefore, a downward (rightward) shift in the Fed's monetary policy reaction function shifts the *AD* curve right.

As we will see in the next chapter, the monetary policy reaction function also will shift if the Fed changes its target real interest rate r^*. Throughout this chapter, however, we will assume that the Fed's target real interest rate r^* remains unchanged. Consequently, in this chapter, shifts in the Fed's monetary policy reaction function occur only when the Fed changes its target inflation rate π^*.

SHIFTS OF THE AD CURVE VERSUS MOVEMENTS ALONG THE AD CURVE

Let's end this section by reviewing and summarizing the important distinction between *movements along* the *AD* curve and *shifts* of the *AD* curve.

The downward slope of the *AD* curve captures the inverse relationship between inflation, on the one hand, and short-run equilibrium output, on the other. As we have seen, a rise in the inflation rate leads the Fed to raise the real interest rate, according to its monetary policy reaction function. The higher real interest rate, in turn, depresses planned spending and hence lowers short-run equilibrium output. The downward slope of the *AD* curve embodies this relationship among inflation, spending, and output. Hence, changes in the inflation rate, and the resultin changes in the real interest rate and short-run equilibrium output resulting from movements along a stationary monetary policy reaction function, are represented by *movements along* the *AD* curve. In particular, as long as the Fed sets the real interest rate in accordance with a fixed policy reaction function, changes in the real interest rate will *not* shift the *AD* curve.

These changes are summarized as follows:

Figure 28.2 (no change in π^*): $\pi \uparrow \Rightarrow$ Movement along a stationary monetary policy reaction function $\Rightarrow r \uparrow \Rightarrow$ Movement along a stationary aggregate demand curve

However, any factor that changes the short-run equilibrium level of output *at a given level of inflation* will *shift* the *AD* curve—to the right if short-run equilibrium output increases, or to the left if short-run equilibrium output decreases. We have identified two factors that can shift the *AD* curve: exogenous changes in spending (that is, changes in spending that are not caused by changes in output or the real interest rate) and changes in the Fed's inflation rate target. (Remember, we will postpone discussing changes in r^* until the next chapter.) An exogenous increase in spending increases short-run equilibrium output at every level of inflation, hence shifting the *AD* curve to the right.

Figure 28.3: Exogenous increase in spending $\Rightarrow$ Shift in aggregate demand curve to the right

The aggregate demand curve also will shift to the right if the Fed *raises* its inflation target, as in Exercise 28.2, which is the opposite of Figure 28.4.

EXERCISE 28.2

Draw the appropriate monetary policy reaction functions and aggregate demand curves and explain what happens when the Fed increases its inflation target.

- A change to an easier monetary policy, as reflected by an increase in the Fed's target inflation rate and a downward (rightward) shift in its monetary policy reaction function, shifts the *AD* curve to the right. A change to a tighter, more anti-inflationary monetary policy, as reflected by a decrease in the Fed's target inflation rate and an upward (leftward) shift in the Fed's monetary policy reaction function, shifts the *AD* curve to the left.

INFLATION AND AGGREGATE SUPPLY

Thus far in this chapter, we have focused on how changes in inflation affect spending and short-run equilibrium output, a relationship captured by the *AD* curve. But we have not yet discussed how inflation itself is determined. From the chapter "Money, Prices, and the Federal Reserve," we know that in the long run, inflation is determined primarily by the growth of the money supply. In the rest of this chapter, however, we will examine the main factors that determine the inflation rate in modern industrial economies in the short, medium, and long run, as well as the options that policymakers have to control inflation. In doing so, we will introduce a useful diagram for analyzing the behavior of output and inflation, called the *aggregate demand–aggregate supply diagram.*

Physicists have noted that a body will tend to keep moving at a constant speed and direction unless it is acted upon by some outside force—a tendency they refer to as *inertia.* Applying this concept to economics, many observers have noted that inflation seems to be inertial, in the sense that it tends to remain roughly constant as long as the economy is at full employment and there are no external shocks to the price level. In the first part of this section, we will discuss why inflation behaves in this way.

However, just as a physical object will change speed if it is acted on by outside forces, so various economic forces can change the rate of inflation. Later in this section, we will discuss three factors that can cause the inflation rate to change. The first is the presence of an *output gap:* Inflation tends to rise when there is an expansionary output gap and to fall when there is a recessionary output gap. The second factor that can affect the inflation rate is a shock that directly affects prices, which we will refer to as an *inflation shock*. A large increase in the price of imported oil, for example, raises the price of gasoline, heating oil, and other fuels, as well as of goods made with oil or services using oil. Finally, the third factor that directly affects the inflation rate is a *shock to potential output,* or a sharp change in the level of potential output—a natural disaster that destroyed a significant portion of a country's factories and businesses is one extreme example. Together, inflationary shocks and shocks to potential output are known as *aggregate supply shocks*.

INFLATION INERTIA

In low-inflation industrial economies like that of the United States today, inflation tends to change relatively slowly from year to year, a phenomenon that is sometimes referred to as *inflation inertia*. If the rate of inflation in one year is 2 percent, it may be 3 percent or even 4 percent in the next year. But unless the nation experiences very unusual economic conditions, inflation is unlikely to rise to 6 percent or 8 percent or fall to −2 percent in the following year. This relatively sluggish behavior contrasts sharply with the behavior of economic variables such as stock or commodity prices, which can change rapidly from day to day. For example, oil prices might well rise by 20 percent over the course of a year and then fall 20 percent over the next year. Yet since about 1992, the U.S. inflation rate has generally remained in the range of 2–3 percent per year.

Why does inflation tend to adjust relatively slowly in modern industrial economies? To answer this question, we must consider two closely related factors that play an important role in determining the inflation rate: the behavior of the public's *inflation expectations* and the existence of *long-term wage and price contracts.*

First, consider the public's expectations about inflation. In negotiating future wages and prices, both buyers and sellers take into account the rate of inflation they expect to prevail in the next few years. As a result, today's *expectations* of future inflation may help to determine the future inflation rate. Suppose, for example, that office worker Fred and his boss Colleen agree that Fred's performance this past year justifies an increase of 2 percent in his real wage for next year. What *nominal,* or dollar, wage increase should they agree on? If Fred believes that inflation is likely to be 3 percent over the next year, he will ask for a 5 percent increase in his nominal wage to obtain a 2 percent increase in his real wage. If Colleen agrees that inflation is likely to be 3 percent, she should be willing to go along with a 5 percent nominal increase, knowing that it implies only a 2 percent increase in Fred's real wage. Thus, the rate at which Fred and Colleen *expect* prices to rise affects the rate at which at least one price—Fred's nominal wage—*actually* rises.

A similar dynamic affects the contracts for production inputs other than labor. For example, if Colleen is negotiating with her office supply company, the prices she will agree to pay for next year's deliveries of copy paper and staples will depend on what she expects the inflation rate to be. If Colleen anticipates that the price of office supplies will not change relative to the prices of other goods and services, and that the general inflation rate will be 3 percent, then she should be willing to agree to a 3 percent increase in the price of office supplies. On the other hand, if she expects the general inflation rate to be 6 percent, then she will agree to pay 6 percent more for copy paper and staples next year, knowing that a nominal increase of 6 percent implies no change in the price of office supplies relative to other goods and services.

Economywide, then, the higher the expected rate of inflation, the more nominal wages and the cost of other inputs will tend to rise. But if wages and other costs of production grow rapidly in response to expected inflation, firms will have to raise their prices rapidly as well in order to cover their costs. Thus, a high rate of expected inflation tends to lead to a high rate of actual inflation. Similarly, if expected inflation is low, leading wages and other costs to rise relatively slowly, actual inflation should be low as well.

EXERCISE 28.4

Assume that employers and workers agree that real wages should rise by 2 percent next year.

a. If inflation is expected to be 2 percent next year, what will happen to nominal wages next year?

b. If inflation is expected to be 4 percent next year, rather than 2 percent, what will happen to nominal wages next year?

c. Use your answers from parts a and b to explain how an increase in expected inflation will tend to affect the following year's actual rate of inflation.

The conclusion that actual inflation is partially determined by expected inflation raises the question of what determines inflation expectations. To a great extent, people's expectations are influenced by their recent experience. If inflation has been low and stable for some time, people are likely to expect it to continue to be low. But if inflation has recently been high, people will expect it to continue to be high. If inflation has been unpredictable, alternating between low and high levels, the

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public's expectations will likewise tend to be volatile, rising or falling with news or rumors about economic conditions or economic policy.

Figure 28.5 illustrates schematically how low and stable inflation may tend to be self-perpetuating. As the figure shows, if inflation has been low for some time, people will continue to expect low inflation. Increases in nominal wages and other production costs thus will tend to be small. If firms raise prices only by enough to cover costs, then actual inflation will be low, as expected. This low actual rate in turn will promote low expected inflation, perpetuating the "virtuous circle." The same logic applies in reverse in an economy with high inflation: A persistently high inflation rate leads the public to expect high inflation, resulting in higher increases in nominal wages and other production costs. This in turn contributes to a high rate of actual inflation, and so on in a vicious circle. This role of inflation expectations in the determination of wage and price increases helps to explain why inflation often seems to adjust slowly.

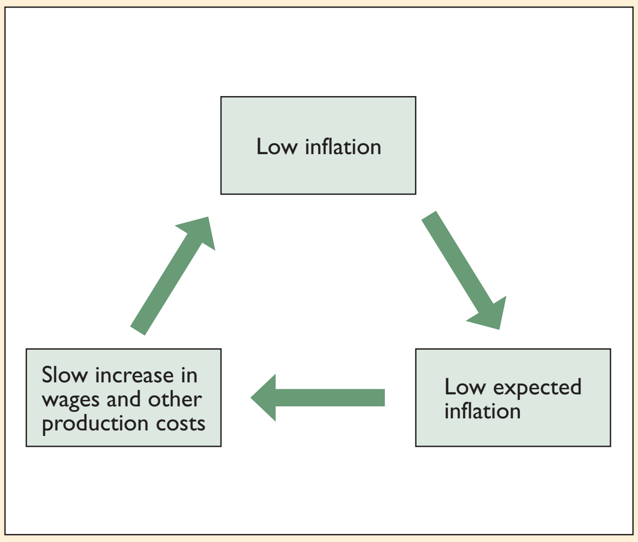


FIGURE 28.5
A Virtuous Circle of Low Inflation and Low Expected Inflation.
Low inflation leads people to expect low inflation in the future. As a result, they agree to accept small increases in wages and in the prices of the goods and services they supply, which keeps inflation—and expected inflation—low. In a similar way, high inflation leads people to expect high inflation, which in turn tends to produce high inflation.

The role of inflation expectations in the slow adjustment of inflation is strengthened by a second key element, the existence of *long-term wage and price contracts*. Union wage contracts, for example, often extend for three years into the future. Likewise, contracts that set the prices manufacturing firms pay for parts and raw materials often cover several years. Long-term contracts serve to "build in" wage and price increases that depend on inflation expectations at the time the contracts were signed. For example, a union negotiating in a high-inflation environment is much more likely to demand a rapid increase in nominal wages over the life of the contract than would a union in an economy in which prices are stable.

To summarize, in the absence of external shocks, inflation tends to remain relatively stable over time—at least in low-inflation industrial economies like that of the United States. In other words, inflation is *inertial* (or as some people put it, "sticky"). Inflation tends to be inertial for two main reasons. The first is the behavior of people's expectations of inflation. A low inflation rate leads people to expect low inflation in the future, which results in reduced pressure for wage and price increases. Similarly, a high inflation rate leads people to expect high inflation in the future, resulting in more rapid increases in wages and prices. Second, the effects of expectations are reinforced by the existence of long-term wage and price contracts, which is the second reason inflation tends to be stable over time. Long-term contracts tend to build in the effects of people's inflation expectations.

