Questions for Review

1. In this chapter we looked at three models of the short-run aggregate supply curve. All three models attempt to explain why, in the short run, output might deviate from its long-run "natural rate"—the level of output that is consistent with the full employment of labor and capital. All three models result in an aggregate supply function in which output deviates from its natural rate $\overline{Y}$ when the price level deviates from the expected price level:

$$Y = \overline{Y} + \alpha(P - P^e).$$

   The first model is the sticky-wage model. The market failure is in the labor market, since nominal wages do not adjust immediately to changes in labor demand or supply—that is, the labor market does not clear instantaneously. Hence, an unexpected increase in the price level causes a fall in the real wage (W/P). The lower real wage induces firms to hire more labor, and this increases the amount of output they produce.

   The second model is the imperfect-information model. As in the worker-misperception model, this model assumes that there is imperfect information about prices. Here, though, it is not workers in the labor market who are fooled: it is suppliers of goods who confuse changes in the price level with changes in relative prices. If a producer observes the nominal price of the firm's good rising, the producer attributes some of the rise to an increase in relative price, even if it is purely a general price increase. As a result, the producer increases production.

   The third model is the sticky-price model. The market imperfection in this model is that prices in the goods market do not adjust immediately to changes in demand conditions—the goods market does not clear instantaneously. If the demand for a firm's goods falls, it responds by reducing output, not prices.

2. In this chapter, we argued that in the short run, the supply of output depends on the natural rate of output and on the difference between the price level and the expected price level. This relationship is expressed in the aggregate-supply equation:

$$Y = \overline{Y} + \alpha(P - P^e).$$

   The Phillips curve is an alternative way to express aggregate supply. It provides a simple way to express the tradeoff between inflation and unemployment implied by the short-run aggregate supply curve. The Phillips curve posits that inflation π depends on the expected inflation rate π^e, on cyclical unemployment $u - u^n$, and on supply shocks[ϵ]:

$$\pi = \pi^e - \beta(u - u^n) + {}^{\epsilon}.$$

   Both equations tell us the same information in a different way: both imply a connection between real economic activity and *unexpected* changes in prices.

3. Inflation is inertial because of the way people form expectations. It is plausible to assume that people's expectations of inflation depend on recently observed inflation. These expectations then influence the wages and prices that people set. For example, if prices have been rising quickly, people will expect them to continue to rise quickly. These expectations will be built into the contracts people set, so that actual wages and prices will rise quickly.

4. *Demand-pull inflation* results from high aggregate demand: the increase in demand "pulls" prices and output up. *Cost-push inflation* comes from adverse supply shocks that push up the cost of production—for example, the increases in oil prices in the mid- and late-1970s.

   The Phillips curve tells us that inflation depends on expected inflation, the difference between unemployment and its natural rate, and a shock ϵ:

   $$\pi = \pi^e - \beta(u - u^n) + \epsilon.$$

   The term "$-\beta(u - u^n)$" is the demand-pull inflation, since if unemployment is below its natural rate $(u < u^n)$, inflation rises. The supply shock ϵ is the cost-push inflation.

5. The Phillips curve relates the inflation rate to the expected inflation rate and to the difference between unemployment and its natural rate. So one way to reduce inflation is to have a recession, raising unemployment above its natural rate. It is possible to bring inflation down without a recession, however, if we can costlessly reduce *expected* inflation.

   According to the rational-expectations approach, people optimally use all of the information available to them in forming their expectations. So to reduce expected inflation, we require, first, that the plan to reduce inflation be announced before people form expectations (e.g., before they form wage agreements and price contracts); and second, that those setting wages and prices believe that the announced plan will be carried out. If both requirements are met, then expected inflation will fall immediately and without cost, and this in turn will bring down actual inflation.

6. One way in which a recession might raise the natural rate of unemployment is by affecting the process of job search, increasing the amount of frictional unemployment. For example, workers who are unemployed lose valuable job skills. This reduces their ability to find jobs after the recession ends because they are less desirable to firms. Also, after a long period of unemployment, individuals may lose some of their desire to work, and hence search less hard.

