


THE PRACTICE AND PITFALLS OF MACROECONOMIC POLICY



 On October 6, 1979, the Federal Open Market Committee, the policy-making committee of the Federal Reserve (see the chapter “Money, Prices, and the Federal Reserve”), held a highly unusual—and unusually secretive—Saturday meeting. Fed Chairman Paul Volcker may have called the Saturday meeting because he knew the financial markets would be closed and thus would not be able to respond to any “leaks” to the press about the discussions. Or perhaps he hoped that the visit of Pope John Paul II to Washington on the same day would distract the news media from goings-on at the Fed. However unnoticed this meeting may have been at the time, in retrospect it marked a turning point in postwar U.S. economic history.

When Volcker called the October 6 meeting, he had been chairman of the Fed for only six weeks. Six feet eight inches tall with a booming bass voice, and a chain-smoker of cheap cigars, Volcker had a reputation for financial conservatism and personal toughness. Partly for those qualities, President Carter had appointed Volcker to head the Federal Reserve in August 1979. Carter needed a tough Fed chairman to restore confidence in both the economy and the government’s economic policies. The U.S. economy faced many problems, including a doubling of oil prices following the overthrow of the Shah of Iran and a worrisome slowdown in productivity growth. But in the minds of the public, the biggest economic worry was an inflation rate that seemed to be out of control. In the second half of 1979, the annual rate of increase in consumer prices had reached 13 percent; by the spring of 1980 the inflation rate had risen to nearly 16 percent. Volcker’s assignment: to bring inflation under control and stabilize the U.S. economy.



Paul Volcker faced a tough assignment.

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Volcker knew that getting rid of inflation would not be easy, and he warned his colleagues that a “shock treatment” might be necessary. His plan was couched in technical details, but in essence he proposed to reduce the rate of growth of the money supply sharply. Everyone in the room knew that slowing the growth of the money supply would cause interest rates to rise and aggregate spending to fall. Inflation might be brought down, but at what cost in terms of recession, lost output, and lost jobs? And how would the financial markets, which were already shaky, react to the new approach?

Officials in the room stirred nervously as Volcker spoke about the necessity of the move. Finally, a vote was called. Every hand went up.

What happened next? We will discuss the policies of the Volcker Fed and their effects later in this chapter. First, however, we must develop more background on the links between monetary policy and inflation.

We begin this chapter by extending the model used in preceding chapters to illustrate the short-run and long-run effects of tightening monetary policy in order to reduce inflation. We then use the model to discuss how the Fed can maintain low inflation when the economy is hit by shocks to aggregate demand or aggregate supply, and we also describe the ways in which monetary policy might be made more effective. Finally, we examine several practical difficulties in devising and implementing monetary and fiscal policy.

REDUCING HIGH INFLATION

High or even moderate rates of inflation are economically costly. What, then, should policymakers do if the inflation rate is too high? As Example 29.1 shows, inflation can be slowed by policies that shift the aggregate demand curve leftward. Although they produce the long-term gains in productivity and economic growth associated with low inflation, such policies are likely to impose significant short-run costs in the form of lost output and increased unemployment.

EXAMPLE 29.1

The effects of anti-inflationary monetary policy

Figure 29.1 illustrates both the short-run and long-run effects of an anti-inflationary monetary policy. In Figure 29.1(a), we depict the Fed’s monetary policy reaction function we introduced in the chapter “Stabilizing the Economy.” Recall that the Fed’s monetary policy reaction function is described in Equation 27.2 as

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

In Figure 29.1(a), the line labeled *MPRF* represents the monetary policy reaction function corresponding to an initial target inflation rate of 10 percent. When inflation is at its target, Equation 27.2 indicates that the actual real interest rate r will be equal to the Fed’s target for the real interest rate r^* . Thus, at point *A* in Figure 29.1(a), $\pi = \pi_1^* = 10$ percent, and $r = r^*$.

In Figure 29.1(b), we connect the monetary policy reaction function to the aggregate demand–aggregate supply curves we introduced in the last chapter. The initial equilibrium at point *A* is depicted as a short-run equilibrium because it occurs at the intersection of the initial aggregate demand curve *AD* and the initial short-run aggregate supply line *SRAS*. Point *A* is also a long-run equilibrium because it is located at the intersection of *AD* and the long-run aggregate supply line *LRAS*. Consequently, at point *A*, actual output is equal to potential output ($Y = Y^*$). Note that inflation, which is measured on the horizontal axis in Figure 29.1(a), is measured on the vertical axis in Figure 29.1(b).

Suppose the Fed decides that the high inflation is impeding economic performance and long-run economic growth. Consequently, it decides to adopt a tighter monetary policy, under which the long-run target inflation rate is 3 percent, rather than 10 percent. As we will show, the economic effects of adopting a tighter monetary

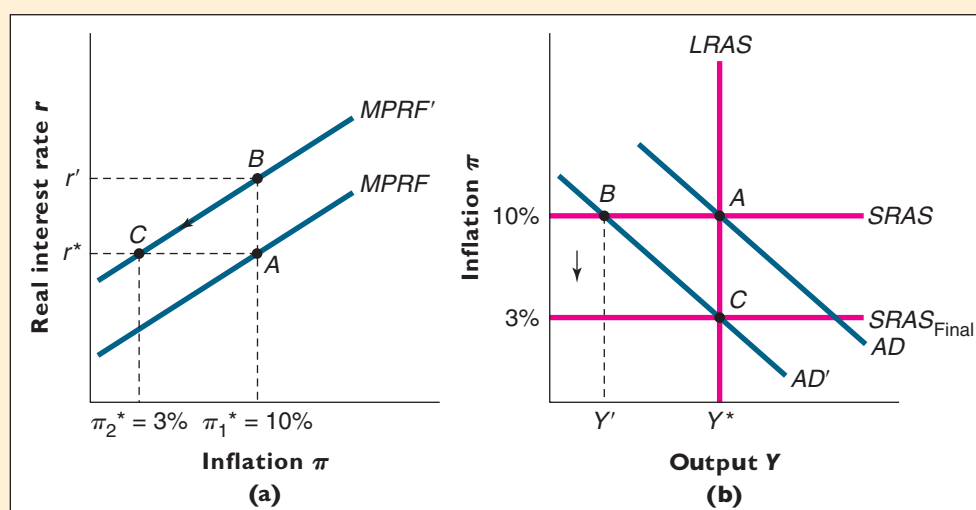


FIGURE 29.1

Short-Run and Long-Run Effects of an Anti-inflationary Monetary Policy.

(a) Initially, the economy is in long-run equilibrium at point A with actual inflation equal to the Fed's target rate of inflation of 10 percent, the real interest rate equal to the target real interest rate, and actual output equal to potential. If the Fed reduces its target inflation rate to 3 percent, the monetary policy reaction function MPRF shifts left (upwards) to MPRF'. At the initial inflation rate of 10 percent, this will require an increase in the real interest rate. (b) In the short run, the inflation rate remains unchanged but the rise in the real interest rate shifts the aggregate demand curve to the left, from AD to AD'. The economy reaches a new short-run equilibrium at point B, at the intersection of AD' and SRAS. In the short run, output falls to Y' , but inflation doesn't change. Following the adoption of a tighter monetary policy, a recessionary gap exists at point B, which eventually causes inflation to decline. The short-run aggregate supply line shifts downward, from SRAS to SRAS_{Final}. Long-run equilibrium is restored at point C. In the long run, real output returns to potential, inflation falls to the new lower target inflation rate of 3 percent, and the real interest rate returns to its target, r^* .

policy are very different in the short run and in the long run. The Fed begins to reduce inflation by decreasing its target rate of inflation. In Figure 29.1(a), we assume that the Fed reduces its target inflation rate to 3 percent. As we saw in the last chapter, the monetary policy reaction function will then shift to the left (or upwards) in Figure 29.1(a) so that $r = r^*$ when $\pi = \pi^* = 3$ percent, at point C. The economy, however, does not move directly from point A to point C. At the initial rate of inflation of 10 percent, the Fed must first increase the real interest rate to r' at point B.

An increase in the real interest rate will reduce consumption and investment spending, lowering aggregate demand at every inflation rate and shifting the aggregate demand curve to the left in Figure 29.1(b) from AD to AD'. After the Fed's action, the AD' curve and the SRAS line intersect at point B, the new short-run equilibrium. Actual output has fallen to Y' , which is less than potential output Y^* . In other words, the Fed's action has allowed a recessionary gap to develop, so that unemployment will exceed the natural rate. At point B, however, the inflation rate is still 10 percent. Thus, in the short run, a monetary tightening pushes the economy into recession but has little or no effect on the inflation rate because of inflation inertia.

The short-run effects of the anti-inflationary shift in monetary policy—lower output, higher unemployment, and little or no reduction of inflation—are not encouraging, and they explain why such policy shifts are often unpopular in their early stages. Fortunately, the economy will not remain at point B indefinitely. The existence of a recessionary gap at point B eventually causes inflation to decline, as firms become more reluctant to raise their prices in the face of weak demand.

The eventual decline in inflation that results from a recessionary gap is illustrated by the gradual downward shift of the short-run aggregate supply line, from SRAS to

$SRAS_{\text{Final}}$ in Figure 29.1(b) and the movement along the new monetary policy reaction function $MPRF'$ in Figure 29.1(a). As the economy moves from point B to point C in Figure 29.1(a), inflation falls. This allows the Fed to lower the real interest rate from r' to r^* while staying on its new policy reaction function (with its lower target inflation rate). The reduction in the real interest rate spurs investment from its depressed level and moves output back to potential, reflected by the move from point B to point C along the AD' curve in Figure 29.1(b). Inflation will continue to fall until the economy returns to long-run equilibrium at point C in both graphs. At that point, actual output has returned to potential, the inflation rate has stabilized at the new target inflation rate of 3 percent, and the real interest rate is once again equal to its target, r^* .

The adoption of a tighter monetary policy (reflected by a reduction in the Fed's target rate of inflation) therefore inflicts short-term pain (a decline in output, high unemployment, and a temporarily high real interest rate) to achieve a long-term gain (a permanent reduction in inflation). In the long run, however, the adoption of a tighter monetary policy will result in lower inflation but will affect neither real output nor the real interest rate. Recall that any change in the Fed's target for inflation will shift its monetary policy reaction function. Any shift in the Fed's monetary policy reaction function will then shift the aggregate demand curve. The adoption of a tighter monetary policy (a shift in $MPRF$ up or to the left) will shift the AD curve left; the adoption of a looser monetary policy (a shift in $MPRF$ down or to the right) will shift the AD curve right.

EXERCISE 29.1

Show the typical time paths of output, inflation, and the real interest rate when the Fed adopts a tighter (more anti-inflationary) monetary policy. Draw a separate graph for each variable, showing time on the horizontal axis. Be sure to distinguish the short run from the long run. Specific numerical values are not necessary.



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“I don’t like 6 per-cent unemployment, either. But I can live with it.”