Although the rate of inflation tends to be inertial, it does of course change over time. We next discuss a key factor causing the inflation rate to change.

EXERCISE 28.5

Based on Figure 28.5, discuss why the Federal Reserve has a strong incentive to maintain a low inflation rate in the economy.

THE OUTPUT GAP AND INFLATION

An important factor influencing the rate of inflation is the output gap, or the difference between potential output and actual output ($Y^* - Y$). We have seen that, in the short-run, firms will meet the demand for their output at previously determined prices. For example, Al's ice cream shop will serve ice cream to any customer who comes into the shop at the prices posted behind the counter. The level of output that is determined by the demand at preset prices is called *short-run equilibrium output*.

At a particular time, the level of short-run equilibrium output may happen to equal the economy's long-run productive capacity, or potential output. But that is not necessarily the case. Output may exceed potential output, giving rise to an expansionary gap, or it may fall short of potential output, producing a recessionary gap. Let's consider what happens to inflation in each of these three possible cases: no output gap, an expansionary gap, and a recessionary gap.

If actual output equals potential output, then by definition there is no output gap. When the output gap is zero, firms are satisfied, in the sense that their sales equal their maximum sustainable production rates. As a result, firms have no incentive either to reduce or increase their prices *relative* to the prices of other goods and services. However, the fact that firms are satisfied with their sales does *not* imply that inflation—the rate of change in the overall price level—is zero.

To see why, let's go back to the idea of inflation inertia. Suppose that inflation has recently been steady at 3 percent per year, so that the public has come to expect an inflation rate of 3 percent per year. If the public's inflation expectations are reflected in the wage and price increases agreed to in long-term contracts, then firms will find their labor and materials costs are rising at 3 percent per year. To cover their costs, firms will need to raise their prices by 3 percent per year. Note that if all firms are raising their prices by 3 percent per year, the *relative* prices of various goods and services in the economy—say, the price of ice cream relative to the price of a taxi ride—will not change. Nevertheless, the economywide rate of inflation equals 3 percent, the same as in previous years. We conclude that, *if the output gap is zero, the rate of inflation will tend to remain the same.*

Suppose instead that an expansionary gap exists, so that most firms' sales exceed their maximum sustainable production rates. As we might expect in situations in which the quantity demanded exceeds the quantity firms desire to supply, firms will ultimately respond by trying to increase their relative prices. To do so, they will increase their prices by *more* than the increase in their costs. If all firms behave this way, then the general price level will begin to rise more rapidly than before. Thus, *when an expansionary gap exists, the rate of inflation will tend to increase.*

Finally, if a recessionary gap exists, firms will be selling an amount less than their capacity to produce, and they will have an incentive to cut their relative prices so they can sell more. In this case, firms will raise their prices less than needed to cover fully their increases in costs, as determined by the existing inflation rate. As a result, *when a recessionary gap exists, the rate of inflation will tend to decrease.* These important results are summarized in Box 28.1.

BOX 28.1: THE OUTPUT GAP AND INFLATION

Relationship of output to potential output		Behavior of inflation
1. No output gap $Y = Y^*$	→	Inflation remains unchanged
2. Expansionary gap $Y > Y^*$	→	Inflation rises $\pi\uparrow$
3. Recessionary gap $Y < Y^*$	→	Inflation falls $\pi\downarrow$

EXAMPLE 28.1

Spending changes and inflation

In the two previous chapters, we saw that changes in spending can create expansionary or recessionary gaps. Therefore, based on the discussion above, we can conclude that changes in spending also lead to changes in the rate of inflation. If the economy is currently operating at potential output, what effect will a fall in consumer confidence that makes consumers less willing to spend at each level of disposable income have on the rate of inflation in the economy?

A decrease in exogenous consumption spending, C, for a given level of inflation, output, and real interest rates, reduces aggregate expenditures and short-run equilibrium output. If the economy was originally operating at potential output, the reduction in consumption will cause a recessionary gap, since actual output, Y, will now be less than potential output, Y^*. As indicated above, when $Y < Y^*$, the rate of inflation will tend to fall because firms' sales fall short of maximum sustainable production rates, leading them to slow down the rate at which they increase their prices.

EXERCISE 28.6

Suppose that firms become optimistic about the future and decide to increase their investment in new capital. What effect will this have on the rate of inflation, assuming that the economy is currently operating at potential output?

THE AGGREGATE DEMAND–AGGREGATE SUPPLY DIAGRAM

The adjustment of inflation in response to an output gap can be shown conveniently in a diagram. Figure 28.6, drawn with inflation π on the vertical axis and real output Y on the horizontal axis, is an example of an *aggregate demand–aggregate supply diagram,* or *AD-AS diagram* for short. The diagram has three elements, one of which is the downward-sloping *AD* curve, introduced earlier in the chapter. Recall that the *AD* curve shows how planned aggregate spending, and hence short-run equilibrium output, depends on the inflation rate. The second element is a vertical line marking the economy's potential output Y^*. Because potential output represents the economy's long-run productive capacity, we will refer to this vertical line as the **long-run aggregate supply line,** or ***LRAS*** line. The third element in Figure 28.6, and a new one, is the *short-run aggregate supply line,* labeled *SRAS* in the diagram. The **short-run aggregate supply** (***SRAS***) **line** is a horizontal line that shows the current rate of inflation in the economy, which in the figure is labeled π. We can think of the current rate of inflation as having been determined by past expectations of inflation and past pricing decisions. The short-run aggregate supply line is horizontal because, in the short run, producers supply whatever output is demanded at preset prices.

long-run aggregate supply (LRAS) line a vertical line showing the economy's potential output Y^*

short-run aggregate supply (SRAS) line a horizontal line showing the current rate of inflation, as determined by past expectations and pricing decisions

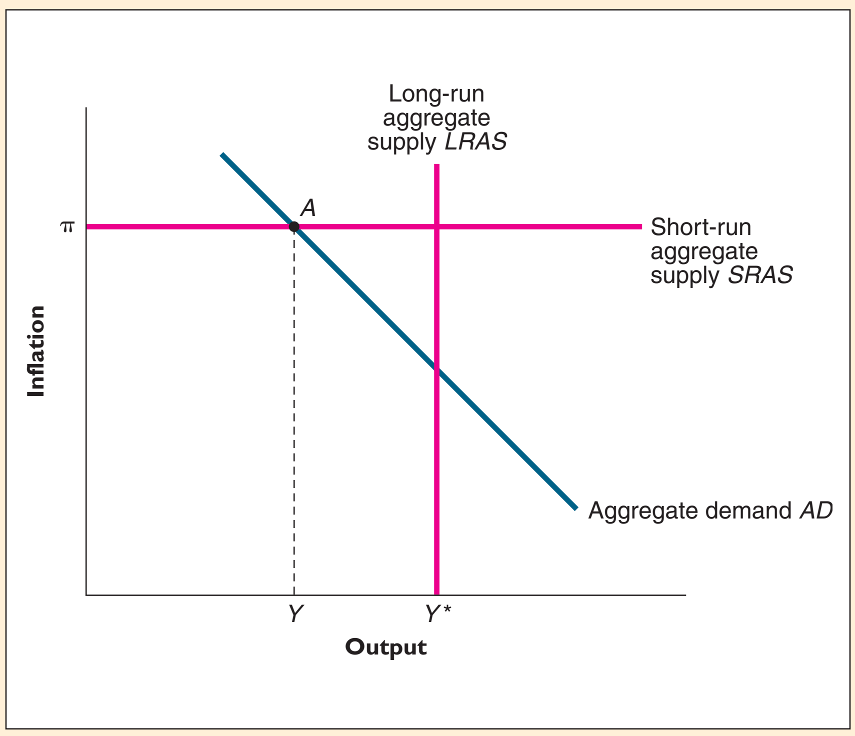


FIGURE 28.6
The Aggregate Demand–Aggregate Supply (*AD-AS*) Diagram.
This diagram has three elements: the *AD* curve, which shows how short-run equilibrium output depends on inflation; the long-run aggregate supply (*LRAS*) line, which marks the economy's potential output Y^*: and the short-run aggregate supply (*SRAS*) line, which shows the current value of inflation π. Short-run equilibrium output, which is equal to Y here, is determined by the intersection of the *AD* curve and the *SRAS* line (point *A*). Because actual output Y is less than potential output Y^*, this economy has a recessionary gap.

The *AD-AS* diagram can be used to determine the level of output prevailing at any particular time. As we have seen, the inflation rate at any moment is given directly by the position of the *SRAS* line—for example, current inflation equals π in Figure 28.6. To find the current level of output, recall that the *AD* curve shows the level of short-run equilibrium output at any given rate of inflation. Since the inflation rate in this economy is π, we can infer from Figure 28.6 that short-run equilibrium output must equal Y, which corresponds to the intersection of the *AD* curve and the *SRAS* line (point *A* in the figure). Notice that in Figure 28.6, short-run equilibrium output Y is smaller than potential output Y^*, so there is a recessionary gap in this economy.

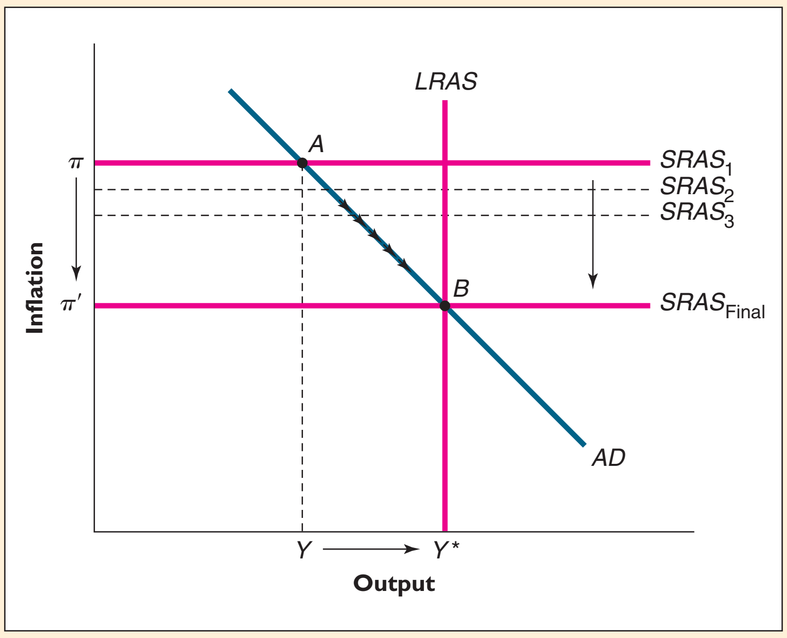
The intersection of the *AD* curve and the *SRAS* line (point *A* in Figure 28.6) is referred to as the point of *short-run equilibrium* in this economy. When the economy is in **short-run equilibrium,** inflation equals the value determined by past expectations and past pricing decisions, and output equals the level of short-run equilibrium output that is consistent with that inflation rate.

short-run equilibrium a situation in which inflation equals the value determined by past expectations and pricing decisions and output equals the level of short-run equilibrium output that is consistent with that inflation rate; graphically, short-run equilibrium occurs at the intersection of the *AD* curve and the *SRAS* line

Although the economy may be in short-run equilibrium at point *A* in Figure 28.6, it will not remain there. The reason is that at point *A*, the economy is experiencing a recessionary gap (output is less than potential output, as indicated by the *LRAS* line). As we have just seen, when a recessionary gap exists, firms are not selling as much as they would like to and so they slow down the rate at which they increase their prices. Eventually, the low level of aggregate demand that is associated with a recessionary gap causes the inflation rate to fall.