   Second, a recession may affect the process that determines wages, increasing wait unemployment. Wage negotiations may give a greater voice to "insiders," those who actually have jobs. Those who become unemployed become "outsiders." If the smaller group of insiders cares more about high real wages and less about high employment, then the recession may permanently push real wages above the equilibrium level and raise the amount of wait unemployment.

   This permanent impact of a recession on the natural rate of unemployment is called *hysteresis*.

Problems and Applications

1. In the sticky-wage model, we assumed that the wage did not adjust immediately to changes in the labor market. This resulted in an upward-sloping aggregate supply curve with the form

   $$Y = \overline{Y} + \alpha(P - P^e).$$

   In this problem, we consider the effect of allowing these contracts to be indexed for inflation.

   a. In the simple sticky-wage model, the nominal wage W equals the desired real wage ω times the expected price level P^e:

   $$W = \omega P^e.$$

Full indexing, however, makes the nominal wage depend on the *actual* price level. That is, the contract specifies the desired real wage ω, and the nominal wage adjusts fully to changes in the price level. As a result,

$$W = \omega P,$$

or

$$W/P = \omega.$$

This means that unexpected price changes do not affect the real wage and, hence, do not affect the amount of labor used or the amount of output produced. The aggregate supply schedule is thus vertical at $Y = \overline{Y}$.

b.   If there is partial indexing, then the aggregate supply curve will be steeper than it is without indexing, although it will not be vertical. In the sticky-wage model, an unexpected increase in the price level reduces the real wage W/P, since the nominal wage W is unaffected. With partial indexing, the increase in the price level causes an increase in the nominal wage. Since the indexing is only partial, the nominal wage increases by less than the price level does, so the real wage falls. This causes firms to use more labor and increase production. However, the real wage does not fall as much as it does without indexing, so output does not rise as much.

In effect, this is like making the parameter α smaller in the equation for aggregate supply. That is, output fluctuations become less responsive to surprises in the price level.

2. In this question, we examine two special cases of the sticky-price model developed in this chapter. In the sticky-price model, all firms have a desired price p that depends on the overall level of prices P as well as the level of aggregate demand $Y - \overline{Y}$. We wrote this as

$$p = P + a(Y - \overline{Y}).$$

There are two types of firms. A proportion $(1 - s)$ of the firms have flexible prices and set prices using the above equation. The remaining proportion s of the firms have sticky prices—they announce their prices in advance based on the economic conditions that they expect in the future. We assume that these firms expect output to be at its natural rate, so $(Y^e - \overline{Y}^e) = 0$. Hence, these firms set their prices equal to the expected price level:

$$p = P^e.$$

The overall price level is a weighted average of the prices set by the two types of firms:

$$P = sP^e + (1 - s)[P + a(Y - \overline{Y})].$$

Rearranging:

$$P = P^e + [a(1 - s)/s](Y - \overline{Y}).$$

a.   If no firms have flexible prices, then $s = 1$. The above equation tells us that

$$P = P^e.$$

That is, the aggregate price level is fixed at the expected price level: the aggregate supply curve is horizontal in the short run, as assumed in Chapter 9.

b.   If desired relative prices do not depend at all on the level of output, then $a = 0$ in the equation for the price level. Once again, we find $P = P^e$: the aggregate supply curve is horizontal in the short run, as assumed in Chapter 9.