Now that we have seen how the adoption of a tighter monetary policy affects the economy, Economic Naturalist 29.1 discusses the situation faced by the Fed and Paul Volcker that we introduced at the beginning of this chapter.

How was inflation conquered in the 1980s?

After reaching double-digit levels in the late 1970s and 13.5 percent in 1980, inflation in the United States fell all the way to 3.2 percent in 1983, and it remained in the 2–5 percent range for the rest of the decade. In the 1990s, inflation fell even lower, in the 2–3 percent range in most years. How was inflation conquered in the 1980s?

The person who was most directly responsible for the conquest of inflation in the 1980s was the Federal Reserve's chairman, Paul Volcker. Following the secret Saturday meeting he called on October 6, 1979 (described in the introduction to this chapter), the Federal Open Market Committee agreed to adopt a strongly anti-inflationary monetary policy. The results of this policy change on the U.S. economy are shown in Table 29.1, which includes selected macroeconomic data for the period 1978–1985.

The data in Table 29.1 fit our analysis of anti-inflationary monetary policy quite well. First, as our model predicts, in the short run the Fed's adoption of a tighter monetary policy led to a recession. In fact, two recessions followed the Fed's action in 1979, a short one in 1980 and a deeper one in 1981–1982. Note that growth in real GDP was negative in 1980 and 1982, and the unemployment rate rose significantly, peaking at 9.7 percent in 1982. Nominal and real interest rates also rose, a direct effect of the shift in monetary policy. Inflation, however, did not respond much during the period 1979–1981. All these results are consistent with the short-run analysis in Figure 29.1.

By 1983, however, the situation had changed markedly. The economy had recovered, with strong growth in real GDP in 1983–1985 (see Table 29.1). In 1984 the unemployment rate, which tends to lag the recovery, began to decline. Interest rates remained relatively high, perhaps reflecting other factors besides monetary policy. Most significantly, inflation fell in 1982–1983 and stabilized at a much lower level. Inflation has remained low in the United States ever since.

ECONOMIC NATURALIST 29.1



TABLE 29.1
U.S. Macroeconomic Data, 1978–1985

Year	Growth in real GDP (%)	Unemployment rate (%)	Inflation rate (%)	Nominal interest rate (%)	Real interest rate (%)
1978	5.5	6.1	7.6	8.3	0.7
1979	3.2	5.8	11.4	9.7	-1.7
1980	-0.2	7.1	13.5	11.6	-1.9
1981	2.5	7.6	10.3	14.4	4.1
1982	-2.0	9.7	6.2	12.9	6.7
1983	4.3	9.6	3.2	10.5	7.3
1984	7.3	7.5	4.3	11.9	7.6
1985	3.8	7.2	3.6	9.6	6.0

SOURCE: *Economic Report of the President* (<http://www.gpoaccess.gov/eop>) and calculations by the author.



disinflation a substantial reduction in the rate of inflation

A substantial reduction in the rate of inflation, like the one the Fed engineered in the 1980s, is called a **disinflation**. But again, disinflation may come at the cost of a large recessionary gap and high unemployment like that experienced by the United States in the early 1980s. Is this cost worth bearing? This question is not an easy one to answer because the costs of inflation are difficult to measure. Policy-makers around the world appear to agree on the necessity of containing inflation, however, as many countries fought to bring their own inflation rates down to 2 percent or less in the 1980s and 1990s. Canada and Great Britain are among the many industrial countries that have borne the costs of sharp reductions in inflation.

Can the costs of disinflation be reduced? Unfortunately, no one has found a pain-free method of lowering the inflation rate. Accordingly, in recent years central banks around the world have striven to keep inflation at manageable levels, to avoid the costs of disinflation. In the next section, we discuss how the Fed can maintain a low rate of inflation when the economy is buffeted by shocks to aggregate demand or aggregate supply.

RECAP	REDUCING HIGH INFLATION
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<p>Inflation can be reduced by policies that shift the aggregate demand curve leftward, such as the adoption of a “tighter” monetary policy (an upward or leftward shift in the monetary policy reaction function). In the short run, the effects of a change to a tighter, more anti-inflationary monetary policy are felt largely on output, so that a disinflation (a substantial reduction in inflation) may create a significant recessionary gap. In the long run, output should return to potential and inflation should decline. These predictions were borne out during the Volcker disinflation of the early 1980s.</p>

KEEPING INFLATION LOW

In the two decades since the Volcker disinflation, the United States has had relatively low inflation. Although inflation briefly rose above 5 percent in 1990, it has stayed below the 3.6 percent achieved in 1986 in all but three years. During this same period, real GDP growth has averaged 3.2 percent per year and the two economic recessions the United States has experienced have been short and relatively mild. Most economists believe that low inflation is an important reason for increased economic growth and greater economic stability. Moreover, a low inflation rate makes costly disinflations unnecessary. Thus, keeping inflation low is one of the best things that the Federal Reserve can do for the U.S. economy.

In this section, we examine the Fed’s policy choices in a low-inflation environment. We illustrate how policy responses and the consequences of anti-inflationary policies may differ according to whether the disturbances in the economy are caused by shocks in spending or shocks to aggregate supply.

EXAMPLE 29.2

Responding to shocks in spending

As we learned in the last chapter, changes in monetary policy are not the only factors that shift the aggregate demand curve. The aggregate demand curve also will shift in response to changes in fiscal policy and other exogenous changes in spending. As we will see, if these changes in spending are permanent, the Fed will be able to maintain inflation at its original target inflation rate in the long run only if it changes its target real interest rate.

To understand this important point, let’s re-examine the analysis of the effects of a change in fiscal policy that we began in the last chapter. In Figure 29.2(b), we depict the situation in Figure 28.8, where we examined the effects of an increase in

military spending. As before, we begin at point A, at which output is equal to potential output and inflation is steady. In Figure 29.2(a), note that this corresponds to a point on the Fed's monetary policy reaction function at which actual inflation π is equal to the Fed's target rate of inflation π^* and the actual real interest rate r is equal to the Fed's target real interest rate r_1^* .

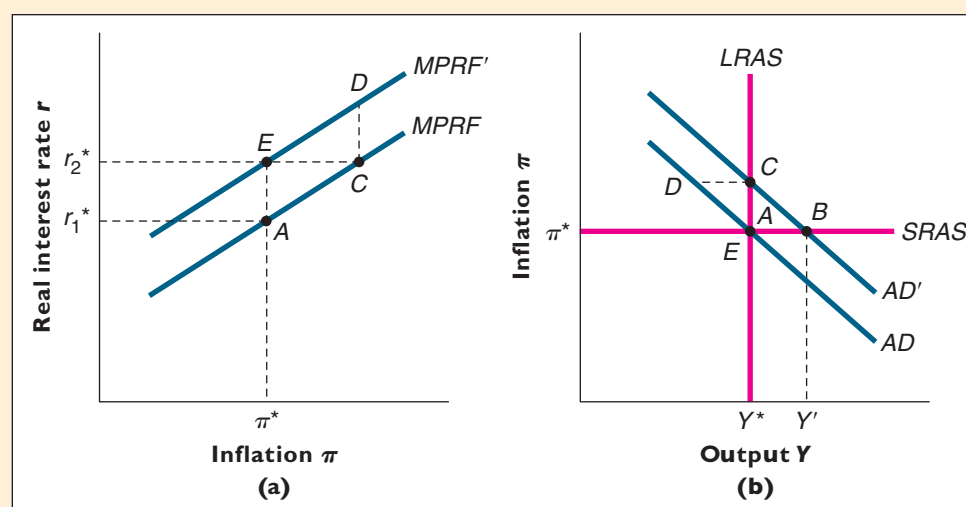


FIGURE 29.2

Maintaining Low Inflation After a Change in Spending.

Initially the economy is in long-run equilibrium at point A with actual inflation equal to the Fed's initial target rate of π^* and actual output equal to potential output. An increase in spending shifts the AD curve to the right, to AD'. In the short run, real GDP rises to Y' , but inflation does not change. The expansionary gap leads to rising inflation, causing the SRAS line to shift up. If the Fed accommodates this increase in inflation, the economy moves to point C in the long run. Actual output returns to its potential level with a higher inflation rate. If, however, the Fed does not want inflation to exceed its target, it can raise the target real interest rate to r_2^* . This will shift the monetary policy reaction function up, and the aggregate demand curve will shift back to AD. Actual output will again be equal to its potential level in the long run, but inflation will return to the target level of π^* . If inflation has already risen to point C, the real interest rate will rise temporarily to point D in Figure 29.2(a) before falling to r_2^* . If the Fed acts pre-emptively, however, it can raise r immediately from r_1^* to r_2^* . This action would offset the initial shift in the AD curve caused by the increase in spending, and output would remain at Y^* (points A and E in both graphs).

Now let us suppose an increase in military spending shifts the aggregate demand curve to the right. The shift in aggregate demand also could come from a cut in taxes or a sudden increase in consumption or investment spending. If the Fed does not shift its monetary policy reaction function, the economy moves from point A to point B in Figure 29.2(b) in the short run. Real GDP rises, creating an expansionary gap, but initially inflation does not change. Over time, however, the short-run aggregate supply line shifts up in response to the expansionary gap. As a result, inflation will begin to rise.

At this point, the Fed has a choice. If it acts to allow inflation to rise above its target, the economy will gradually move to point C in Figure 29.2(a) and (b). Inflation will continue to rise, and the economy will gradually move back to potential output in the long run at a permanently higher rate of inflation. At point C, however, both inflation and the real interest rate will exceed the Fed's targets.

The Fed, however, can prevent inflation from rising by raising its target for the real interest rate to r_2^* . Recall that the monetary policy reaction function is drawn so that when actual inflation is equal to the Fed's target for inflation, the real interest



rate is equal to the Fed's target real interest rate. Consequently, an increase in the Fed's target real interest rate will shift the Fed's monetary policy reaction function up (to the left) from $MPRF$ to $MPRF'$. This shift in the Fed's monetary policy reaction function will shift the aggregate demand curve back to AD . Output will return to potential and inflation will eventually return to π^* at point E in Figures 29.2(a) and 29.2(b). While output returns to potential regardless of what the Fed does, the Fed can prevent inflation from permanently rising by increasing its target real interest rate and acting accordingly.

If the Fed waits to raise r^* until the economy moves from point B to point C , it will temporarily have to raise the real interest rate to point D in Figure 29.2(a). The economy will then experience a period of rapid growth followed by a period of slow growth until it returns to potential output at point E in Figure 29.2(b). The Fed, however, may decide to act earlier and avoid both the elevated inflation and the boom-bust cycle in output. It can act *preemptively* by raising its target real interest rate immediately to r_2^* .¹ This increase in r^* would shift the monetary policy reaction function up immediately. Although the initial increase in spending may shift the aggregate demand curve from AD to AD' , the Fed's action would shift it relatively quickly back to AD . As a result, the economy would remain at full employment and inflation would never change from its initial level. Output can be stabilized at potential and inflation can be kept low.