The adjustment of inflation in response to a recessionary gap is shown graphically in Figure 28.7. As inflation declines, the *SRAS* line moves downward. Because of inflation inertia (caused by the slow adjustment of the public's inflation expectations and the existence of long-term contracts), inflation adjusts downward only gradually. The *SRAS* line, for example, may shift from *SRAS* to $SRAS_2$ to $SRAS_3$. It will continue to shift down as long as a recessionary gap exists. Thus, the *SRAS* line will move downward until it intersects the *AD* curve at point *B* in Figure 28.7. At that point, actual output equals potential output and the recessionary gap has been

FIGURE 28.7
The Adjustment of Inflation When a Recessionary Gap Exists.
At the initial short-run equilibrium point *A*, a recessionary gap exists, which puts downward pressure on inflation. As inflation gradually falls, the *SRAS* line moves downward gradually until it reaches $SRAS_{Final}$, and actual output equals potential output (point *B*). Once the recessionary gap has been eliminated, inflation stabilizes at π', and the economy settles into long-run equilibrium at the intersection of *AD, LRAS,* and $SRAS_{Final}$ (point *B*).



long-run equilibrium a situation in which actual output equals potential output and the inflation rate is stable; graphically, long-run equilibrium occurs when the *AD* curve, the *SRAS* line, and the *LRAS* line all intersect at a single point

eliminated. Consequently, the final *SRAS* line is labeled $SRAS_{Final}$. Because there is no further pressure on inflation at point *B*, the inflation rate stabilizes at the lower level. A situation like that represented by point *B* in Figure 28.7, in which the inflation rate is stable and actual output equals potential output, is referred to as **long-run equilibrium** of the economy. Long-run equilibrium occurs when the *AD* curve, the *SRAS* line, and the *LRAS* line all intersect at a single point.

Figure 28.7 illustrates the important point that when a recessionary gap exists, inflation will tend to fall. It also shows that as inflation declines, short-run equilibrium output rises, increasing gradually from *Y* to *Y** as the short-run equilibrium point moves down the *AD* curve. The source of this increase in output is the behavior of the Federal Reserve, which lowers the real interest rate as inflation falls, stimulating aggregate demand. Falling inflation stimulates spending and output in other ways, such as by reducing uncertainty.[4] As output rises, cyclical unemployment, which by Okun's law is proportional to the output gap, also declines. This process of falling inflation, falling real interest rates, rising output, and falling unemployment continues until the economy reaches full employment at point *B* in Figure 28.7, the economy's long-run equilibrium point.

What happens if instead of a recessionary gap, the economy has an expansionary gap, with output greater than potential output? An expansionary gap would cause the rate of inflation to *rise,* as firms respond to high demand by raising their prices more rapidly than their costs are rising. In graphical terms, an expansionary gap would cause the *SRAS* line to move upward over time. Inflation and the *SRAS* line would continue to rise until the economy reached long-run equilibrium, with actual output equal to potential output. This process is illustrated in Figure 28.8. Initially, the economy is in short-run equilibrium at point *A,* where $Y > Y^*$ (an expansionary gap). The expansionary gap causes inflation to rise over time; graphically, the short-run aggregate supply line moves upward, from *SRAS* to $SRAS_2$ and then to $SRAS_3$. As the *SRAS* line rises, short-run equilibrium output falls—the result of the Fed's tendency to increase the real interest rate when inflation rises. Eventually the *SRAS* line reaches $SRAS_{Final}$, where it intersects the *AD* curve and the *LRAS* line

[4]Our explanation for the downward slope of the *AD* curve, earlier in the chapter, described some of these other factors.

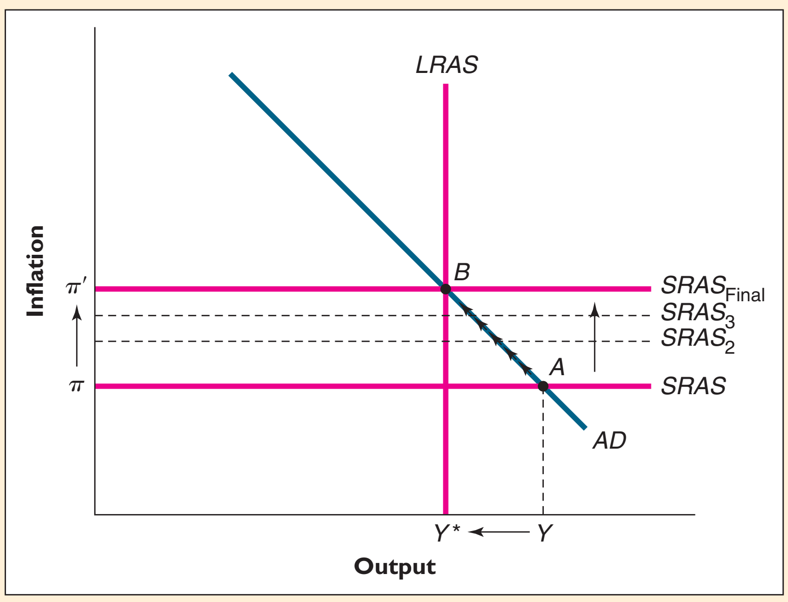


FIGURE 28.8
The Adjustment of Inflation When an Expansionary Gap Exists. At the initial short-run equilibrium point *A*, an expansionary gap exists. Inflation rises gradually (the *SRAS* line moves upward) and output falls. The process continues until the economy reaches long-run equilibrium at point *B*, where inflation stabilizes and the output gap is eliminated.

at point *B*. This is the point at which the economy reaches long-run equilibrium, with no output gap and stable inflation.

THE SELF-CORRECTING ECONOMY

Our analysis of Figures 28.7 and 28.8 makes an important general point: The economy tends to be *self-correcting* in the long run. In other words, given enough time, output gaps tend to disappear without changes in monetary or fiscal policy (other than the change in the real interest rate embodied in the Fed's policy reaction function). Expansionary output gaps are eliminated by rising inflation, while recessionary output gaps are eliminated by falling inflation. This result contrasts sharply with the basic Keynesian model, which does not include a self-correcting mechanism. The difference in results is explained by the fact that the basic Keynesian model concentrates on the short-run period, during which prices do not adjust, and does not take into account the changes in prices and inflation that occur over a longer period.

Does the economy's tendency to self-correct imply that aggressive monetary and fiscal policies are not needed to stabilize output? The answer to this question depends crucially on the *speed* with which the self-correction process takes place. If self-correction takes place very slowly, so that actual output differs from potential for protracted periods, then active use of monetary and fiscal policy can help to stabilize output. But if self-correction is rapid, then active stabilization policies are probably not justified in most cases, given the lags and uncertainties that are involved in policymaking in practice. Indeed, if the economy returns to full employment quickly, then attempts by policymakers to stabilize spending and output may end up doing more harm than good, for example, by causing actual output to "overshoot" potential output.

The speed with which a particular economy corrects itself depends on a variety of factors, including the prevalence of long-term contracts and the efficiency and flexibility of product and labor markets. (For a case study, see the comparison of U.S. and European labor markets in the chapter "Workers, Wages, and unemployment in the Modern Economy.") However, a reasonable conclusion is that the greater the initial output gap, the longer the economy's process of self-correction will take. This observation suggests that stabilization policies should not be used actively to try to eliminate relatively small output gaps, but that they may be quite useful in remedying large gaps—for example, when the unemployment rate is exceptionally high.

RECAP | ***AD-AS* AND THE SELF-CORRECTING ECONOMY**

- The economy is in short-run equilibrium when inflation equals the value determined by past expectations and pricing decisions, and output equals the level of short-run equilibrium output that is consistent with that inflation rate. Graphically, short-run equilibrium occurs at the intersection of the *AD* curve and the *SRAS* line.
- The economy is in long-run equilibrium when actual output equals potential output (there is no output gap) and the inflation rate is stable. Graphically, long-run equilibrium occurs when the *AD* curve, the *SRAS* line, and the *LRAS* line intersect at a common point.
- Inflation adjusts gradually to bring the economy into long-run equilibrium (a phenomenon called the economy's self-correcting tendency). Inflation rises to eliminate an expansionary gap and falls to eliminate a recessionary gap. Graphically, the *SRAS* line moves up or down as needed to bring the economy into long-run equilibrium.
- The more rapid the self-correction process, the less need for active stabilization policies to eliminate output gaps. In practice, policymakers' attempts to eliminate output gaps are more likely to be helpful when the output gap is large than when it is small.

SOURCES OF INFLATION

We have seen that inflation can rise or fall in response to an output gap. But what creates the output gaps that give rise to changes in inflation? And are there factors besides output gaps that can affect the inflation rate? In this section we use the *AD-AS* diagram to explore the ultimate sources of inflation. We first discuss how excessive growth in aggregate spending can spur inflation, then turn to factors operating through the supply side of the economy.

EXCESSIVE AGGREGATE SPENDING

One important source of inflation in practice is excessive aggregate spending—or, in more colloquial terms, "too much spending chasing too few goods." Example 28.2 illustrates.

EXAMPLE 28.2

Military buildups and inflation

Wars and military buildups are sometimes associated with increased inflation. Explain why, using the *AD-AS* diagram. Can the Fed do anything to prevent the increase in inflation caused by a military buildup?

Wars and military buildups are potentially inflationary because increased spending on military hardware raises total demand relative to the economy's productive capacity. In the face of rising sales, firms increase their prices more quickly, raising the inflation rate.

The two panels of Figure 28.9 illustrate this process. Looking first at Figure 28.9(a), suppose that the economy is initially in long-run equilibrium at point *A*, where the aggregate demand curve *AD* intersects both the short-run and long-run

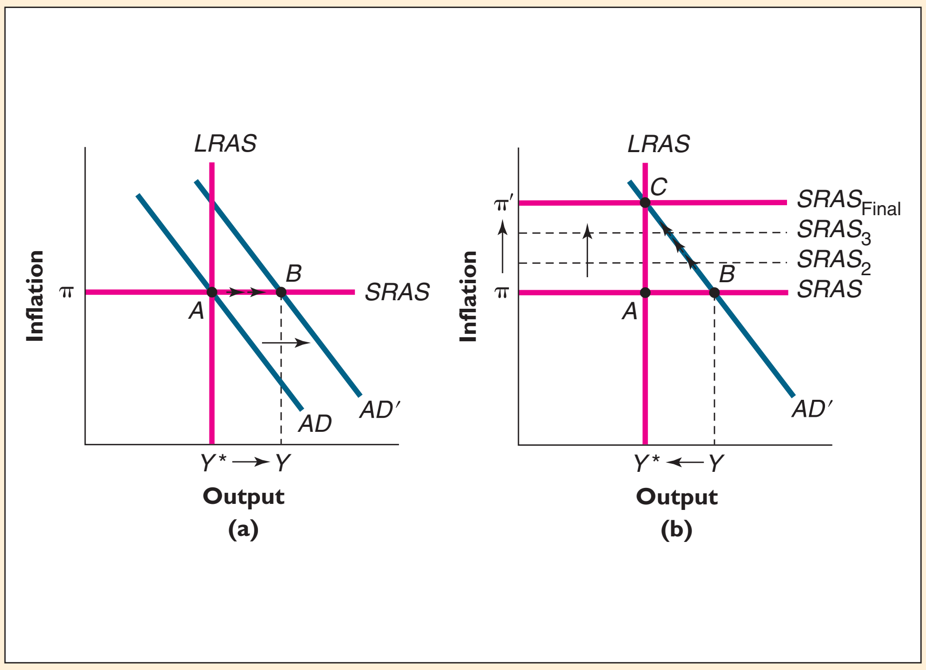


FIGURE 28.9
War and Military Buildup as a Source of Inflation.
(a) An increase in military spending shifts the *AD* curve to the right, from *AD* to *AD′*. At the new short-run equilibrium point *B*, actual output has risen above potential output *Y**, creating an expansionary gap. (b) This gap leads to rising inflation, shown as an upward movement of the *SRAS* line, from *SRAS*, eventually to $SRAS_{Final}$. At the new long-run equilibrium point *C*, actual output has fallen back to the level of potential output, but at π' inflation is higher than it was originally.

aggregate supply lines, *SRAS* and *LRAS*, respectively. Point *A* is a long-run equilibrium point, with output equal to potential output and stable inflation. Now suppose that the government decides to spend more on armaments. Increased military spending is an increase in government purchases *G*, an exogenous increase in spending. We saw earlier that, for a given level of inflation, an exogenous increase in spending raises short-run equilibrium output, shifting the *AD* curve to the right. Figure 28.9(a) shows the aggregate demand curve shifting rightward, from *AD* to *AD′*, as the result of increased military expenditure. The economy moves to a new, short-run equilibrium at point *B*, where *AD′* intersects *SRAS*. Note that at point *B* actual output has risen above potential, to $Y > Y^*$, creating an expansionary gap. Because inflation is inertial and does not change in the short run, the immediate effect of the increase in government purchases is only to increase output, just as we saw in the Keynesian cross analysis of the chapter "Spending and Output in the Short Run."