3. The economy has the Phillips curve:

$$\pi = \pi_{-1} - 0.5(u - 0.06).$$

a.   The natural rate of unemployment is the rate at which the inflation rate does not deviate from the expected inflation rate. Here, the expected inflation rate is just

last period's actual inflation rate. Setting the inflation rate equal to last period's inflation rate, that is, $\pi = \pi_{-1}$, we find that $u = 0.06$. Thus, the natural rate of unemployment is 6 percent.

b.   In the short run (that is, in a single period) the expected inflation rate is fixed at the level of inflation in the previous period, π_{-1}. Hence, the short-run relationship between inflation and unemployment is just the graph of the Phillips curve: it has a slope of -0.5, and it passes through the point where $\pi = \pi_{-1}$ and $u = 0.06$. This is shown in Figure 13–1. In the long run, expected inflation equals actual inflation, so that $\pi = \pi_{-1}$, and output and unemployment equal their natural rates. The long-run Phillips curve thus is vertical at an unemployment rate of 6 percent.
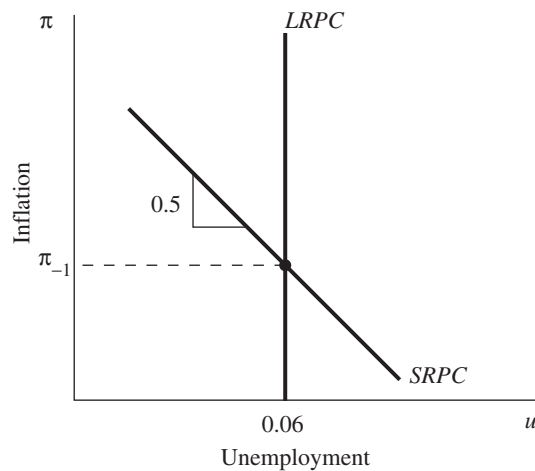

Figure 13–1

c.   To reduce inflation, the Phillips curve tells us that unemployment must be above its natural rate of 6 percent for some period of time. We can write the Phillips curve in the form

$$\pi - \pi_{-1} = 0.5(u - 0.06).$$

Since we want inflation to fall by 5 percentage points, we want $\pi - \pi_{-1} = -0.05$. Plugging this into the left-hand side of the above equation, we find

$$-0.05 = -0.5(u - 0.06).$$

We can now solve this for u:

$$u = 0.16.$$

Hence, we need 10 percentage point-years of cyclical unemployment above the natural rate of 6 percent.

Okun's law says that a change of 1 percentage point in unemployment translates into a change of 2 percentage points in GDP. Hence, an increase in unemployment of 10 percentage points corresponds to a fall in output of 20 percentage points. The sacrifice ratio is the percentage of a year's GDP that must be forgone to reduce inflation by 1 percentage point. Dividing the 20 percentage-point decrease in GDP by the 5 percentage-point decrease in inflation, we find that the sacrifice ratio is $20/5 = 4$.

d.   One scenario is to have very high unemployment for a short period of time. For example, we could have 16 percent unemployment for a single year. Alternatively, we could have a small amount of cyclical unemployment spread out over a long period of time. For example, we could have 8 percent unemployment for 5 years. Both of these plans would bring the inflation rate down from 10 percent to 5 percent, although at different speeds.

4. The cost of reducing inflation comes from the cost of changing people's expectations about inflation. If expectations can be changed costlessly, then reducing inflation is also costless. Algebraically, the Phillips curve tells us that

$$\pi = \pi^e - \beta(u - u^n).$$

If the government can lower expected inflation π^e to the desired level of inflation, then there is no need for unemployment to rise above its natural rate.

   According to the rational-expectations approach, people form expectations about inflation using all of the information that is available to them. This includes information about current policies in effect. If everyone *believes* that the government is committed to reducing inflation, then expected inflation will immediately fall. In terms of the Phillips curve, π^e falls immediately with little or no cost to the economy. That is, the sacrifice ratio will be very small.

   On the other hand, if people *do not* believe that the government will carry out its intentions, then π^e remains high. Expectations will not adjust because people are skeptical that the government will follow through on its plans.