As we saw in the last chapter, changes in fiscal policy and other changes in spending do not change real output in the long run. Now, however, we see that inflation will change only if the Fed allows it to change. Sometimes economists use the word *accommodating* to describe a policy that allows the effects of a shock to occur. In this example, **accommodating monetary policy** would allow the spending shock to increase output in the short run and inflation in the long run. Rather than accommodate the spending shock, however, the Fed could block its effects on both output and inflation by raising its target real interest rate.

Why does the Fed have to increase its target for the real interest rate in order to maintain stable output and inflation? Recall from the chapter "Saving and Capital Formation" that the real interest rate is determined by saving and investment in the long run. An increase in military spending, or any other increase in government spending (or reduction in net taxes) will increase the government budget deficit. As we saw in Figure 22.9, an increase in the federal budget deficit reduces national saving and increases the real interest rate in the long run. In order to avoid long-run inflationary consequences, the Fed must raise its target real interest rate to a level that is compatible with long-run equilibrium in the market for saving and investment.

This model also can be used to analyze a sudden reduction in spending. Starting again at potential output, a reduction in spending will shift the aggregate demand curve to the left. The Fed can eliminate the recessionary gap resulting from this shift by reducing its real interest rate target. Once again, real GDP returns to potential and inflation returns to the Fed's target rate of inflation.

EXERCISE 29.2

Suppose the economy is initially in long-run equilibrium and there is a sudden decrease in spending. Use the monetary policy reaction function graph and aggregate supply–aggregate demand graphs to illustrate and explain what happens to output and inflation in the short run and the long run. Assume that after the economy moves back to potential output, the Fed lowers its target real interest rate to the new real interest rate at which saving equals investment in the long run. Then explain what the differences would be if the Fed lowers its target real interest rate immediately after the decrease in spending.

¹Note that r_2^* is also the actual real interest rate that is consistent with full employment after the shift in aggregate demand.

accommodating policy a policy that allows the effects of a shock to occur



Why did the Fed lower interest rates again in 2003?

As we discussed in the last chapter, the Fed reduced the federal funds rate from 6.50 percent in January 2001 to 1.75 percent in December 2001 in order to fight the 2001 recession. After the economy began to recover in 2002 and 2003, however, the Fed again reduced the federal funds rate to 1.25 percent in November 2002 and 1.0 percent in June 2003. Why did the Fed continue to reduce the federal funds rate even during the recovery?

There were several reasons for the Fed's policy choices. First, as we mentioned before, economic growth even during the recovery was slower than it had been in previous recoveries. Second, job growth did not keep up with the growth in output, due to the unusual increases in productivity. In addition, there was a major slowdown in investment spending as businesses became more cautious, especially following the decline in the stock market. As a result, the Fed was concerned that aggregate demand might fall and create a recessionary gap. The reduction in investment spending also implied that there might have been a reduction in the long-run real interest rate at which saving equaled investment. In response, the Fed reduced its target real interest rate, which shifted its monetary policy reaction function down (to the right).

The Fed's action prevented the aggregate demand curve from falling further and thereby avoided a recession. This is another illustration of how the Fed can stabilize both inflation and output when there is a shock to aggregate demand.

Example 29.2 and Economic Naturalist 29.2 illustrated that shocks in aggregate demand do not require the Fed to make a difficult choice between inflation and the stability of output. The Fed can maintain stable inflation and output by adjusting its target real interest rate to the real interest rate at which saving equals investment in the long run. We examine the Fed's possible responses to an aggregate supply shock in the next example.

Responding to shocks in aggregate supply

Although shocks to aggregate demand do not require the Fed to choose between inflation and output stability, shocks to aggregate supply do create such a dilemma. If the Fed maintains its initial target inflation rate, the economy may experience a protracted recessionary or expansionary gap. If, on the other hand, it wants to hasten the return to potential GDP, it may have to change its inflation target.

We illustrate this situation in Figure 29.3. Once again, the economy starts at point *A* in both diagrams, with $Y = Y^*$, $\pi = \pi_1^*$, and $r = r^*$. Now suppose an adverse inflation shock shifts the short-run aggregate supply line up in Figure 29.3(b), just as in Figure 28.9. In the short run, the economy moves to point *B*, with higher inflation and a recessionary gap.

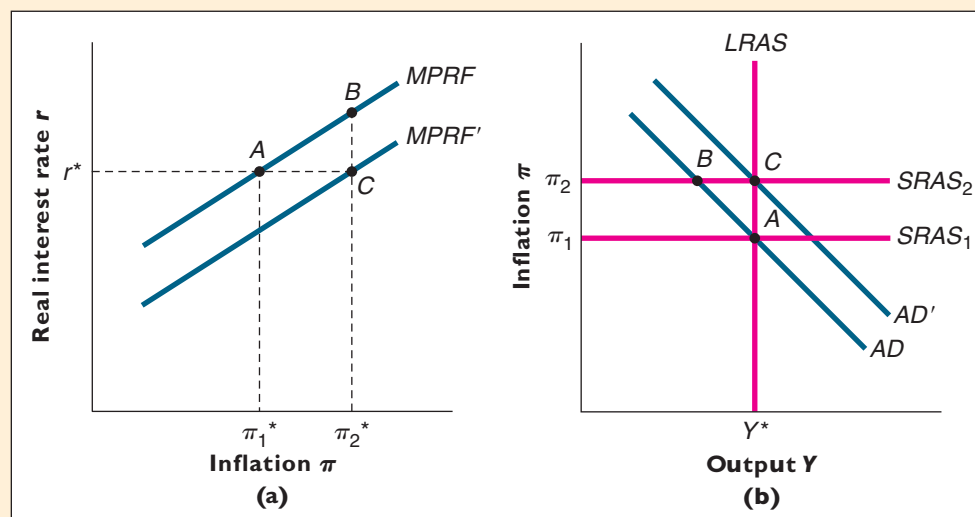
At this point, the Fed faces the dilemma we introduced in the last chapter. If it wants to avoid a recession, it can increase its target inflation rate to π_2^* . This will shift the monetary policy reaction function down (to the right) to $MPRF'$ and the aggregate demand curve to the right, to AD' . Output will return quickly to potential at point *C*, but inflation will be permanently higher. The initial bulge in inflation following the supply shock will be followed by a second round of inflation. In the second round, the initial increase in inflation leads to a change in inflationary expectations. Workers and firms will then expect prices to continue to rise, so they push for continued increases in wages and prices. Consequently, the higher inflation rate will be sustained.

Alternatively, when the economy is buffeted by an adverse inflation shock, the Fed can prevent inflation from becoming permanently higher by maintaining its original target inflation rate. By doing so, the Fed can preempt the second round of inflation and prevent the bulge in inflation from becoming permanent. If the Fed

ECONOMIC NATURALIST 29.2



EXAMPLE 29.3

**FIGURE 29.3****Maintaining Low Inflation after an Adverse Inflation Shock.**

Initially the economy is in long-run equilibrium at point A with actual inflation equal to the Fed's initial target rate of π_1^* and actual output equal to potential output. An oil price increase or another adverse inflation shock shifts the SRAS line up to $SRAS_2$. If the Fed accommodates the supply shock, it increases its target inflation rate to π_2^* . This shifts the monetary policy reaction function downwards (to the right) to $MPRF'$, and the AD curve also shifts right to AD' . The economy moves quickly to point C and any recession is short-lived. If, however, the Fed does not change its target inflation rate, neither the monetary policy reaction function nor the aggregate demand curve will shift. In the short run, we move to point B and real GDP falls. The recessionary gap at point B will gradually shift the short-run aggregate supply line down until real output again returns to potential and inflation falls back to its unchanged target at point A.

does not change its monetary policy (in which case the monetary policy reaction function does not shift), the recessionary gap that exists at point B will gradually shift the short-run aggregate supply line back down to $SRAS_1$, and the economy will move back to point A in the long run. Inflation will return to its initial rate and real GDP will return to potential. In the interim, however, the economy may experience a recession.

In deciding which of these two policy alternatives to follow, the Fed might like to know how long it would take for the economy to return to potential (at point A) if it did not change monetary policy. The answer depends on the speed with which the short-run aggregate supply line shifts down when an adverse inflation shock creates a recessionary gap. If the SRAS line shifts down quickly, the Fed is more likely to keep its target inflation rate unchanged at π_1^* because any recession will probably be short. If, on the other hand, the SRAS line shifts down very slowly, the Fed may be more inclined to increase its target inflation rate to avoid a lengthy recession.

Ironically, the speed with which the short-run aggregate supply line shifts back down following an adverse inflation shock depends partly on the public's expectation of how the Fed will act. If people are confident that the Fed will maintain its original target inflation rate, their expectations of future inflation will not change even if inflation rises temporarily. If this is the case, we describe people's expectations of inflation as being **anchored**. When an adverse supply shock increases inflation, people with anchored expectations believe that the Fed

anchored inflationary expectations when people's expectations of future inflation do not change even if inflation rises temporarily

will act to ensure that inflation quickly falls back to its initial level. Workers will then be less likely to ask for inflationary wage increases and firms will be less likely to raise prices. The second round of inflation will be eliminated, the short-run aggregate supply line will shift back to $SRAS_1$ more rapidly, and output will return to potential more quickly. Because any recession will be shorter if inflationary expectations are anchored, the Fed also will be comfortable keeping its target inflation rate unchanged.

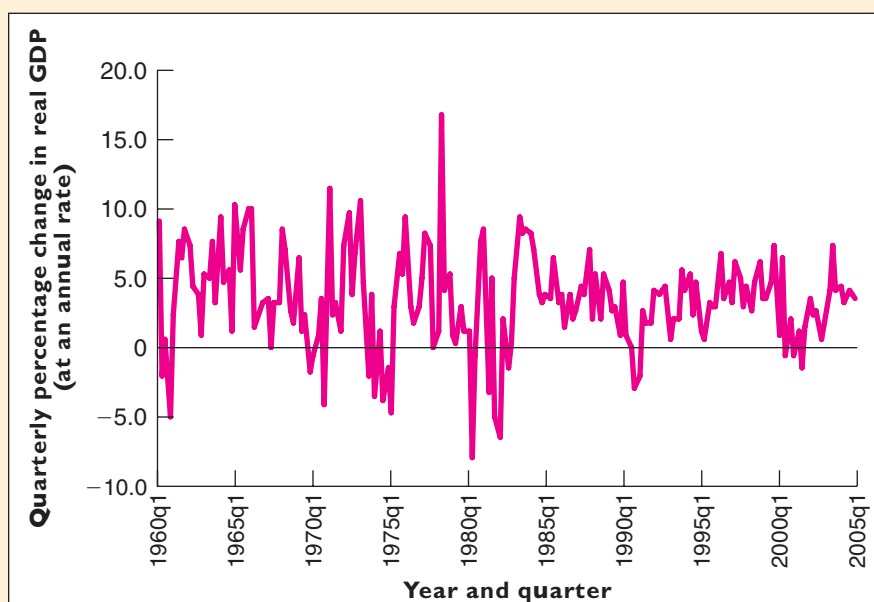
If, on the other hand, the Fed has frequently accommodated higher inflation rates in the past, expectations of inflation may not be anchored. If the public believes the Fed will raise its target inflation rate, expectations of future inflation will be higher. Workers will then demand larger wage increases and firms will raise prices more rapidly. In that event, the short-run aggregate supply line will shift down more slowly, and the return to full employment will be prolonged. Thus, the Fed has a stake in convincing the public that it will maintain its original target inflation rate. In Economic Naturalists 29.3 and 29.4, we suggest two periods during which anchored inflationary expectations may have contributed to improved macroeconomic performance.