The process doesn't stop there, however, because inflation will not remain the same indefinitely. At point *B* an expansionary gap exists, so inflation will gradually begin to increase. Figure 28.9(b) shows this increase in inflation as a shift of the *SRAS* line from its initial position to successively higher levels and eventually to $SRAS_{Final}$. When inflation has risen to π', enough to eliminate the output gap (point *C*), the economy is back in long-run equilibrium. We see now that the increase in output created by the military buildup was only temporary. In the long run, actual output has returned to the level of potential output, but at a higher rate of inflation.

Since output has returned to its original level while government spending has increased, some other component of spending must now be lower than it was originally. Indeed, as we move from point *B* to point *C* along the *AD′* curve, the Fed is raising the real interest rate in response to higher inflation. As a result, investment will fall. In the chapter "Saving and Capital Formation," we called this phenomenon the crowding out of investment in the long run, following an increase in government spending.

Does the Fed have the power to prevent the increased inflation that is induced by a rise in military spending? The answer is yes. We saw earlier that a decision by the Fed to reduce its target monetary inflation rate will shift the policy reaction function upward (left) and the *AD* curve to the left. So if the Fed aggressively tightens monetary policy (shifts its reaction function) as the military buildup proceeds, it can reverse the rightward shift of the *AD* curve caused by increased government spending. Offsetting the rightward shift of the *AD* curve in turn avoids the development of an expansionary gap, with its inflationary consequences. The Fed's policy works because the higher real interest rate it sets at each level of inflation acts to reduce consumption and investment spending. The reduction in private spending offsets the increase in demand by the government, eliminating—or at least moderating—the inflationary impact of the military purchases.

We should not conclude, by the way, that avoiding the inflationary consequences of a military buildup makes the buildup costless to society. When the Fed reduces its target inflation rate, it increases the real interest rate more rapidly than in Figure 28.9. Consequently, the economy moves back to Y^* more rapidly, and consumption and investment are also reduced to their final levels more rapidly. The private sector must give up some resources so that more of the nation's output can be devoted to military purposes. This reduction in resources reduces both current living standards (by reducing consumption) and future living standards (by reducing investment).

ECONOMIC NATURALIST 28.1

How did inflation get started in the United States in the 1960s?

In the United States from 1959 through 1963, inflation hovered around 1 percent per year. Beginning in 1964, however, inflation began to rise, reaching nearly 6 percent in 1970. Why did inflation become a problem in the United States in the 1960s?

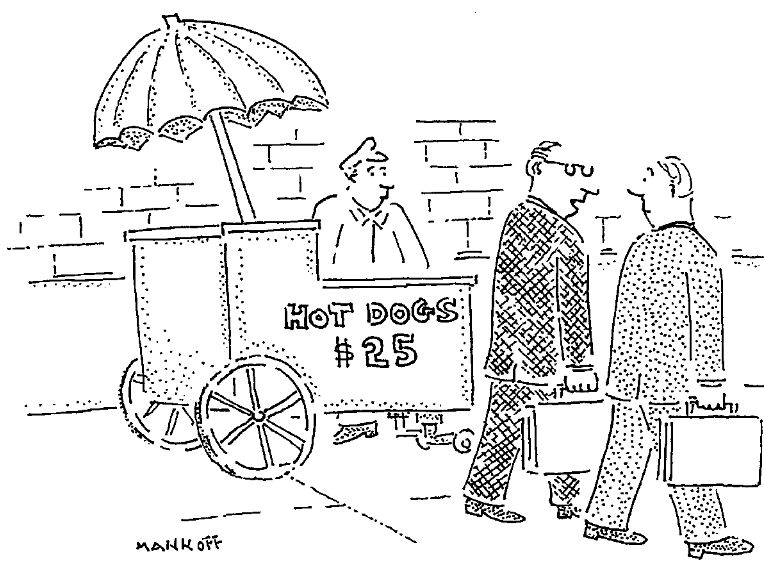
Increases in government spending, plus the failure of the Federal Reserve to act to contain inflation, appear to explain most of the increase in inflation during the 1960s. On the fiscal side, military expenditures increased dramatically in the latter part of the decade, as the war in Vietnam escalated. Defense spending rose from \$50.6 billion, or about 7.4 percent of GDP, in 1965 to \$81.9 billion, or 9.4 percent of GDP, in 1968, and it remained at a high level for some years. To appreciate the size of this military buildup relative to the size of the economy, note that the *increase* in military spending alone between 1965 and 1968 was about 2 percent of GDP. In contrast, in 2001 the *total* U.S. defense budget was a little over 3 percent of GDP. Moreover, at about the same time as the wartime military buildup, government spending on social programs—reflecting the impact of President Lyndon Johnson's Great Society and War on Poverty initiatives—also increased dramatically.

These government-induced increases in total spending contributed to an economic boom. Indeed, the 1961–1969 economic expansion was the longest in history at the time, being surpassed only recently by the long expansion of the 1990s. However, an expansionary gap developed and eventually inflation began to rise, as would have been predicted by the analysis in Example 28.2.

An interesting contrast exists between these effects of the 1960s military buildup and those of the 1980s buildup under President Reagan, which did not lead to an increase in inflation. One important difference between the two eras was the behavior of the Federal Reserve. As we saw in Example 28.2, the Fed can offset the inflationary impact of increased government spending by fighting inflation more aggressively (shifting its policy reaction function upward). Except for a brief attempt in 1966, the Federal Reserve generally did not try actively to offset inflationary pressures during the 1960s. That failure may have been simply a miscalculation, or it may have reflected a reluctance to take the politically unpopular step of slowing the economy during a period of great political turmoil. But in the early 1980s, under Paul Volcker, the Federal Reserve acted vigorously to contain inflation. As a result, inflation actually declined in the 1980s, despite the military buildup.

EXERCISE 28.7

In Example 28.1 we found that a decline in consumer spending tends to reduce the rate of inflation. Using the *AD-AS* diagram, illustrate the short-run and long-run effects of a fall in consumer spending on inflation. How does the decline in spending affect output in the short run and in the long run?



"I told you the Fed should have tightened."

Whereas output gaps cause gradual changes in inflation, on occasion an economic shock can cause a relatively rapid increase or decrease in inflation. Such jolts to prices, which we call *inflation shocks,* are the subject of the next section.

OPEC's 1974 cutback in oil production created long lines, rising prices, and frayed tempers at the gas pump.

INFLATION SHOCKS

In late 1973, at the time of the Yom Kippur War between Israel and a coalition of Arab nations, the Organization of Petroleum-Exporting Countries (OPEC) dramatically cut its supplies of crude oil to the industrialized nations, quadrupling world oil prices. The sharp increase in oil prices was quickly transferred to the price of gasoline, heating oil, and goods and services that were heavily dependent on oil, such as air travel. The effects of the oil price increase, together with agricultural shortages that increased the price of food, contributed to a significant rise in the overall U.S. inflation rate in 1974.[5]

The increase in inflation in 1974 is an example of what is referred to as an *inflation shock*. An **inflation shock** is a sudden change in the normal behavior of inflation, unrelated to the nation's output gap. An inflation shock that causes an increase in inflation, like the large rise in oil prices in 1973, is called an *adverse* inflation shock. An inflation shock that reduces inflation, such as the sharp decline in oil prices that occurred in 1986, is called a *favorable* inflation shock. Economic Naturalist 28.2 gives more details on the economic effects of inflation shocks.

inflation shock a sudden change in the normal behavior of inflation, unrelated to the nation's output gap

[5]In the chapter "Measuring the Price Level and Inflation," we distinguished between relative price changes (changes in the prices of individual goods) and inflation (changes in the overall price level). In the 1973–1974 episode, changes in the prices of individual categories of goods, such as energy and food, were sufficiently large and pervasive that the overall price level was significantly affected. Thus, these relative price changes carried an inflationary impact as well.

ECONOMIC NATURALIST 28.2

Why did inflation escalate in the United States in the 1970s?

Having risen in the second half of the 1960s, inflation continued to rise in the 1970s. Already at 6.2 percent in 1973, inflation jumped to 11.0 percent in 1974. After subsiding from 1974 to 1978, it began to rise again in 1979, to 11.4 percent, and reached 13.5 percent in 1980. Why did inflation increase so much in the 1970s?

We have already described the quadrupling of oil prices in late 1973 and the sharp increases in agricultural prices at about the same time, which together constituted an adverse inflation shock. A second inflation shock occurred in 1979, when the turmoil of the Iranian Revolution restricted the flow of oil from the Middle East and doubled oil prices yet again.

Figure 28.10 shows the effects of an adverse inflation shock on a hypothetical economy. Before the inflation shock occurs, the economy is in long-run equilibrium at point *A*, at the intersection of *AD*, *LRAS*, and *SRAS*. At point *A* actual output is equal to potential output Y^*, and the inflation rate is stable at π. However, an adverse inflation shock directly increases inflation, so that the *SRAS* line shifts rapidly upward to *SRAS′*. A new short-run equilibrium is established at point *B*, where *SRAS′* intersects the aggregate demand curve *AD*. In the wake of the inflation shock, inflation rises to π' and output falls, from Y^* to Y'. Thus, an inflation shock creates the worst possible scenario: higher inflation coupled with a recessionary gap. The combination of inflation and recession has been referred to as *stagflation*, or stagnation plus inflation. The U.S. economy experienced a stagflation in 1973–1975, after the first oil shock, and again in 1980, after the second oil shock.