Why has macroeconomic volatility in the United States declined so much since 1985?

Since about 1985, both real GDP growth and inflation have become much less volatile than they were prior to 1985. As shown in Figure 29.4, the variability in the growth rate of real GDP has been about half of what it was prior to 1985. In addition, the rate of inflation has declined by two-thirds.²

Reduced macroeconomic volatility has numerous benefits for the economy. It improves market functioning, makes economic and business planning easier, and reduces the resources devoted to managing inflation risks. More stable output and employment reduce the economic uncertainty confronting households and

ECONOMIC NATURALIST 29.3



SOURCE: Bureau of Economic Analysis (<http://www.bea.gov/>).

FIGURE 29.4
The Changing Volatility of Real GDP.

Since 1985 there has been a dramatic reduction in the volatility of real GDP.

²Olivier J. Blanchard and John A. Simon, "The Long and Large Decline in U.S. Output Volatility," *Brookings Papers on Economic Activity*, 1: 135–164, 2001. Students who have taken statistics know that scientists generally use the variance of a variable (or its square root, called the standard deviation) to measure its variability.



firms. But why has macroeconomic volatility in the United States declined so markedly?

Many economists believe that better macroeconomic policy, especially monetary policy, is responsible for the reduced variability in both output and inflation. Prior to 1981, the Federal Reserve often allowed inflation to rise in response to shocks to aggregate demand and aggregate supply. This was followed by periodic attempts to rein in the inflation that followed. These swings in monetary policy from ease to tightness contributed to volatility in both output and inflation. Since the early 1980s, however, the Fed has been more consistent in its efforts to keep inflation from rising. These efforts have paid off by anchoring inflationary expectations, which, as we have just discussed, can stabilize not only inflation, but output, too.³

While most economists attribute the reduced variability in inflation to actions of the Fed, others believe that structural changes in the economy, and not the Fed, are largely responsible for the reduced variability in output. These structural changes include changes in technology, business practices, and other structural features that have improved the ability of the economy to absorb shocks. Some examples of these changes include better management of inventories, deregulation, the shift away from manufacturing and toward services, and an increased openness to trade and international capital flows.



ECONOMIC NATURALIST 29.4

Why didn't the oil price increases of 2003–2005 lead to a recession or a substantial increase in inflation?

Economic Naturalist 28.2 discussed the experience of the U.S. economy following the substantial oil price increases of 1973–1974 and 1979. The world price of crude oil was about \$3 per barrel in 1972; by the end of 1974, that price had quadrupled to \$12. After remaining relatively constant for the next four years, the price nearly tripled again between 1978 and 1981, reaching \$35 per barrel in 1981. In both cases, the price increases caused inflation shocks and were followed by stagflation—a period of recession and high inflation. With the exception of several periods of very low prices and an upward spike in 1999–2000, the price of oil fell gradually after 1981, reaching about \$23 per barrel in 2002.

Starting in 2002, oil prices again rose dramatically, and the increase accelerated in 2003, 2004, and 2005.⁴ By late 2004, average oil prices had exceeded \$40 per barrel and prices rose above \$65 per barrel in August 2005. At the time this edition is being written, however, the oil price increase has led to neither a recession nor a substantial increase in inflation. Real GDP grew at an annual rate of 2.7 percent in 2003, 4.2 percent in 2004, and 3.5 percent during the first half of 2005. Although the consumer price index rose by 1.9 percent in 2003, 3.4 percent in 2004, and 3.5 percent (at an annual rate) during the first seven months of 2005, this increase was much less dramatic than in earlier periods. Why did the economy respond so differently after the most recent oil price increase? Several explanations have been offered.

The first thing to note is that the real price of oil, which is the price of oil relative to the CPI, reached its (annual average) peak in 1981, when its price was \$35 per barrel and the CPI was 0.91. By July 2005, the CPI had risen to 1.95. Consequently, a price of \$35 per barrel in 1981 was equivalent to a price of $\$35(1.95/0.91) = \75 per barrel in July 2005. In real terms, the actual price of \$65 in August 2005 was still below its peak in 1981.

Prior to the first inflation shock of 1973, the technology used in U.S. factories was based on cheap oil. When the real price rose sharply during the next decade, some energy-intensive factories became obsolete and were shut down.

³Ben Bernanke, “The Great Moderation,” February 20, 2004, <http://www.federalreserve.gov/boarddocs/speeches/2004/20040220/default.htm>.

⁴U.S. Department of Energy, *Monthly Energy Review*, (www.eia.doe.gov/emeu/mer/prices.html).



Over time, new energy-saving technologies were also developed and adopted. Consequently, by the time real oil prices increased again in 2003–2004, U.S. factories already employed technologies that were profitable even with high energy prices.

Furthermore, the U.S. economy as a whole is now less reliant on energy. Manufacturing, which is still energy-intensive, comprises a smaller share of GDP as the United States has become a more service-oriented economy. New homes are better insulated and appliances and cars (even some SUVs) have become more energy efficient. As a result, the ratio of energy use per dollar of output fell from 14,427 Btus⁵ per dollar of real GDP (in 2000 dollars) in 1981 to 9,462 Btus per dollar of real GDP in 2003.

A third reason for the (to-date) relatively benign response of the American economy to the latest oil price increase is related to inflationary expectations and the inflation-fighting reputation of the Fed. When the first two oil price increases shifted the short-run aggregate supply line up, the initial bulges in inflation were followed by second rounds of inflation. The oil price increases led to increases in inflationary expectations because the public thought the Fed might accommodate the higher inflation, and higher inflationary expectations in turn led to further increases in wages and prices. In this manner, the higher inflation was sustained.

In contrast, today most economists believe that inflationary expectations are more firmly anchored than they were in the 1970s. Much of the credit for this development belongs to Paul Volcker and Alan Greenspan. During their terms as Chair of the Federal Reserve, the Fed acquired a reputation as an inflation fighter. Similar to the earlier oil price shocks, the 2003–2005 oil price increase also pushed the short-run aggregate supply line up. In this later period, however, people believed the Fed would quickly act to keep inflation low and preempt the second round of inflation. Consequently, expectations of inflation did not rise, and the short-run aggregate supply line shifted down much more quickly.

THE CORE RATE OF INFLATION

A bulge in inflation is not inevitable when there is an adverse aggregate supply shock, such as a sharp increase in energy prices. In principle, the Fed could prevent inflation from rising by adopting such a tight monetary policy that the initial bulge coming from higher energy prices would be offset by declines in nonenergy prices. Yet experience suggests that such a policy is likely to be too costly in terms of lost output as well as unnecessary for keeping inflation under control in the longer term. Instead, some economists suggest that the Fed accept the immediate inflationary effect of an oil price increase but act to minimize any second-round effect that occurs if the shock changes inflationary expectations and thereby affects wages and nonoil prices. If the Fed can prevent energy price increases from changing inflationary expectations, it can prevent inflation from becoming permanently higher.

To allow a temporary bulge but keep long-term inflationary expectations from rising, the Fed can focus on the **core rate of inflation**, defined as the rate of increase of all prices *except energy and food*, the two items most frequently responsible for inflation shocks.⁶ Because core inflation excludes the sources of the most volatile price changes, it is considered to be a useful short-term measure of the underlying inflation trend. If the core rate of inflation does not change, the initial supply shock probably has not led to any second-round effects. Thus, the Fed may decide to adopt a tighter monetary policy only if the core rate of inflation exceeds its target inflation rate. Note that the Fed's focus on core inflation does not mean that it does not care about overall inflation, which includes oil and food prices. Rather, by

core rate of inflation the rate of increase of all prices except energy and food

⁵A British thermal unit (Btu) is a measure of energy consumption.

⁶Since energy and food are used as inputs in many other industries, some of the indirect effects of an increase in the prices of energy and food will be included even in the core rate of inflation.



focusing on the core rate of inflation, the Fed can prevent the bulge in inflation following an inflation shock from becoming permanent.

Table 29.2 presents the general and core rates of inflation from July, 2002, through July, 2005. During this period the general rate of inflation rose significantly, reflecting the sharp increase in oil prices. The core rate of inflation, however, was both lower and increased by less, implying that the Fed had so far successfully mitigated the second round effects.

TABLE 29.2
U.S. Annualized Inflation Rates, July, 2002–July, 2005

Period	Annualized CPI inflation (%)	Annualized core inflation (CPI inflation excluding food and energy) (%)
July 2002–July 2003	2.1	1.5
July 2003–July 2004	2.9	1.8
July 2004–July 2005	3.1	2.1

SOURCE: U.S. Bureau of Labor Statistics (<http://www.bls.gov/data/>).

RECAP KEEPING INFLATION LOW

In response to changes in spending that create shocks in aggregate demand, the Fed can maintain stable inflation and output by adjusting its target real interest rate to the real interest rate at which saving equals investment in the long run. Shocks to aggregate supply (such as inflation shocks), however, force the Fed to choose between maintaining inflation and stabilizing output. If inflationary expectations are anchored, however, the return to potential output following an inflation shock will occur more rapidly. By monitoring the core rate of inflation, the Fed can determine whether an inflation shock has led to any second-round effects on inflation and can act accordingly.

INFLATIONARY EXPECTATIONS AND CREDIBILITY

As we saw in the previous section, macroeconomic performance may be improved if inflationary expectations are anchored. But what determines whether expectations are anchored? Most economists believe that it depends on the **credibility of monetary policy**, which is the degree to which the public believes the central bank's promises to keep inflation low, even if doing so may impose short-run economic costs.

The importance of credibility was illustrated in Example 29.3 following an adverse inflation shock. In that case, the Fed's credibility as an inflation-fighter preempted the second-round effects of inflation and hastened the return to full employment at the original rate of inflation. Economists have identified several institutional characteristics that may affect the credibility of the central bank's pronouncements to keep inflation low and thus its ability to do so. These include the degree of central bank independence, the announcement of explicit inflation targets, and the establishment of a reputation for fighting inflation.