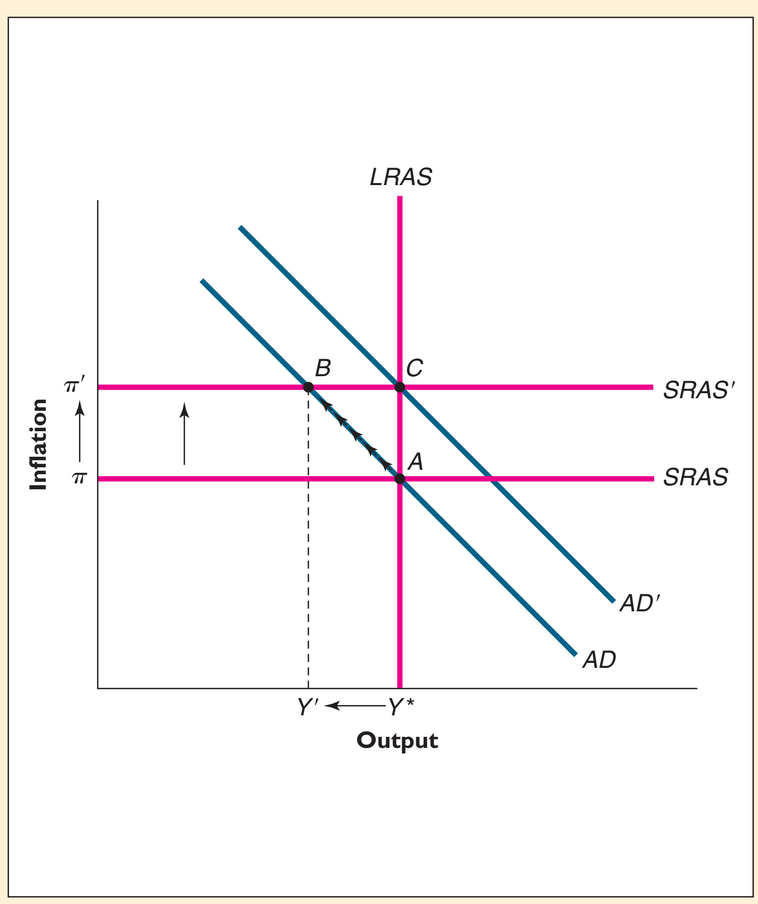


FIGURE 28.10
The Effects of an Adverse Inflation Shock.
Starting from long-run equilibrium at point *A*, an adverse inflation shock directly raises current inflation, causing the *SRAS* line to shift upward to *SRAS′*. At the new short-run equilibrium, point *B*, inflation has risen to π' and output has fallen to Y', creating a recessionary gap. If the Fed does nothing, eventually the economy will return to point *A*, restoring the original inflation rate but suffering a long recession in the process. The Fed could ease monetary policy by shifting down its monetary policy reaction function, shifting the *AD* curve to *AD′* and restoring full employment more quickly at point *C*. The cost of this strategy is that inflation remains at its higher level.

As we discuss in more detail in the next chapter, an adverse inflation shock creates a dilemma for macroeconomic policymakers. Suppose monetary and fiscal policies were left unchanged following an inflationary shock. Soon after the inflation shock, the economy would reach its short-run equilibrium at point *B* in Figure 28.10, with higher inflation. Because of the recessionary gap that exists at point *B*, eventually inflation would begin to drift downward, until finally the recessionary gap is eliminated. Graphically, this decline in inflation would be represented by a downward movement of the *SRAS* line, from *SRAS′* back to *SRAS*. Inflation would stop declining only when long-run equilibrium is restored, at point *A* in the figure, where inflation is at its original level of π and output equals potential output.

Although a "do-nothing" policy approach would ultimately eliminate both the output gap and the surge in inflation, it also would put the economy through a protracted recession. Consequently, policymakers might opt to eliminate the recessionary gap more quickly by pursuing a more expansionary fiscal policy or by choosing an easier monetary policy (more precisely, by raising the target inflation rate and thereby shifting down the monetary policy reaction.) An increase in the Fed's target inflation rate, for example, would shift the *AD* curve to the right, from *AD* to *AD′*, taking the economy to a new long-run equilibrium, point *C* in Figure 28.10. This expansionary policy would help to restore output to the full-employment level more quickly, but as Figure 28.10 shows, it also would allow inflation to stabilize at the new, higher level.

In the 1970s, though U.S. policymakers tried to strike a balance between stabilizing output and containing inflation, the combination of recession and increased inflation hobbled the economy.

In the chapter "Money, Prices, and the Federal Reserve," we discussed the long-run relationship between inflation and money growth. The example of an inflation shock shows that inflation does not always originate from excessive money growth; it can arise from a variety of factors. However, our analysis also shows that, in the absence of monetary easing, inflation that arises from factors such as inflation shocks eventually will die away. By contrast, *sustained* inflation requires that monetary policy remain easy, that is, policymakers allow the money supply to rise rapidly. In this respect, our analysis of this chapter is consistent with the earlier long-run analysis, which concluded that sustained inflation is possible only if monetary policy is sufficiently expansionary.

EXERCISE 28.8

Inflation shocks also can be beneficial for the economy, such as when oil prices declined in the late 1990s. What effect would a decrease in oil prices have on output and inflation?

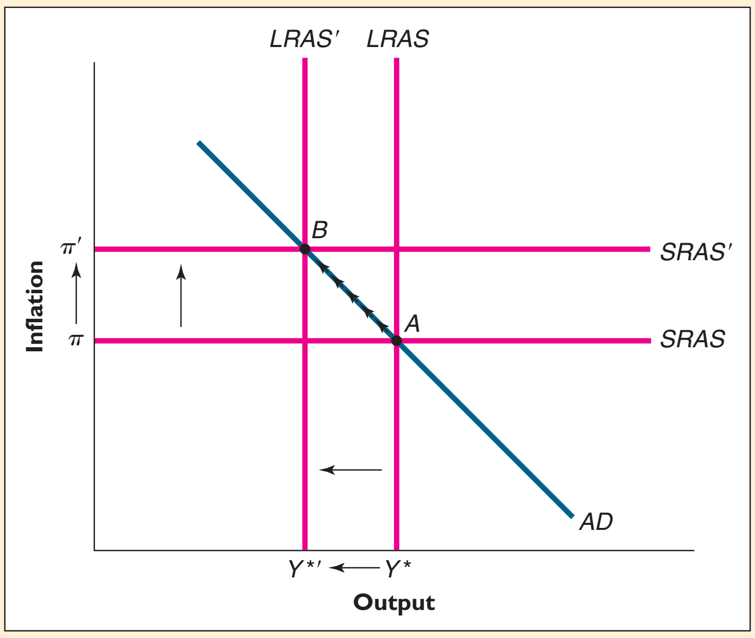
SHOCKS TO POTENTIAL OUTPUT

In analyzing the effects of increased oil prices on the U.S. economy in the 1970s, we assumed that potential output was unchanged in the wake of the shock. However, the sharp rise in oil prices during that period probably affected the economy's potential output as well. As oil prices rose, for example, many companies retired less energy-efficient equipment or scrapped older "gas-guzzling" vehicles. A smaller capital stock implies lower potential output.

If the increases in oil prices did reduce potential output, their inflationary impact would have been compounded. Figure 28.11 illustrates the effects on the economy of a sudden decline in potential output. For the sake of simplicity, the figure includes only the effects of the reduction in potential output, and not the direct effect of the inflation shock. (Problem 7 at the end of the chapter asks you to combine the two effects.)

Suppose once again that the economy is in long-run equilibrium at point *A*. Then potential output falls unexpectedly, from Y^* to $Y^{*\prime}$, shifting the long-run

FIGURE 28.11
The Effects of a Shock to Potential Output.
The economy is in long-run equilibrium at point *A* when a decline in potential output, from Y^* to $Y^{*\prime}$, creates an expansionary gap. Inflation rises, and the short-run aggregate supply line shifts upward from *SRAS* to *SRAS′*. A new long-run equilibrium is reached at point *B*, where actual output equals the new, lower level of potential output, $Y^{*\prime}$, and inflation has risen to π'. Because it is the result of a fall in potential output, the decline in output is permanent.



aggregate supply line leftward from *LRAS* to *LRAS′*. After this decline in potential output, is the economy still in long-run equilibrium at point *A*? The answer is no, because output now exceeds potential output at that point. In other words, an expansionary gap has developed. This gap reflects the fact that although planned spending has not changed, the capacity of firms to supply goods and services has been reduced.

As we have seen, an expansionary gap leads to rising inflation. In Figure 28.11, increasing inflation is represented by an upward movement of the *SRAS* line. Eventually the short-run aggregate supply line reaches *SRAS′*, and the economy reaches a new long-run equilibrium at point *B*. (Why is point *B* a long-run, and not just a short-run, equilibrium?) At that point, output has fallen to the new, lower level of potential output, $Y^{*\prime}$, and inflation has risen to π'.

aggregate supply shock either an inflation shock or a shock to potential output; adverse aggregate supply shocks of both types reduce output and increase inflation

Sharp changes in potential output and inflation shocks are both referred to as **aggregate supply shocks.** As we have seen, an adverse aggregate supply shock of either type leads to lower output and higher inflation, and therefore poses a difficult challenge for policymakers. A difference between the two types of aggregate supply shocks is that the output losses associated with an adverse inflation shock are temporary (because the economy self-corrects and will ultimately return to its initial level of potential output), but those associated with a fall in potential output are permanent (output remains lower even after the economy has reached a new long-run equilibrium).

ECONOMIC NATURALIST 28.3

Was Greenspan right in 1996?

In the introduction to this chapter, we described the Fed's dilemma in 1996. Although the unemployment rate was falling below what many economists considered to be the natural rate of unemployment at that time, Alan Greenspan believed that the economy could continue to grow without stoking inflation. Because he did not see inflation as a threat, despite the rapid rate of economic growth, Geenspan did not support an increase in interest rates to slow the economy. Consequently, the Fed did not increase interest rates. Was it the right decision? What did Greenspan see?

Prior to becoming chairman of the Fed, Greenspan had his own economic consulting company. In that capacity, he had acquired a reputation for his knowledge of the economy and his ability to dissect economic data to discover trends not obvious to others. He continued his practice of painstaking data analysis when he went to the Fed.

During the summer and fall of 1996, Greenspan was puzzled. Although most people thought the economy was operating close to full employment, both price and wage inflation were lower than they had been at full employment in the past. Furthermore, though companies did not seem to be raising their prices, corporate profits were surging. Putting these and other clues together, Greenspan concluded that productivity must be rising rapidly. Higher productivity reduces firms' costs and allows them to increase profits even if they don't increase prices. Indeed, businesspeople in a range of industries were reporting productivity gains resulting from business restructuring and expanded capital investment. Since the official government data did not indicate substantial increases in productivity, Greenspan asked economists at the Fed to examine the official data in greater detail.

What they found was puzzling. When they used the official government data to construct detailed productivity data for each industry, some of the results didn't seem to make sense. The industry data, for example, implied that productivity in many service-producing industries had risen very slowly and had actually *fallen* in several industries. Given the substantial improvements in communications and information technology (see Economic Naturalist 20.3), these results were implausible. As reported in the minutes of the September 24, 1996 meeting of the Federal Reserve Open Market Committee, "this result . . . suggested considerable error in estimating output and prices for many services. Consequently, it was likely that actual productivity growth was higher than the current measures indicated."[6]

The economists' analysis convinced Greenspan that substantial but as yet unmeasured gains in productivity had increased productive capacity in many industries and in the economy as a whole. Consequently, potential output was higher than people had thought. With potential output higher, the economy could continue to grow without generating an expansionary gap or higher inflation. An increase in the federal funds rate was not necessary.

History tells us that Greenspan was right. As we discussed in Economic Naturalist 20.3 during the latter part of the 1990s, the U.S. economy benefited from a large, positive shock to potential output. The main contributing factor was impressive technological advance, particularly in computers, software, and communications. These advances were reflected in more rapid productivity growth and an increase in potential output. And productivity gains from the adoption of new information technology propelled the economy without exacerbating inflation.

As Table 28.1 shows, real GDP growth during the 1995–2000 period was 4.1 percent per year, significantly higher than the average growth rate over the previous decade; and unemployment averaged only 4.8 percent, also significantly better than the prior decade. Despite this rapid economic growth, inflation during 1995–2000 averaged only 2.5 percent per year. Furthermore, average annual growth of output per hour worked accelerated from 1.5 percent during the 1985–1995 period to 2.5 percent during 1995–2000.

TABLE 28.1
U.S. Macroeconomic Data, Annual Averages, 1985–2000

Years	% Growth in real GDP	Unemployment rate (%)	Inflation rate (%)	Productivity growth (%)
1985–1995	2.8	6.3	3.5	1.5
1995–2000	4.1	4.8	2.5	2.5

SOURCE: *Economic Report of the President* (http://www.gpoaccess/gov/eop).

[6]Minutes from the Federal Reserve's September 24, 1996, meeting (http://www.federalreserve.gov/FOMC/minutes/19960924.htm).

Graphically, the effects of a positive shock to potential output are just the reverse of those seen in Figure 28.11, which shows the effects of an adverse shock. A positive shock to potential output causes the *LRAS* line to shift right, leading in the short run to a recessionary gap (output is lower than the new, higher level of potential output), inflation declines, reflected in a downward movement of the *SRAS* line. In the new, long-run equilibrium, output is higher and inflation lower than initially. These results are consistent with the U.S. experience of the latter part of the 1990s. As Greenspan said in a January 2000 speech to the Economic Club of New York, "When we look back at the 1990s . . . (w)e may conceivably conclude . . . (that) the American economy was experiencing a once-in-a-century acceleration of innovation, which propelled forward productivity, output, corporate profits, and stock prices at a pace not seen in generations, if ever."

EXERCISE 28.9

What if productivity hadn't increased in the late 1990s? How would the economy have been different in 2000?

RECAP | **SOURCES OF INFLATION**

Inflation may result from excessive spending, which creates an expansionary output gap and puts upward pressure on prices. For example, a military buildup that raises government purchases sharply may cause the economy to overheat. However, monetary policy or fiscal policy can be used to offset excessive spending, preventing higher inflation from emerging.

Inflation also may arise from an aggregate supply shock, either an inflation shock or a shock to potential output. An inflation shock is a sudden change in the normal behavior of inflation, unrelated to the nation's output gap. An example of an inflation shock is a run-up in energy and food prices large enough to raise the overall price level. An inflation shock creates stagflation, a combination of recession and higher inflation.

Stagflation poses a difficult dilemma for policymakers. If they take no action, eventually inflation will subside and output will recover, but in the interim, the economy may suffer a protracted period of recession. If they use monetary or fiscal policy to increase aggregate demand, they will shorten the recession but also may lock in the higher level of inflation.

A shock to potential output is a sharp change in potential output. Like an adverse inflation shock, an adverse shock to potential output results in both higher inflation and lower output. Because lower potential output implies that productive capacity has fallen, however, output does not recover following a shock to potential output, as it eventually does following an inflation shock.

FISCAL POLICY AND THE SUPPLY SIDE

In this chapter and in the chapter "Spending and Output in the Short Run," we focused on the role of fiscal policy—government spending and taxes—in the determination of aggregate expenditure and aggregate demand. We have seen, for example, that increased government spending or lower taxes can expand the economy by increasing aggregate expenditure. However, most economists agree that fiscal policies affect the economy's productive capacity, or potential output, as well as aggregate expenditure. In general, a **supply-side policy** is a policy that affects potential output (the "supply side" of the economy). As we discuss here, fiscal policies are often supply-side policies in this sense.

supply-side policy a policy that affects potential output

For example, government expenditures on public capital, such as roads, airports, and schools, increase aggregate spending, as we have already discussed. However, they also may increase the economy's potential output. The interstate highway system, begun under President Eisenhower, is a case in point: By lowering the costs of long-distance transportation, interstate highways made the U.S. economy more productive and increased potential output. Thus, spending on public capital may be a supply-side policy as well as influence on aggregate demand.

Government tax and transfer programs affect the incentives, and thus the economic behavior, of households and firms. To the extent that changes in behavior in turn affect potential output, tax and transfer programs also have supply-side effects. A lower tax rate on interest income (as opposed to all income), for example, may increase people's willingness to save for the future, as we saw in the chapter "Saving and Capital Formation." Although greater saving implies lower consumption expenditures and thus weaker aggregate demand in the short run, greater saving also leads to more investment in the long run and a faster rate of capital formation in the economy. As a result, potential output and aggregate supply will grow more rapidly.

Tax and transfer policies also affect potential output by affecting the supply of labor. For example, lower tax rates on earnings may increase potential output by inducing people to work more hours. To illustrate, suppose that Tom earns $10 per hour before taxes and his tax rate is 40 percent. Thus, for each hour he works, Tom earns $10; pays 40 percent of $10, or $4, in taxes; and takes home $6 in after-tax earnings. Tom's situation is depicted in the first line of Table 28.2. Now suppose his tax rate is reduced to 30 percent. If Tom's before-tax wage rate remains equal to $10, his taxes on each hour of work fall to 30 percent of $10, or $3, and he takes home $7 in after-tax earnings, as illustrated in the second line of Table 28.2. Consequently, a *reduction* in Tom's tax rate from 40 percent to 30 percent *increases* his after-tax wage from $6 to $7 per hour.

TABLE 28.2
The Effects of a Reduction in Tax Rates on Tom's After-Tax Wage Rates

Pre-tax wage	Tax rate	Taxes paid	After-tax wage
$10%	40% (= 0.40)	$4	$6
$10	30% (= 0.30)	$3	$7

Reductions in tax rates may increase the number of hours people want to work and reduce the amount of time they want to spend at home watching television and doing chores because the *opportunity cost* of watching television has risen. Tom's opportunity cost of watching an additional hour of television is equal to the amount of after-tax earnings he could have earned during that hour, which has risen from $6 to $7.

According to the cost-benefit principle, individuals make decisions by comparing the extra benefits with the extra costs. In examining the effects of tax rates on economic incentives, therefore, economists focus on people's **marginal tax rate** which is the tax rate on the *marginal* or extra dollar of income, or the amount by which taxes rise when before-tax income rises by one dollar. Someone's marginal tax rate can differ considerably from his **average tax rate,** which is calculated by dividing his total taxes by his total before-tax income to obtain the percentage of before-tax income he pays in taxes.

marginal tax rate the amount by which taxes rise when before-tax income rises by one dollar

average tax rate total taxes divided by total before-tax income

Although there was no difference between Tom's marginal and average tax rates in Table 28.2, this is not true for most people, as we show in Exercise 28.10. In 2004 total taxes collected by federal, state, and local governments were about

27 percent of U.S. GDP and many of these taxes, such as property taxes, do not depend on income. As Economic Naturalist 28.4 illustrates, however, most Americans face marginal tax rates on their incomes that are greater than 27 percent.

EXERCISE 28.10

Suppose Tom pays no taxes on the first $10,000 of his income. Suppose, however, he has to pay taxes of 20 percent on any *additional* income. Thus, if he earns $11,000, he pays .20($11,000 − $10,000) = $200 in taxes. Similarly, if he earns $15,000 he pays .20($15,000 − $10,000) = $1,000 in taxes. Calculate Tom's average and marginal tax rates if he earns $5,000, $11,000, and $15,000.

ECONOMIC NATURALIST 28.4

Estimating your marginal tax rate

Recall that a person's marginal tax rate is the amount by which her taxes rise when her before-tax income rises by one dollar. Calculating one's marginal tax rate can be difficult because there are many taxes that depend directly on income, such as federal income taxes, state income taxes, and Social Security, Disability, and Medicare taxes. Calculating some of these taxes can be complicated and depends upon family composition, sources of income (wages, interest, dividends, etc.), medical expenses, and many other details.

Nevertheless, you can estimate your marginal tax rate at several internet Web sites. Table 28.3 lists the marginal tax rates from one popular Web site for a single, self-employed person with no dependents at various income levels.

TABLE 28.3

Marginal Tax Rates Faced by a Self-Employed Single Person in the United States, 2005

Pre-tax earnings	Marginal tax rate
$ 10,000	28%
25,000	32
50,000	42
100,000	36
250,000	41
$500,000	42

ASSUMPTIONS: All income is earned income, and there are no itemized deductions. Taxes include federal and state income taxes, as well as Social Security, Disability, and Medicare taxes. The marginal state income tax rate, which differs among states, is assumed to be 3 percent on income between $10,000 and $50,000, 4 percent on income between $50,000 and $100,000, and 5 percent on income above $100,000.

SOURCE: http://www.smartmoney.com/tax/filing/index.cfm?story=marginal.

Note that the marginal tax rate in every case in Table 28.3 is greater than the average economoywide tax rate of 27 percent.[7] Note also that the marginal tax rate actually falls between $50,000 and $100,000. Although the marginal federal income tax rates increase with income, the marginal Social Security and Medicare tax

[7]Marginal tax rates for families with children are more difficult to calculate because of the earned income tax credit, which subsidizes low-income workers with children. If one treats the credit as a negative tax, the marginal tax rate for low-income families with children is often negative, and many Web sites that calculate marginal tax rates, like Smart Money's, do not account for the tax credit. On the other hand, if one counts as a tax the reduction in government transfer payments and benefits (such as food stamps, welfare benefits, and Medicaid) that low-income families lose when they earn additional income, their marginal tax rates can often exceed 50 percent.

rate falls after one earns more than about $90,000 per year, and most Americans pay more in Social Security taxes than they do in federal income taxes.[8]

EXERCISE 28.11

Go to the Web site listed in Table 28.3 and estimate your own marginal tax rate.

Changes in marginal tax rates may affect other aspects of the labor supply decision besides the number of hours worked. For example, consider a student's decision about whether to invest the time and money necessary to become a doctor. From an economic perspective, the return to that investment in human capital is the extra income that the student will be able to earn as a doctor, relative to what he or she might earn without a medical degree. If the marginal tax rate on earnings is high, the economic incentive to become a doctor will be lower, and the student may decide not to make that investment. Likewise, a lower marginal tax rate increases the incentive for people to be entrepreneurial and to take risks—for example, by starting their own companies—since they know that they will be able to keep a larger portion of the returns to their efforts. As we discussed in the chapter "Economic Growth, Productivity, and Living Standards," entrepreneurship is an important source of economic growth.

In Figure 28.12 we illustrate one scenario in which a cut in marginal tax rates increases both aggregate demand and aggregate supply. As before, the tax cut shifts the aggregate demand curve to the right, from *AD* to *AD*′. Now, however, the tax cut also increases potential output so the long-run aggregate supply line also shifts to the right. As a result, real output will increase in both the short run and the long run. Whether the rate of inflation also will increase depends on the relative size of

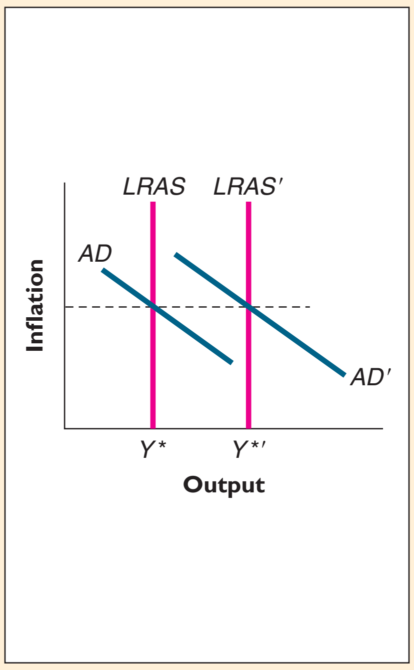


FIGURE 28.12
The Potential Effects of Tax Rate Reductions on Both Aggregate Demand and Aggregate Supply. The economy begins in long-run equilibrium at point *A*. A reduction in tax rates shifts the aggregate demand curve to the right, from *AD* to *AD*′. It also may increase potential output from *Y** to *Y**′. This is represented by a shift in the long-run aggregate supply line from *LRAS* to *LRAS*′. Output will definitely rise. In the long run, inflation may rise, fall, or remain unchanged, depending on the relative magnitudes of the shifts in *AD* and *LRAS*.