CENTRAL BANK INDEPENDENCE

The credibility of monetary policy may be enhanced if central bankers are insulated from short-term political considerations, a condition that is sometimes referred to

credibility of monetary policy
the degree to which the public believes the central bank's promises to keep inflation low, even if doing so may impose short-run economic costs



as **central bank independence**. Independent central banks will be better able to take a long-term view of the economy. In particular, they can pursue anti-inflation policy when it is necessary, even if it leads to a temporary recession. Elected politicians, on the other hand, face frequent reelections, and they may be swayed by short-term political considerations to allow the economy to overexpand at the cost of higher inflation in the long run. Because of its enhanced credibility, an independent central bank may find it easier to anchor the public's expectations of inflation, reducing the duration of any inflationary or recessionary gap and promoting overall economic stability.

Various factors contribute to a central bank's independence. Among the many possible factors, we list four:

- The length of appointments to the central bank. Central banks are considered to be more independent if their central bankers are appointed for long terms, especially if the terms are staggered so that a single president or legislative branch of government cannot replace them all at once.
- Whether the central bank's actions are subject to frequent interference, review, or veto by the legislative branch. Central banks are considered to be more independent if their actions are not subject to frequent interference or review.
- Whether the central bank has the obligation, as it does in some countries, to finance the national deficit by buying newly issued government bonds. The obligation to do so reduces a central bank's independence.
- The degree to which the central bank's budget is controlled by the legislative or executive branch of government. Central banks are considered to be more independent if they are allowed to set and control their own budgets.

The U.S. Federal Reserve is generally considered to be a relatively independent central bank. The seven members of the Federal Reserve are appointed to staggered terms of 14 years, in contrast to the members of the U.S. House of Representatives, the president, and members of the Senate, who must face reelection every two, four, and six years, respectively. Although appointments to the Fed's Board of Governors must be approved by the Senate, and the Federal Reserve is subject to general oversight by the Congress, the daily policy actions of the Fed are not subject to review, approval, or veto by either the executive, legislative, or judicial branches of government. Finally, the Fed is under no obligation to finance the national deficit, and it controls its own budget. On the other hand, the law that created the Fed (the Federal Reserve Act) does not explicitly prohibit interference in monetary policy decisions by the legislative and executive branches of government. This prohibition is explicit in the central banking laws of many other countries.

Empirical evidence supports the proposition that countries should foster the independence of their central banks. Countries whose central banks are more independent have lower rates of inflation. More importantly, the lower inflation does not appear to come at the cost of lower output or higher unemployment, according to most studies. By enhancing a central bank's credibility, greater central bank independence leads to better overall economic outcomes.

ANNOUNCING A NUMERICAL INFLATION TARGET

Some economists believe that expectations are more firmly anchored and the central bank is perceived as more credible in those countries in which the central bank announces an explicit, numerical target for inflation. We have already introduced the idea of a target rate of inflation, or π^* , in our discussion of the monetary policy reaction function. Generally speaking, central banks must have an idea of the inflation rate they would like to achieve in order to make sensible policy. The more controversial question is whether central banks should announce their target inflation

central bank independence
when central bankers are insulated from short-term political considerations and are allowed to take a long-term view of the economy



rate to the public. Proponents argue that announcing a numerical target for long-run inflation, and then sticking to it, will increase credibility and better anchor inflation expectations.

Many central banks publicly announce their inflation target. The Bank of Canada, for example, began announcing its inflation target in 1991. Since 1995, that target has been 2 percent. In April 2005, the Bank of England's inflation target was 2 percent, and the Central Bank of Brazil's target was 4.5 percent. Other central banks provide a range for their target rather than, or in addition to, a single number. The Bank of Israel and the Reserve Bank of New Zealand, for example, both had a 1–3 percent target range as of April 2005; in Chile the range was 2–4 percent. Of course, the inflation targets must be consistently met if they are to be effective. The Reserve Bank of Zimbabwe's target range of 20–35 percent as of March 2005, for example, was generally believed to be implausibly low since prices more than doubled in 2004. It subsequently raised the target to 75–80 percent in April.

Central banks that announce their targets typically provide additional information to the public. This information may include their forecasts of inflation, real GDP, and other variables, as well as some discussion of the specific policies that will be needed to meet their targets. Advocates believe that announcing inflation targets and accompanying them with supporting information enhances the credibility of the central bank and reduces uncertainty among households and firms. This helps to anchor inflationary expectations, keep inflation low, and maintain full employment. Note that it makes sense for a central bank to announce a long-run inflation target, in that the central bank is able to control the rate of inflation in the long run. It would *not* make sense for a central bank to announce a long-run target for real GDP or employment, because these variables are determined by a host of factors (such as productivity and the supply of labor) that are not under the control of the central bank.

Once an inflation target is announced, the central bank may choose to adhere to it strictly, or it may be more flexible. A central bank that sets a strict target tries to meet the target all the time without regard for the consequences for output. As we have seen, this policy keeps output at potential when the economy is beset by spending shocks, but it may result in a recession if the central bank acts to eliminate even the initial bulge in inflation following a shock to aggregate supply, such as an inflation shock. In practice, virtually all central banks that announce an inflation target are flexible inflation targeters—they try to hit their inflation target in the long run or on average over a long period while responding to short-term shocks to aggregate supply in a way that takes account of both output gaps and inflation. In these cases, the announced inflation targets correspond to the target inflation rate in the monetary policy reaction function π^* .

Advocates of announcing explicit numerical targets believe that this practice reduces uncertainty in financial markets and among the public. Reduced uncertainty allows people to plan more effectively, save the resources used to protect themselves from unexpected inflation, and improve market functioning. By putting the prestige of the central bank behind its commitment to meet the target, the advocates also believe that explicit inflation targets enhance the central bank's credibility and anchor inflation expectations.

Supporters of inflation targets emphasize that it has been successful in both developing and industrialized countries. They believe that explicit targets in Brazil, Chile, Mexico, and Peru are one important reason why the central banks in nine of the most populous Latin American countries were able to reduce their inflation rates from 160 percent per year in the 1980s and 235 percent during the first half of the 1990s to only 13 percent per year in 1995–1999 and less than 8 percent in the period 2000–2004.⁷

⁷Ben Bernanke, "Inflation in Latin America: A New Era?" February 11, 2005, <http://www.federalreserve.gov/boarddocs/speeches/2005/20050211/default.htm>.

Those central banks, such as the Federal Reserve, that do not announce an explicit target to the public still may have a target or range in mind when making policy. Instead of announcing a specific number to the public, however, these banks typically state that they are interested in keeping inflation low, without defining exactly what that means. Proponents of this approach believe that a system of publicly announced targets is too rigid and may reduce the flexibility of the central bank to deal with unexpected circumstances. They worry that having an explicit inflation target may lead the central bank to pay too much attention to inflation and not enough attention to stabilizing output and maintaining full employment. Finally, opponents of explicit inflation targeting for the United States emphasize that the Fed has achieved good results without having a publicly announced target. They suggest following the adage, “if it ain’t broke, don’t fix it.”

Why shouldn’t the inflation target be zero?

Because central banks often state that they are in favor of stable prices, it would seem that the logical long-run target for inflation is 0 percent. However, most economists believe that an inflation target of zero is too low, and central banks that announce an explicit inflation target usually choose values that are low but above zero. Why shouldn’t the inflation target be zero?

Several reasons have been offered. First, because hitting the target at all times is impossible in practice, an inflation target of 0 percent increases the risk that the economy will experience periods of deflation (negative inflation). The deflationary experiences of the United States in the 1930s and, more recently, in Japan illustrate that deflation can be difficult to stop once it starts, and it can lead to painful and persistent declines in real GDP, especially if people expect it to continue. Many policymakers prefer to reduce the risk of deflation by choosing an inflation target above 0 percent.

Second, there are times when the Fed may wish to counteract negative shocks to the economy with a negative real interest rate, but this requires that inflation be greater than zero. Recall that the real interest rate is equal to the nominal interest rate minus the rate of inflation. Thus, a negative real interest rate requires setting a nominal interest rate less than inflation. If inflation is zero (or less than zero), however, a negative real interest rate would require a negative nominal interest rate. But the federal funds rate cannot fall below zero because banks would rather keep their reserves than lend them out at a negative nominal interest rate. Consequently, a negative real interest rate must be accompanied by inflation greater than zero.

Third, as we saw in the chapter “Measuring the Price Level and Inflation,” some evidence suggests that the conventional measures of inflation tend to overstate the “true” rate of inflation by about one percentage point. Consequently, if the Fed wanted to maintain “true” price stability (that is, “true” inflation of 0 percent), this would require conventionally measured rates of inflation of at least 1 percent.

Finally, some economists believe that a small amount of inflation is necessary to “grease” our economic engine. The analysis in the chapter “Workers, Wages, and Unemployment in the Modern Economy” indicated that technological change and shifts in product demand may require real wages in some industries or occupations to fall in an efficiently operating economy, even when real wages in other industries and occupations are rising. If inflation is positive, a worker’s real wage will fall whenever her nominal wage rises by less than the rate of inflation. If, for example, her nominal wage rises by 4 percent but prices rise by 5 percent, her real wage (that is, the amount of goods and services she can buy with her earnings) will fall. If, however, inflation is 0 percent and prices are not changing, the only way in which a worker’s real wage can fall is if her nominal wage itself falls. Some evidence suggests

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that workers will strenuously resist cuts in their nominal wages.⁸ They seem to be less resistant to having their nominal wages rise by a smaller percent than inflation even though this, too, reduces their real wage. Consequently, inflation can provide the “grease” required to reduce real wages in some industries and achieve economic efficiency.⁹ Critics of the “grease” theory, however, argue that workers will become less resistant to nominal wage cuts at very low or zero rates of inflation. In a low inflation environment, nominal wage cuts would, of necessity, be more common and workers would get used to the idea.



ECONOMIC NATURALIST 29.6

Was inflation almost too low in 2002–2003?

By late 2002, some Fed policymakers began to worry that inflation might actually be too low. Minutes of the Federal Reserve’s September 24, 2002, Federal Open Market Committee meeting indicate that committee members were concerned that continuing weakness in the U.S. economy was likely to lead to “quite low and perhaps declining inflation” well into 2003.¹⁰ With prices of consumer goods rising only about 1.5 percent from September 2001 to September 2002, members noted that “further sizable disinflation . . . could create problems for the implementation of monetary policy through conventional means in the event of an adverse shock to the economy.”

During 2001 and 2002 the Federal Reserve had reduced the federal funds rate to 1.75 percent, the lowest level in four decades, in an attempt to provide economic stimulus to an economy slowly emerging from recession. Why did low inflation and a low federal funds rate create a potential problem for the Fed?

As pointed out in the chapter “Stabilizing the Economy,” business and consumer spending respond to real interest rates, not nominal interest rates. With a federal funds rate of 1.75 percent and an inflation rate of 1.5 percent, the resulting real rate of interest—the difference between the nominal interest rate and the inflation rate—was already down to 0.25 percent. If the Fed was forced in the future to stimulate aggregate spending further in response to a negative economywide spending shock, it might need to reduce the real rate of interest below 0 percent, which, as we have learned in Economic Naturalist 29.5, requires a positive rate of inflation. Thus, if the inflation rate fell to 0 percent, the Fed’s ability to conduct expansionary monetary policy to offset a recessionary gap would be limited. Indeed, partly as a preemptive measure to prevent further economic weakening and declines in inflation, the Fed acted at its next meeting, in November 2002, to cut the federal funds rate to 1.25 percent, and it was reduced even further, to 1.0 percent, in June 2003.

Even if the federal funds rate were reduced all the way to 0 percent, however, Fed officials at the time also noted that the Fed would still have options available to stimulate aggregate spending. Although the federal funds rate is a very short-term interest rate, large portions of investment and especially mortgage lending are influenced more by long-term interest rates. Long-term rates are typically higher than and may not move in concert with the federal funds rate. If the Fed wanted to spur investment and the federal funds rate was pushed to zero, it could offer to buy large quantities of long-term U.S. Treasury bonds. Recall from the chapter “Financial Markets, and International Capital Flows” that bond prices and interest rates move in opposite directions. Consequently, if the Fed bought long-term bonds, bond prices would rise and long-term interest rates would fall. Alternatively, a central bank could buy other financial assets. For example, some central banks,

⁸This does not mean that nominal wages never fall. Many workers in the airline industry, for example, have had to accept lower nominal wages as their employers compete with newer low-cost airlines, such as Southwest and Jet Blue.

⁹George A. Akerlof, William T. Dickens, and George L. Perry, “The Macroeconomics of Low Inflation,” *Brookings Papers on Economic Activity*, 1:1–76, 1996.

¹⁰Minutes from the Federal Reserve’s September 2002 FOMC meeting are available online at <http://www.federalreserve.gov/fomc/minutes/20020924.htm>.



although not the Fed, are allowed to buy stocks. Central bank purchases of stocks would increase stock prices and household wealth and might stimulate consumption. When short-term interest rates fell to zero in Japan, for example, the Bank of Japan bought a limited amount of stocks from Japanese banks that were in financial trouble.

Another option might be for the Fed to commit itself to keeping both the current and future federal funds rate very low. This policy, which was actually implemented by the Bank of Japan in its “zero interest rate policy” (called ZIRP), might give some firms the confidence to invest today, which would increase spending and raise output. By using these “nontraditional” monetary policy tools, the Fed could, if necessary, stimulate the economy even if the federal funds rate fell to 0 percent. However, these alternative tools are largely untested and would be difficult to apply with precision. Hence, the Fed and most other central banks try to keep inflation from falling so low that achieving a negative real interest rate is impossible.

CENTRAL BANK REPUTATION

Ultimately, credibility can be won and maintained only by performance, and a central bank’s performance will depend partly on its reputation as being an “inflation hawk” or an “inflation dove.” An **inflation hawk** is someone who is committed to achieving and maintaining low inflation, even at some short-run cost in reduced output and employment. An **inflation dove** is someone who is not strongly committed to achieving and maintaining low inflation.

Inflation hawks believe that low and stable inflation allows the economy to grow more rapidly in the long run and therefore will be worth the possible short-run cost. Somewhat paradoxically, inflation hawks also may achieve more stable output and employment, even in the short run. Central banks that have acquired reputations as an inflation hawk will find it easier to anchor inflationary expectations. As we have learned, anchored expectations reduce the inflationary impact of an inflation shock by minimizing the second-round effects of that shock. Recall that anchored expectations also increase the speed with which the short-run aggregate supply line shifts down following an adverse inflation shock or an aggregate demand shock. Consequently, by anchoring expectations, a central bank that is viewed as an inflation hawk may be better able to stabilize output at potential GDP, even in the short run.

But how does a central bank acquire a reputation as an inflation hawk? Some central bankers acquire this reputation only after conducting monetary policy like an inflation hawk. Sometimes, however, the president can select people to serve on the Fed who already have acquired reputations as inflation hawks, based on their professional or academic backgrounds. Jimmy Carter’s appointment of Paul Volcker as chair of the Fed is a famous example of a chair coming to the Fed with a well-established reputation as an inflation hawk.

inflation hawk someone who is committed to achieving and maintaining low inflation, even at some short-run cost in reduced output and employment

inflation dove someone who is not strongly committed to achieving and maintaining low inflation

RECAP

INFLATIONARY EXPECTATIONS AND CREDIBILITY

Macroeconomic performance may be improved if expectations of inflation are anchored. Anchored expectations, in turn, depend on the extent to which a central bank’s anti-inflation pronouncements are viewed as credible. Several institutional characteristics may help to enhance a central bank’s credibility: the extent to which the central bank is independent from the executive and legislative branches of the government, the announcement of a numerical inflation target, and the reputation of the central bank as an “inflation hawk.”



POLICYMAKING: ART OR SCIENCE?

In the last four chapters, we have analyzed the basic economics underlying fiscal and monetary policy. We worked through some examples showing how much fiscal policymakers would have to increase government spending or cut taxes in order to eliminate a specific recessionary gap and restore output to its full employment level in the short run. We also calculated the real interest rate the Fed would have to set in order to eliminate other output gaps. While those examples are useful in understanding how fiscal and monetary policy works, they overstate the precision of policymaking.

In analyzing macroeconomic policy, one might be tempted to think of the economy as an automobile and the policymaker as its driver. By judiciously steering, braking, or accelerating at the appropriate times, the driver of a car can safely control it. He can steer it around obstacles. He can accelerate when the car is sluggish going up hills or if it needs an extra boost to pass another car. And he can step on the brake if the car is going too fast down a hill or if a hazard lies ahead.

Unfortunately, conducting macroeconomic policy is much more difficult than driving a car. The driver of a car typically knows exactly where he is at all times. He also knows his destination and can clearly see the road ahead. He has precise control over the accelerator, brake, and steering wheel. Finally, in most instances, he knows from experience how and when the car will respond to his actions. The real-world economy, on the other hand, is more complex because the economic policymaker has less information and control than the driver of a car.

Perfect macroeconomic policy would require each of the following: (1) accurate knowledge of the current state of the economy, (2) knowledge of the future path of the economy if no policy changes are implemented, (3) the precise value of potential output to determine the existence and size of any output gap, (4) complete and immediate control over the tools of fiscal and monetary policy, and (5) knowledge of how and when the economy will respond to changes in policy.

Unfortunately, macroeconomic policy in reality is far from this ideal. The current levels of many macroeconomic indicators such as real GDP often are not known until several months later, and even after that they are subject to multiple revisions. Because policymakers do not have very precise knowledge of the current state of the economy, they may not be able to act decisively.

Second, policymakers are often unsure about the future path of the economy if no policy changes are implemented. If the economy will move to its potential level in the near future in the absence of any policy changes, it will be unnecessary and often unwise for policymakers to act now to eliminate an output gap. Instead of hastening the move back to full employment, policy changes may lead the economy to overshoot, necessitating a policy reversal in the future and potentially destabilizing the economy.

Economists are also unsure about the exact levels of potential output and the natural rate of unemployment. For example, most economists now believe that macroeconomic policy was often too expansionary (and, hence, too inflationary) during the 1970s because policymakers overestimated the potential level of output and hence underestimated the natural rate of unemployment.

Even when policy changes are needed, it can take a long time for policymakers to implement the appropriate policy changes. The **inside lag** of macroeconomic policy refers to the delay between the date a policy change is needed and the date that policy change is implemented. During this period, the policymakers' economic advisers must recognize that a persistent output gap exists and determine the correct policy change. The policymakers must then accept the desirability of that policy change and implement it.

The inside lag for monetary policy is substantially shorter than the inside lag for fiscal policy. Once monetary policymakers accept the desirability of a change in the federal funds rate, they only have to wait until the next meeting of the Federal Open Market Committee. Since this committee meets eight times per year, the maximum delay is about seven weeks. In urgent situations, the Committee has been

inside lag (of macroeconomic policy) the delay between the date a policy change is needed and the date it is implemented



known to act during conference calls in between meetings. And once the Committee decides to change the federal funds rate, the Federal Reserve Bank of New York almost immediately conducts the open market operations sufficient to move the rate to its desired level.

The inside lag for fiscal policy, on the other hand, is considerably longer. After the president proposes a change in tax rates or government spending, both houses of Congress must approve it. This process can take a long time, especially when one or both of the houses of Congress are controlled by the opposing political party. One of the reasons for these delays is that the exact form of a change in taxes or government spending can vary considerably. Should personal income taxes or business taxes be cut? Should defense spending or spending on education be increased? Even after Congress has approved the policy change and the president has signed the bill, it sometimes takes a long time to implement the tax changes or make the additional expenditures.

Finally, economists have only an approximate idea of the exact output effect of a change in policy. The marginal propensity to consume is not known with certainty and need not be the same for all changes in income. Similarly, Fed policymakers have only an approximate idea of the effect of a given change in the real interest rate on planned spending. Economists have constructed statistical models of the economy that track the historical performance of the economy reasonably well. Yet these same statistical models have often yielded disappointing and unreliable forecasts of the future path of the economy. Part of the problem is that it is difficult to predict the values of the exogenous variables in the economy, such as government spending or tax rates. In addition, the economic structure of the economy itself occasionally changes over time. The extent to which investment responds to changing real interest rates, for example, has varied over time.

Furthermore, both fiscal and monetary policymakers are never sure about the length of time before the effects on planned spending will occur. The **outside lag** of macroeconomic policy refers to the delay between the date a policy change is implemented and the date by which most of its effects on the economy have occurred. Although fiscal policy has a longer inside lag than monetary policy, its outside lag may be shorter. Changes in government spending have an immediate effect on real GDP and the economy, although the multiplier effects continue into the future. Similarly, households often respond to tax cuts by increasing their consumption expenditures immediately. On the other hand, investment responds more slowly when the Fed changes the real interest rate since the interest rate is one among many factors that businesses look at before building a new factory or buying an expensive new machine.

Because our knowledge of the economy is imperfect, policymaking at its best also will be imperfect. In terms of our aggregate supply–aggregate demand model, policymakers don’t know exactly how much or how fast the aggregate demand curve will shift in response to policy changes. They also don’t know how fast the short-run aggregate supply line shifts up when output exceeds its potential level or how fast it shifts down if output is less than potential.

During the 1960s, economists were more confident about their ability to maintain output at its potential level using the appropriate monetary and fiscal policies. They believed they could compute the size of any output gaps, and devise policies to eliminate these gaps. Many also believed they could easily predict the future path of the economy under alternate policy scenarios, and they were comfortable implementing frequent policy changes in order to “fine-tune” the economy. Finally, many economists mistakenly thought policymakers could deliver a permanently higher level of output with just a bit more inflation and did not believe the now generally accepted view that the long-run aggregate supply line is vertical.