[8]Since the data in Table 28.3 refer to self-employed individuals, they include Social Security, Disability, and Medicare taxes of 15.3 percent on all earned income below about $90,000 and 2.9 percent on all earned income above that amount. Although the employers of workers who are not self-employed are responsible for paying half of these taxes, most economists agree that employees effectively pay both the employee and employer portions of the tax. The tax rate calculations do not account for the fact that some (but not all) of the extra Social Security and Medicare taxes people pay will result in greater Social Security benefits when they retire.

the two shifts. For simplicity, we have drawn them so that inflation remains constant, but this need not be the case.

Although economists agree that tax rates affect economic behavior, the magnitude and sometimes even the direction of the effects can be controversial. In our earlier example, we showed that a decline in Tom's tax rate implies an increase in his after-tax wage rate. As we mentioned, the increase in Tom's after-tax wage gives him an incentive to work more hours and to watch less television, because the opportunity cost of watching television instead of working has risen. On the other hand, the reduction in Tom's tax rate also might increase his after-tax wage to such an extent that he may feel that he can afford to work even fewer hours and still pay his bills.[9] Empirical studies of the labor market suggest that the responsiveness of an individual's labor supply to changes in taxes depends on many factors, including age, sex, marital status, and education. For example, married women have traditionally been more likely to move in and out of the labor force and appear to be more responsive to changes in after-tax wages than are their husbands, who have historically tended to remain in the labor market on a full-time basis even when tax rates change.

While many Americans may be dismayed by what they consider to be high taxes, Europeans generally have considerably higher marginal tax rates. In Economic Naturalist 25.8, we examine the claim that the higher marginal tax rates in Europe are responsible for the fact that the typical European works many fewer hours each year than the typical American.

ECONOMIC NATURALIST 28.5

Why do Americans work more hours than Europeans?

The average American works many more hours than the average Western European. Not only is the average workweek longer in America, but Americans generally take fewer vacations, have fewer holidays, retire later, and experience less unemployment than Europeans. As indicated in Table 28.4, during the period 1993–1996, the average American worked $100/64 = 1.56$ times as many hours as the average Italian, or 56 percent more hours. Similarly, the average American worked $(100 - 75)/75 = 33$ percent more hours than the average German. The average Japanese, on the other hand, worked $(104 - 100)/100 = 4$ percent more hours than the average American. Why?

Edward Prescott found that most of these differences can be explained by the variation in marginal tax rates on labor income among these countries.[10] The Japanese,

TABLE 28.4
Hours Worked per Person and Marginal Tax Rates, 1993–1996

Country	Hours worked per person per year relative to the U.S. (U.S. = 100)	Marginal tax rate
Japan	104	37%
United States	100	40
United Kingdom	88	44
Canada	88	52
Germany	75	59
France	68	59
Italy	64	64

SOURCE: Edward C. Prescott, "Why Do Americans Work So Much More Than Europeans?" Federal Reserve Bank of Minneapolls *Quarterly Review,* July 2004, pp. 2–13.

[9]Students who have taken introductory microeconomics may recognize this as an example of substitution and income effects.
[10]Prescott's marginal tax rates include taxes on consumption as well as income.

for example, worked the most and had the lowest marginal tax rate of 37 percent, while the Italians worked the least and had the highest marginal tax rate of 64 percent. Moreover, during the period 1970–1974, when the marginal tax rates in Europe were much closer to those in the United States, the average European worked as much as the average American. Prescott concludes that reductions in marginal tax rates in Europe would considerably increase both labor supply and potential output.

Most economists agree that higher tax rates help to explain why continental Europeans work fewer hours than Americans, but many note that there are other explanations as well. These explanations include Europe's higher unionization rates and government regulations that limit workweeks and the number of hours that stores may remain open. The differences in workhours also may be related to more generous social security systems supporting the unemployed, the sick and disabled, and those who retire early in many European countries.[11]

Some observers also have suggested that Europeans simply have a greater taste for leisure and the "good life" than Americans do. However, as Prescott points out, people in most European countries worked much longer hours in the past (when, among other things, tax rates were lower) than they do today, which suggests that the underlying preferences of Europeans and Americans may not be all that different. Yet, the decrease in hours worked over time among a larger sample of European countries is only weakly related to the increase in tax rates.[12] Clearly, this remains a controversial issue.

If lower tax rates tend to increase potential output, why not reduce taxes to zero? The answer is that, ultimately, government expenditures can be paid for only through taxes. Of course, the government can run a deficit for a while, borrowing to cover the difference between what it spends and what it collects in taxes. But deficits can be harmful (they may reduce national saving, as we saw in the chapter "Saving and Capital Formation"), and in any case the government's borrowing eventually must be repaid with future taxes. Thus, in the long run, taxes should be set at a level commensurate with the government's rate of spending.

The important message is that fiscal policy affects aggregate supply as well as aggregate demand. Thus, in making fiscal policy, government officials should take into account not only the need to stabilize aggregate demand but also the likely effects of government spending, taxes, and transfers on the economy's productive capacity.

RECAP — FISCAL POLICY AND THE SUPPLY SIDE

A supply-side policy is a policy that affects potential output. Fiscal policies affect aggregate demand, but they also may be supply-side policies.

Government expenditures on public capital—such as roads, airports, and schools—increase aggregate expenditure but also may increase potential output.

Government tax and transfer programs affect the incentives, and thus the economic behavior, of households and firms.

People may respond to reductions in their marginal tax rates by working more hours, investing more in education, and taking more entrepreneurial risks, all of which contribute to greater potential output. The size of the effect of tax changes on labor supply remains somewhat controversial.

Fiscal policymakers should take into account the effects of spending and tax decisions on aggregate supply as well as on aggregate demand.

[11]Stephen Nickell, "Employment and Taxes," London School of Economics Centre for Economic Performance Discussion Paper No. 634, May 2004 and Alberto Alesina, Edward Glaeser, and Bruce Sacardote, "Work and Leisure in the U.S. and Europe: Why So Different?" National Bureau of Economic Research Working Paper No. 11278, April, 2005.

[12]Olivier Blanchard, "The Economic Future of Europe," *Journal of Economic Perspectives* 18(1): 3–26, 2004.

SUMMARY

- This chapter extended the basic Keynesian model to include inflation. First, we showed how planned spending and short-run equilibrium output are related to inflation, a relationship that is summarized by the aggregate demand curve. Second, we discussed how inflation itself is determined. In the short run, inflation is determined by past expectations and pricing decisions, but in the longer run inflation adjusts as needed to eliminate output gaps.

- The *aggregate demand (AD) curve* shows the relationship between short-run equilibrium output and inflation. Because short-run equilibrium output is equal to planned spending, the aggregate demand curve also relates spending to inflation. Increases in inflation reduce planned spending and short-run equilibrium output, so the aggregate demand curve is downward-sloping.

- The inverse relationship of inflation and short-run equilibrium output is the result, in large part, of the behavior of the Federal Reserve. To keep inflation low and stable, the Fed reacts to rising inflation by increasing the real interest rate. A higher real interest rate reduces consumption and planned investment, lowering planned aggregate expenditure and hence short-run equilibrium output. Other reasons that the aggregate demand curve slopes downward include the effects of inflation on the real value of money, distributional effects (inflation redistributes wealth from the poor, who save relatively little, to the more affluent, who save more), uncertainty created by inflation, and the impact of inflation on foreign sales of domestic goods.

- For any given value of inflation, an exogenous increase in spending (that is, an increase in spending at given levels of output and the real interest rate) raises short-run equilibrium output, shifting the aggregate demand (*AD*) curve to the right. Likewise, an exogenous decline in spending shifts the *AD* curve to the left. The *AD* curve also can be shifted by a change in the Fed's monetary policy reaction function. If the Fed gets "tougher," shifting up its reaction function and thus choosing a higher real interest rate at each level of inflation, the aggregate demand curve will shift to the left. If the Fed gets "easier," shifting down its reaction function and thus setting a lower real interest rate at each level of inflation, the *AD* curve will shift to the right.

- In low-inflation industrial economies like the United States today, inflation tends to be inertial, or slow to adjust to changes in the economy. This inertial behavior reflects the fact that inflation depends in part on people's expectations of future inflation, which in turn depend on their recent experience with inflation. Long-term wage and price contracts tend to "build in" the effects of people's expectations for multiyear periods. In the aggregate demand–aggregate supply diagram, the *short-run aggregate supply (SRAS) line* is a horizontal line that shows the current rate of inflation, as determined by past expectations and pricing decisions.

- Although inflation is inertial, it does change over time in response to output gaps. An expansionary gap tends to raise the inflation rate, because firms raise their prices more quickly when they are facing demand that exceeds their normal productive capacity. A recessionary gap tends to reduce the inflation rate, as firms become more reluctant to raise their prices.

- The economy is in *short-run equilibrium* when the inflation rate equals the value determined by past expectations and pricing decisions, and output equals the level of short-run equilibrium output that is consistent with that inflation rate. Graphically, short-run equilibrium occurs at the intersection of the *AD* curve and the *SRAS* line. If an output gap exists, however, the inflation rate will adjust to eliminate the gap. Graphically, the *SRAS* line moves upward or downward as needed to restore output to its full-employment level. When the inflation rate is stable and actual output equals potential output, the economy is in *long-run equilibrium.* Graphically, long-run equilibrium corresponds to the common intersection point of the *AD* curve, the *SRAS* line, and the long-run aggregate supply (*LRAS*) line, a vertical line that marks the economy's potential output.

- Because the economy tends to move toward long-run equilibrium on its own through the adjustment of the inflation rate, it is said to be self-correcting. The more rapid the self-correction process, the smaller the need for active stabilization policies to eliminate output gaps. In practice, the larger the output gap, the more useful such policies are.

- Excessive spending, which increases aggregate demand, may lead to expansionary output gaps and result in higher inflation. The increase in spending can result from increases in private spending (consumption or private investment) or increases in government spending.

- Aggregate supply shocks also may cause inflation. *Aggregate supply shocks* include both *inflation shocks*—sudden changes in the normal behavior of inflation, created, for example, by a rise in the price of imported all—and shocks to potential output. Adverse supply shocks both lower output and increase inflation, creating a difficult dilemma for policymakers.

- Reductions in marginal tax rates on income will increase aggregate demand by increasing consumption, and reductions in taxes on business income may increase investment. Reductions in marginal tax rates also may increase aggregate supply by increasing work effort and the willingness to save and invest.

KEY TERMS

aggregate demand (*AD*) curve (•••)
aggregate supply shock (•••)
average tax rate (•••)
inflation shock (•••)
long-run aggregate supply (*LRAS*) line (•••)
long-run equilibrium (•••)
marginal tax rate (•••)
short-run aggregate supply (*SRAS*) line (•••)
short-run equilibrium (•••)
supply-side policy (•••)

REVIEW QUESTIONS

1. What two variables are related by the aggregate demand (*AD*) curve? Explain how the behavior of the Fed helps to determine the slope of this curve. List and discuss two other factors that lead the curve to have the slope that it does.
2. State how each of the following affects the *AD* curve and explain:
   a. An increase in government purchases.
   b. A cut in taxes.
   c. A decline in planned investment spending by firms.
   d. A decision by the Fed to increase its target rate of inflation.
3. Why does the overall rate of inflation tend to adjust more slowly than prices of commodities, such as oil or grain?
4. Discuss the relationship between output gaps and inflation. How is this relationship captured in the aggregate demand–aggregate supply diagram?
5. Sketch an aggregate demand–aggregate supply diagram depicting an economy away from long-run equilibrium. Indicate the economy's short-run equilibrium point. Discuss how the economy reaches long-run equilibrium over a period of time. Illustrate the process in your diagram.
6. True or false: The economy's self-correcting tendency makes active use of stabilization policy unnecessary. Explain.
7. What factors led to increased inflation in the United States in the 1960s and 1970s?
8. Why does an adverse inflation shock pose a particularly difficult dilemma for policymakers?
9. How does a reduction in the marginal tax rate affect both aggregate demand and aggregate supply?