The experience of the past few decades has made economists more humble, even about identifying an output gap. Some economists believe that we are at potential output when the unemployment rate is 4.5 percent, while others believe the natural rate of unemployment is as high as 5.5 or even 6.0 percent. Consequently, whenever

outside lag (of macroeconomic policy) the delay between the date a policy change is implemented and the date by which most of its effects on the economy have occurred



the actual unemployment rate lies between 4.5 and 6 percent, some economists think they see a recessionary gap while others see an expansionary gap.

Because of these uncertainties, macroeconomic policymakers tend to proceed cautiously. The Fed, for example, avoids large changes in interest rates and rarely raises or lowers the federal funds rate more than one-half of a percentage point (from 5.5 percent to 5 percent, for example) at any one time. Indeed, the typical change in the interest rate is one-quarter of a percentage point. Similarly, policymakers are now less likely to try to “fine-tune” the economy.

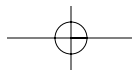
Is macroeconomic policymaking an art or a science, then? In practice it appears to be both. Scientific analyses, such as the development of detailed statistical models of the economy, have proved useful in making policy. But human judgment based on long experience—what has been called the “art” of macroeconomic policy—plays a crucial role in successful policymaking and is likely to continue to do so.

RECAP	POLICYMAKING: ART OR SCIENCE?
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Macroeconomic policymaking is a difficult and inexact science. Policymakers do not know the precise state of the economy, the future path of the economy if no policy changes are implemented, or the precise level of potential output. They also have imperfect control over policy instruments and imprecise knowledge of the effects of any policy changes. The existence of inside and outside lags make policymaking even more difficult. Consequently, macroeconomic policymaking is an art as well as a science.

■ SUMMARY ■

- To reduce inflation, monetary policymakers must shift the aggregate demand curve and the monetary policy reaction function to the left, usually by decreasing the target rate of inflation and adopting a “tighter” monetary policy. In the short run, the main effects of an anti-inflationary policy may be reduced output and higher unemployment, as the economy experiences a recessionary gap. These short-run costs of disinflation must be balanced against the long-run benefits of a lower rate of inflation. Over time, output and employment will return to their maximum sustainable levels and inflation declines. The disinflation engineered by the Fed under Chairman Paul Volcker in the early 1980s followed this pattern.
- Changes in exogenous spending shift the aggregate demand curve. In response, the Fed can maintain stable inflation and output by adjusting its target real interest rate to the real interest rate at which saving equals investment in the long run.
- Supply shocks, such as inflation shocks, however, force the Fed to choose between maintaining inflation and stabilizing output. If inflationary expectations are anchored, the return to potential output following a supply shock will occur more rapidly.
- Changes in the core rate of inflation allow the Fed to determine whether an inflation shock has changed inflationary expectations and led to further changes in wages and nonoil and nonfood prices, which are sometimes called the second-round effects of the inflation shocks. If the core rate of inflation does not change, the effects of the supply shock on inflation are more likely to be temporary.
- Anchored inflationary expectations will improve economic performance in the long run and also may reduce the volatility of output and inflation in the short run. Inflationary expectations are more likely to be anchored if the central bank’s policies are viewed as credible and the public believes the central bank’s promises to keep inflation low.
- A central bank’s credibility may be enhanced if it is insulated from short-term political considerations and is allowed to take a long-term view of the economy. Credibility also may be enhanced if the central bank publicly announces a numerical inflation target and if it has a reputation as an “inflation hawk.”
- Economists now recognize that the analogy between driving a car and managing the economy is a poor one. Unlike driving a car, macroeconomic policymaking is an inexact science. Policymakers do not know the precise state of the economy, the future path of the economy if no policy changes are implemented, or the precise level of potential output. In addition, they have imperfect control over policy instruments and imprecise knowledge of the effects of any policy changes. During the past few decades, economic policymakers have become more humble about their ability to “fine-tune” the economy.



■ KEY TERMS ■

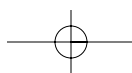
accommodating policy (•••)	core rate of inflation (•••)	inflation hawk (•••)
anchored inflationary expectations (•••)	credibility of monetary policy (•••)	inside lag (•••)
central bank independence (•••)	disinflation (•••)	outside lag (•••)
	inflation dove (•••)	

■ REVIEW QUESTIONS ■

1. How does the adoption of a tighter monetary policy, like that conducted by the Volcker Fed in the early 1980s, affect output, inflation, and the real interest rate in the short run? In the long run?
2. Most central banks place great value on keeping inflation low and stable. Why do they view this objective as so important?
3. Suppose there is an increase in taxes. What is the short-run effect on output, inflation, and the real interest rate, assuming any supply-side effects are minimal? What will be the effect in the long run if the Fed chooses to adjust its target real interest rate to the new long-run real interest rate at which saving equals investment?
4. Suppose there is a sudden increase in oil prices. What will be the effect on output and inflation in the short run? What is the “dilemma” faced by the Fed as a result of the adverse inflation shock?
5. What are anchored inflationary expectations and how do they reduce the cost of an adverse inflation shock?
6. What are the concerns about having an inflation rate that is “too low?”
7. What is the core rate of inflation and what is its relevance for macroeconomic policy-making?
8. Name two reasons why the 2003–2004 increase in oil prices had not led to a recession or a substantial increase in the core rate of inflation as of June 2005.
9. What factors determine a central bank’s independence? What are the benefits of having an independent central bank?
10. In what ways is the Federal Reserve independent? In what ways is it not?
11. What are inside and outside lags? What is their relevance for macroeconomic policy-making?
12. Why are economists now more humble about their ability to fine-tune the economy?

■ PROBLEMS ■

1. The Bank of Lotusland, the central bank, has announced that it will set the real interest rate according to the following policy reaction function: $r = .03 + 1.0(\pi - .01)$. Thus, the target real interest rate is 3 percent and the target inflation rate is 1 percent. (The value of the parameter g also is equal to 1.)
 - a. Construct a table indicating the level of the real interest rate at each of the following rates of inflation: 0, 1, 2, 3, and 4 percent.
 - b. From either your table or the equation, draw the Bank of Lotusland’s monetary policy reaction function.
2. Suppose the economy is initially in long-run equilibrium, and the Fed adopts a looser monetary policy by raising its target inflation rate.
 - a. Illustrate what this switch to a looser monetary policy would do to the Fed’s monetary policy reaction function and the aggregate demand curve.





- b. Use your results from part a and aggregate supply–aggregate demand graphs to illustrate and explain what will happen to real GDP and inflation in both the short run and the long run.
3. Suppose the economy is initially in long-run equilibrium and the Fed reduces its target real rate. Illustrate what this would do to the monetary policy reaction function and the aggregate demand curve.
4. Using the theory presented in this chapter, explain why the adoption of a tighter, more anti-inflationary monetary policy might be politically unpopular.
5. Suppose there is a large increase in oil or food prices.
- If the core rate of inflation remains unchanged, what might the Fed infer about inflationary expectations and the second-round effects of the inflation shock? How might it respond?
 - If the core rate of inflation rises substantially, what might the Fed infer about inflationary expectations and the second-round effects of the inflation shock? How might it respond?
6. What is the advantage of having an independent central bank and what institutional features make a central bank independent?
7. Explain how the recognition that macroeconomic policymaking is an inexact science affects your recommended policy response to the following situations:
- Your estimate of the natural rate of unemployment is 5 percent, and the actual unemployment rate is 5.5 percent.
 - Your estimate of the natural rate of unemployment is 5 percent, and the actual unemployment rate is 8 percent.
- 8.*Suppose an economy is described by the following equations:

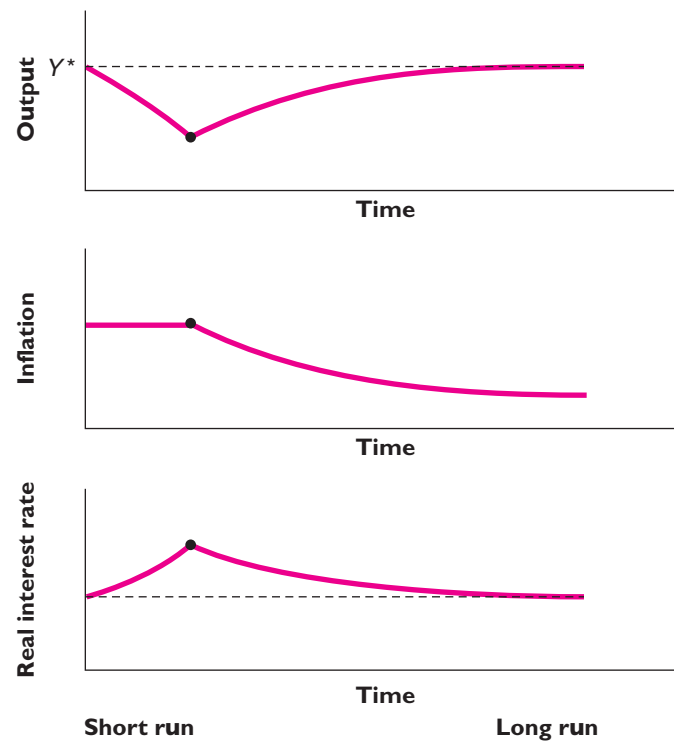
$$\begin{aligned}C &= 1,600 + 0.6(Y - T) - 2,000r, \\I^p &= 2,500 - 1,000r, \\G &= \bar{G} = 2,000, \\NX &= \bar{NX} = 50, \\T &= \bar{T} = 2,000.\end{aligned}$$

- Find an equation relating planned spending to output and the real interest rate.
 - Suppose the central bank's monetary policy reaction function is the same as in problem 1 above. Compute the short-run equilibrium output at each rate of inflation between 0 and 4 percent and graph the *AD* curve for this economy.
- 9.*For the economy described in problem 8a, suppose that the central bank adopts a tighter monetary policy by reducing its target inflation rate to 0.5 percent, while maintaining its target real interest rate of 3 percent. Consequently, it changes its monetary policy reaction function to $r = .03 + 1.0(\pi - .005)$.
- Construct a table indicating the level of the real interest rate at each of the following rates of inflation: 0, 1, 2, 3, and 4 percent. Draw the new monetary policy reaction function and compare it to the monetary policy reaction function you derived in problem 1.
 - Use the planned expenditure equations in problem 8 to construct a table showing the new relationship between short-run equilibrium output and the inflation rate for values of inflation between 0 and 4 percent. Graph the new aggregate demand curve of the economy and compare it to the aggregate demand curve you derived in problem 8b.
- 10.*For the economy described in problem 8a and the monetary policy reaction function described in problem 1, suppose government purchases increase by 100 to 2,100.
- Find the new equation relating planned spending to output and the real interest rate.
 - Compute the short-run equilibrium output at each rate of inflation between 0 and 4 percent.
 - Graph the *AD* curve for this economy and compare it to the *AD* curve in problem 8b.

Problems marked with an asterisk () are more difficult.