PROBLEMS

1. We saw in the last chapter that short-run equilibrium output falls when the Fed raises the real interest rate. Suppose the relationship between short-run equilibrium output Y and the real interest rate r set by the Fed is given by

$$Y = 1{,}000 - 1{,}000r.$$

   Suppose also that the Fed's reaction function is the one shown in Table 27.1. For whole-number inflation rates between 0 and 4 percent, find the real interest rate by the Fed and the resulting short-run equilibrium output. Graph the aggregate demand curve numerically.

2. For the economy in problem 1, suppose that potential output $Y^* = 960$. From the monetary policy reaction function in Table 27.1, what can you infer about the Fed's objective for the inflation rate in the long term?
3. An economy's aggregate demand curve (the relationship between short-run equilibrium output and inflation) is described by the equation

$$Y = 13{,}000 - 20{,}000\pi.$$

   Initially, the inflation rate is 4 percent, or $\pi = 0.04$. Potential output Y^* equals 12,000.
   a. Find inflation and output in short-run equilibrium.
   b. Find inflation and output in long-run equilibrium.

   Show your work.

4. This problem asks you to trace out the adjustment of inflation when the economy starts with an output gap. Suppose that the economy's aggregate demand curve is

$$Y = 1{,}000 - 1{,}000\pi,$$

where Y is short-run equilibrium output and π is the inflation rate, measured as a decimal. Potential output Y^* equals 950, and the initial inflation rate is 10 percent ($\pi = 0.10$).

a. Find output and inflation for this economy in short-run equilibrium and in long-run equilibrium.
b. Suppose that, each quarter, inflation adjusts according to the following rule:

$$\text{This quarter's inflation} = \text{Last quarter's inflation} - 0.0004(Y^* - Y).$$

Starting from the initial value of 10 percent for inflation, find the value of inflation for each of the next five quarters. Does inflation come close to its long-run value?

5. For each of the following, use an *AD-AS* diagram to show the short-run and long-run effects on output and inflation. Assume the economy starts in long-run equilibrium.
a. An increase in consumer confidence that leads to higher consumption spending.
b. A reduction in taxes.
c. An easing of monetary policy by the Fed (a downward shift in the monetary policy reaction function).
d. A sharp drop in oil prices.
e. A war that raises government purchases.

6. Suppose that the government cuts taxes in response to a recessionary gap, but because of legislative delays the tax cut is not put in place for 18 months. Using an *AD-AS* diagram and assuming that the government's objective is to stabilize output and inflation, show how this policy action might actually prove to be counterproductive.

7. Suppose that a permanent increase in oil prices both creates an inflationary shock and reduces potential output. Use an *AD-AS* diagram to show the effects of the oil price increase on output and inflation in the short run and the long run, assuming that there is no policy response. What happens if the Fed responds to the oil price increase by adopting a tighter monetary policy?

8. An economy is initially in recession. Using the *AD-AS* diagram, show the process of adjustment
a. If the Fed responds by adopting a looser monetary policy (moving its monetary policy reaction function down).
b. If the Fed does not change its monetary policy reaction function.

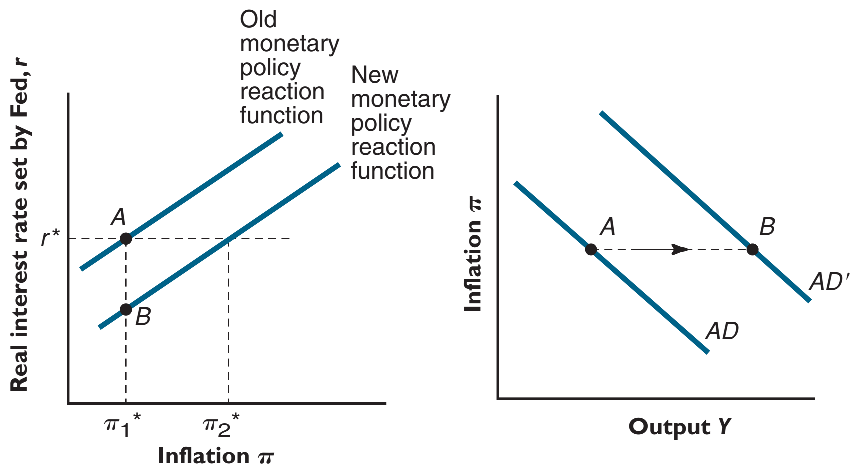
What are the costs and benefits of each approach, in terms of output loss and inflation?

ANSWERS TO IN-CHAPTER EXERCISES

28.1 a. At the current level of inflation, output, and real interest rate, an exogenous reduction in business spending on new capital will reduce planned investment, causing a decline in planned aggregate expenditures (*PAE*) and a reduction in short-run equilibrium output. Because output has fallen for a given level of inflation, the decrease in business spending leads to a leftward shift in the *AD* curve.

b. At the current level of inflation, output, and real interest rate, a reduction in federal income taxes increases consumers' disposable income ($Y - T$), which leads to an exogenous increase in consumption at all income levels, as illustrated in the chapter "Spending and Output in the Short Run." The upward shift in the consumption function increases overall planned aggregate expenditures (*PAE*) and leads to an increase in short-run equilibrium output. Because output has increased for a given level of inflation, the reduction in income taxes leads to a rightward shift in the *AD* curve.

28.2 An increase in the Fed's target inflation rate would shift the monetary policy function down, or to the right. The Fed would then set the real interest rate at a lower level than usual for each given rate of inflation. This change in monetary policy shifts the *AD* curve to the right.



28.3 a. An upward shift in the Fed's monetary policy reaction function means that the Federal Reserve is raising the real interest rate associated with a given level of inflation. An increase in the real interest rate causes both consumption and planned investment spending to fall, reducing overall aggregate expenditures and short-run equilibrium output. Thus, a shift in the Fed's monetary policy reaction function causes the output level to fall for a given level of inflation, resulting in a leftward shift in the *AD* curve.

b. The Federal Reserve's monetary policy reaction function illustrates that the Federal Reserve responds to rising inflation rates by raising the real interest rate (a move *along* the monetary policy reaction function), which causes a reduction in overall aggregate expenditures and short-run equilibrium output. However, in this case, the Fed's response to higher inflation causes a *move along* a given *AD* curve.

Note that while the two actions appear to be similar, there is a key difference. In the first case, the Fed is changing its policy rule for a *given inflation rate,* while in the second case, the Fed is responding to a *changing inflation rate.* Changes in aggregate spending for a given inflation rate shift the *AD* curve, while changes in aggregate spending resulting from Fed policy responses to a rise or fall in inflation lead to moves along a given *AD* curve. Alternatively, in the first case the Fed is changing its (long-run) target rate of inflation, causing the monetary policy reaction function and the *AD* curve to shift. In the second case, the Fed's (long-run) target rate of inflation does not change.

28.4 a. If inflation is expected to be 2 percent next year and workers are expecting a 2 percent increase in their real wages, then they will expect, and ask for, a 4 percent increase in their nominal wages.

b If inflation is expected to be 4 percent next year, rather than 2 percent, workers will expect, and ask for, a 6 percent increase in their nominal wages.

c. If wage costs rise, firms will need to increase the prices of their goods and services to cover their increased costs, leading to an increase in inflation. In part b, when expected inflation was 4 percent, firms will be faced with larger increases in nominal wages than in part a, when expected inflation was only 2 percent. Thus, we can expect firms to raise prices by more when expected inflation is 4 percent than when expected inflation is 2 percent. From this example, we can conclude that increased inflationary expectations lead to higher inflation.

28.5 If the inflation rate is high, the economy will tend to stay in this high-inflation state due to expectations of high inflation and the existence of long-term wage and price contracts, while if the inflation rate is low, the economy will likewise tend to stay in this low-inflation state for similar reasons. However, since high inflation rates impose economic costs on society, as pointed out in the chapter "Measuring the Price Level and Inflation," the Federal Reserve has an incentive to avoid the high-inflation state by keeping inflation low, which helps to maintain people's expectations of low inflation and leads to lower future inflation rates—perpetuating the "virtuous circle" illustrated in Figure 28.5.

28.6 An increase in spending on new capital by firms for a given level of inflation, output, and real interest rate increases aggregate expenditures and short-run equilibrium output. Since the economy was originally operating at potential output, the increase in investment spending will lead to an expansionary gap; actual output, *Y,* will now be greater than potential output, Y^*. When $Y > Y^*$, the rate of inflation will tend to rise.

28.7 The effects will be the opposite of those illustrated in Figure 28.9. Beginning in a long-run equilibrium with output equal to potential output and stable inflation (that is, where the aggregate demand (*AD*) curve intersects both the short-run and long-run aggregate supply lines (*SRAS* and *LRAS,* respectively)), the fall in consumption spending will initially lead to a leftward shift in the *AD* curve and the economy moves to a new, lower, short-run equilibrium output level at the same inflation rate. The shift in *AD* creates a recessionary gap, since *Y* is now less than Y^*. The immediate effect of the decrease in consumption spending is only to reduce output. However, over time inflation will fall because of the recessionary gap. As inflation falls, the *SRAS* line will shift downward. The Federal Reserve responds to the fall in inflation by reducing real interest rates, leading to an increase in aggregate expenditure and output, a move down along the new *AD* curve. When inflation has fallen enough (and real interest rates have fallen enough) to eliminate the output gap, the economy will be back in long-run equilibrium where output equals potential output but the inflation rate will be lower than before the fall in consumption spending.

28.8 A decrease in oil prices is an example of a "beneficial" inflation shock and the economic effects of such a shock are the reverse of those illustrated in Figure 28.10. In this case, starting from a long-run equilibrium where output equals potential output, a beneficial inflation shock reduces current inflation, causing the *SRAS* line to shift downward. The downward shift in the *SRAS* curve leads to a short-run equilibrium with lower inflation and higher output, creating an expansionary gap. If the Fed does nothing, eventually the *SRAS* will begin to shift upward and the economy will return to its original inflation and output levels. However, the Fed may instead choose to tighten its monetary policy by shifting up its monetary policy reaction function, raising the current real interest rate, shifting the *AD* curve to the left, and restoring equilibrium at potential GDP, but at the new, lower inflation rate.

28.9 If productivity growth hadn't increased in the last half of the 1990s, the *LRAS* would not have shifted as far to the right as it actually did. As a consequence, the average inflation rate would not have fallen as much as illustrated in Table 28.1 and average real GDP growth would have been smaller. Similarly, if productivity growth slows in the future from its actual 1995–2000 rate, we can expect higher inflation and lower GDP growth than we otherwise would have experienced.

28.10 If Tom earned \$5,000, he would pay no taxes, so his average tax rate would be 0 percent. If he earned \$5,001, he would still pay no taxes, so his marginal tax rate also would be 0 percent.

If Tom earned \$11,000, he would pay 0.20(\$11,000 − \$10,000) = \$200 in taxes, so his average tax rate would be \$200/\$11,000 = 0.018, or 1.8 percent. If his income rose by \$1 so that he earned \$11,001, his taxes would be 0.20(\$11,001 − \$10,000) = \$200.20. Thus, he would pay an additional \$.20 in taxes and his marginal tax rate would be 20 percent.

If Tom earned \$15,000, he would pay 0.20(\$15,000 − \$10,000) = \$1,000 in taxes, and his average tax rate would be \$1,000/\$15,000 = 0.067, or 6.7 percent. If his income rose by \$1 to \$15,001, he would pay an additional \$.20 in taxes, so his marginal tax rate would still be 20 percent.

28.11 Your answer depends on your particular circumstances.