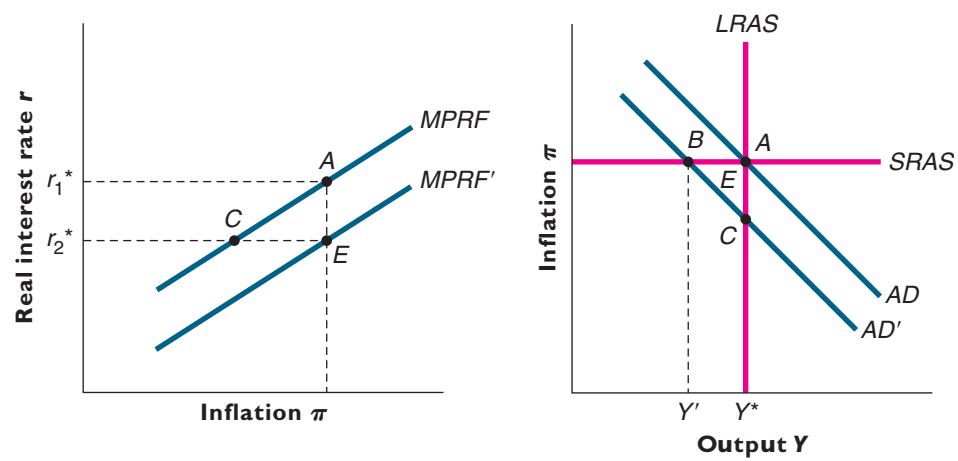
■ ANSWERS TO IN-CHAPTER EXERCISES ■

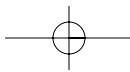
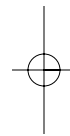
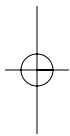
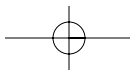
29.1



29.2 A sudden decrease in spending will shift the aggregate demand curve to the left, to AD' in the graph below. In the short run, output will fall to point B , but inflation will be unaffected. Over time, output will return to potential at point C . If the Fed lowers its target real interest rate after output returns to potential, the monetary policy reaction function will shift right (down) and the aggregate demand curve will shift back to AD . In the long run, output will remain at potential and inflation will return to its initial level at point E if the new target real interest rate is equal to the real interest rate that equates saving and investment in the long run.

If the Fed changes r^* immediately after the reduction in spending, the leftward shift in the aggregate demand curve caused by the decrease in spending will be offset by the rightward shift caused by the reduction in r^* (and shift in the $MPRF$). Output and inflation will remain unchanged at Y^* (points A and E) even in the short run.












APPENDIX

THE ALGEBRA OF AGGREGATE DEMAND AND AGGREGATE SUPPLY



In this appendix, we derive the aggregate demand curve algebraically. Then we show how together aggregate demand and aggregate supply determine the short-run and long-run equilibrium points of the economy.

THE AGGREGATE DEMAND CURVE

In the appendix to the chapter “Stabilizing the Economy,” Equation 27A.1 showed that short-run equilibrium output depends on both exogenous components of expenditure and the real interest rate:

$$Y = \left(\frac{1}{1 - mpc} \right) [\bar{C} - mpc\bar{T} + \bar{I} + \bar{G} + \bar{NX} - (a + b)r], \quad (27A.1)$$

where $1/(1 - mpc)$ is the multiplier, $\bar{C} - mpc\bar{T} + \bar{I} + \bar{G} + \bar{NX}$ is the exogenous component of planned spending, the term in brackets is autonomous expenditure, and a and b are positive numbers that measure the effect of changes in the real interest rate on consumption and planned investment, respectively.

The aggregate demand curve incorporates the behavior of the Fed, as described by its policy reaction function. According to its policy reaction function, when inflation rises, the Fed raises the real interest rate. Thus, the Fed’s policy



reaction function can be written as an equation relating the real interest rate r to inflation π and the target levels of the real interest rate r^* and inflation π^* :

$$r = r^* + g(\pi - \pi^*), \quad (29A.1)$$

where r^* , π^* , and the parameter g are positive constants chosen by Fed officials. This equation states that when inflation π rises by one percentage point—say from 2 to 3 percent per year—the Fed responds by raising the real interest rate by g percentage points. So, for example, if $g = 0.5$, an increase in inflation from 2 to 3 percent would lead the Fed to raise the real interest rate by 0.5 percent. If actual inflation is equal to the Fed's target, the term in parentheses is equal to 0 and the Fed sets the real interest rate equal to its target real interest rate r^* .

Equations 27A.1 and 29A.1 together allow us to derive the aggregate demand curve. We can think of the curve as being derived in two steps: First, for any given value of inflation π (and the fixed values of the three constants r^* , π^* , and g), use the policy reaction function, Equation 29A.1, to find the real interest rate by the Fed. Second, for that real interest rate, use Equation 27A.1 to find short-run equilibrium output Y . The relationship between inflation and short-run equilibrium output derived in these two steps is the aggregate demand curve.

Alternatively, we can combine the equation for short-run equilibrium output with the equation for the policy reaction function by substituting the right-hand side of Equation 29A.1 for the real interest rate r in Equation 27A.1:

$$Y = \left(\frac{1}{1 - mpc} \right) [\bar{C} - mpc\bar{T} + \bar{I} + \bar{G} + \bar{NX} - (a + b)(r^* + g(\pi - \pi^*))],$$

or

$$Y = \left(\frac{1}{1 - mpc} \right) [\bar{C} - mpc\bar{T} + \bar{I} + \bar{G} + \bar{NX} - (a + b)(r^* - g(\pi^*)) - (a + b)g(\pi)] \quad (29A.2)$$

This equation, which is the general algebraic expression for the AD curve, summarizes the link between inflation and short-run equilibrium output, as shown graphically in Figure 28.1. Note that Equation 29A.2 implies that an increase in inflation π reduces short-run equilibrium output Y , so that the AD curve is downward-sloping.

For a numerical illustration, we can use the parameter values from Example 27.3. For the economy studied in Example 27.3, we assumed that $\bar{C} = 640$, $\bar{T} = 250$, $\bar{I} = 250$, $\bar{G} = 300$, $\bar{NX} = 20$, $mpc = 0.8$, $a = 400$, and $b = 600$. To derive the aggregate demand curve, we also need values for the Fed's policy reaction function; for illustration, we use the policy reaction function presented in Table 27.1. $r = 0.04 + 1.0(\pi - 0.02)$. This implies that the Fed's targets for the real interest rate and inflation are 4 percent and 2 percent, respectively. Furthermore, the value of g , the slope of the monetary policy reaction function, is 1.0. Several specific values of r and π (shown in Table 27.1) are reproduced here for convenience.

Substituting these numerical values into Equation 29A.2 and simplifying, we get the following numerical equation for the AD curve:

$$Y = 5[640 - 0.8(250) + 250 + 300 + 20 - (400 + 600)(0.04 - 0.02) - (400 + 600)\pi] \quad (29A.3)$$

$$Y = 4,950 - 5,000\pi \quad (29A.4)$$

TABLE 27.1
A Policy Reaction Function for the Fed

Rate of inflation, π	Real interest rate set by Fed, r
0.00 (= 0%)	0.02 (= 2%)
0.01	0.03
0.02	0.04
0.03	0.05
0.04	0.06

Note that in this equation, higher values of inflation imply lower values of short-run equilibrium output, so the aggregate demand curve is downward-sloping. To check this equation, suppose that inflation is 3 percent, so that the Fed sets the real interest rate at 5 percent (see Table 27.1). Setting $\pi = 0.03$ in Equation 29A.4 yields $Y = 4,800$. This is consistent with the answer we found in Example 27.4, where we showed for the same economy that when $r = 0.05$ (the value of the real interest rate set by the Fed when $\pi = 0.03$), then short-run equilibrium output $Y = 4,800$.

SHIFTS OF THE AGGREGATE DEMAND CURVE

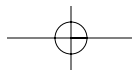
Recall that exogenous changes in spending or in the Fed's policy reaction function will shift the *AD* curve (see pages ●●●-●●●). These results follow from Equation 29A.2. First, the equation shows that for a given rate of inflation π , an increase in exogenous spending, $\bar{C} - mpc\bar{T} + \bar{I} + \bar{G} + \bar{NX}$, will raise short-run equilibrium output Y . Thus, an increase in exogenous spending shifts the *AD* curve to the right; conversely, a decrease in exogenous spending shifts the *AD* curve to the left. A shift in the Fed's policy reaction can be captured by a change in the target rates of interest r^* or inflation π^* in Equation 29A.1. For example, suppose the Fed tightens monetary policy by reducing its target rate of inflation by one percentage point to 1 percent. If $g = 1$, it would then set the real interest rate 1 percent higher than before at every level of inflation. If you look at Equations 29A.2 and 29A.3, you will see that with the level of inflation held constant, a reduction in π^* reduces short-run equilibrium output. Thus, a tightening of monetary policy (an upward movement in the monetary policy reaction function) shifts the *AD* curve to the left. Conversely, an easing of monetary policy (represented by a decline in π^* or a downward shift in the policy reaction function) shifts the *AD* curve to the right.

EXERCISE 29A.1

- For the economy described above, find an algebraic equation for the *AD* curve after an exogenous increase in spending (say, in planned investment) of 10 units.
- For the economy described above, find an algebraic equation for the *AD* curve after a tightening of monetary policy that involves setting the real interest rate one percentage point higher at each level of inflation.

SHORT-RUN EQUILIBRIUM

Recall that in short-run equilibrium, inflation is equal to its previously determined value, and the *SRAS* line is horizontal at that value. At that level of inflation, the level of output in short-run equilibrium is given by the aggregate demand curve,



Equation 29A.2. For instance, in the economy described, suppose the current value of inflation is 5 percent. The value of short-run equilibrium output is therefore

$$\begin{aligned} Y &= 4,950 - 5,000\pi = 4,950 - 5,000(0.05) \\ &= 4,700. \end{aligned}$$

LONG-RUN EQUILIBRIUM

In long-run equilibrium, actual output Y equals potential output Y^* . Thus, in long-run equilibrium, the inflation rate can be obtained from the equation for the AD curve by substituting Y^* for Y . To illustrate, let's write the equation for the AD curve in this sample economy, Equation 29A.4, once again:

$$Y = 4,950 - 5,000\pi.$$

Suppose, in addition, that potential output $Y^* = 4,850$. Substituting this value for Y in the aggregate demand equation yields

$$4,850 = 4,950 - 5,000\pi.$$

Solving for the inflation rate π we get

$$\pi = 0.02 = 2\%.$$

When this economy is in long-run equilibrium, then, the inflation rate will be 2 percent. If we start from the value of inflation in short-run equilibrium, 5 percent, we can see that the short-run aggregate supply line must shift downward until inflation reaches 2 percent before long-run equilibrium can be achieved.

■ ANSWERS TO IN-APPENDIX EXERCISE ■

29A.1 The algebraic solutions for the AD curve in each case, obtained by substituting the numerical values into the formula, are given below.

- $Y = 5,000 - 5,000\pi$.
- $Y = 4,900 - 5,000\pi$.