   Thus, according to the rational-expectations approach, the cost of reducing inflation depends on how resolute and credible the government is. An important issue is how the government can make its commitment to reducing inflation more credible. One possibility, for example, is to appoint people who have a reputation as inflation fighters. A second possibility is to have Congress pass a law requiring the Federal Reserve to lower inflation. Of course, people might expect the Fed to ignore this law, or expect Congress to change the law later. A third possibility is to pass a constitutional amendment limiting monetary growth. People might rationally believe that a constitutional amendment is relatively difficult to change.

5. In this question we consider several implications of rational expectations—the assumption that people optimally use all of the information available to them in forming their expectations—for the models of sticky wages and sticky prices that we considered in this chapter. Both of these models imply an aggregate supply curve in which output varies from its natural rate only if the price level varies from its expected level:

$$Y = \overline{Y} + \alpha(P - P^e).$$

This aggregate supply curve means that monetary policy can affect real GDP only by affecting $(P - P^e)$—that is, causing an unexpected change in the price level.

   a.   Only unanticipated changes in the money supply can affect real GDP. Since people take into account all of the information available to them, they already take into account the effects of anticipated changes in money when they form their expectations of the price level P^e. For example, if people expect the money supply to increase by 10 percent and it actually does increase by 10 percent, then there is no effect on output since there is no price surprise—$(P - P^e) = 0$. On the other hand, suppose the Fed increases the money supply more than expected, so that prices increase by 15 percent when people expect them to increase by only 10 percent. Since $P > P^e$, output rises. But it is only the unanticipated part of money growth that increases output.

   b.   The Fed often tries to stabilize the economy by offsetting shocks to output and unemployment. For example, it might increase the money supply during recessions in an attempt to stimulate the economy, and it might reduce the money supply during booms in an attempt to slow it down. The Fed can only do this by surprising people about the price level: during a recession, they want prices to be higher than expected, and during booms, they want prices to be lower than expected. If people have rational expectations, however, they will *expect* the Fed to respond this way. So if the economy is in a boom, people expect the Fed to reduce the money supply; in a recession, people expect the Fed to increase the money supply. In either case, it is impossible for the Fed to cause $(P - P^e)$ to vary systematically from zero. Since people take into account the systematic, anticipated

movements in money, the effect on output of systematic, active policy is exactly the same as a policy of keeping the money supply constant.

c.   If the Fed sets the money supply after people set wages and prices, then the Fed can use monetary policy systematically to stabilize output. The assumption of rational expectations means that people use all of the information available to them in forming expectations about the price level. This includes information about the state of the economy and information about how the Fed will respond to this state. This does not mean that people *know* what the state of the economy will be, nor do they know exactly how the Fed will act: they simply make their best guess.

   As time passes, the Fed learns information about the economy that was unknown to those setting wages and prices. At this point, since contracts have already set these wages and prices, people are stuck with their expectations P^e. The Fed can then use monetary policy to affect the actual price level P, and hence can affect output systematically.

6. In this model, the natural rate of unemployment is an average of the unemployment rates in the past two years. Hence, if a recession raises the unemployment rate in some year, then the natural rate of unemployment rises as well. This means that the model exhibits hysteresis: short-term cyclical unemployment affects the long-term natural rate of unemployment.

   a.   The natural rate of unemployment might depend on recent unemployment for at least two reasons, suggested by theories of hysteresis. First, recent unemployment rates might affect the level of frictional unemployment. Unemployed workers lose job skills and find it harder to get jobs; also, unemployed workers might lose some of their desire to work, and hence search less hard for a job. Second, recent unemployment rates might affect the level of wait unemployment. If labor negotiations give a greater voice to "insiders" than "outsiders," then the insiders might push for high wages at the expense of jobs. This will be especially true in industries in which negotiations take place between firms and unions.

   b.   If the Fed seeks to reduce inflation permanently by 1 percentage point, then the Phillips curve tells us that in the first period we require

   $$\pi_1 - \pi_0 = -1 = -0.5(u_1 - u_1^n),$$

   or

   $$(u_1 - u_1^n) = 2.$$

   That is, we require an unemployment rate 2 percentage points above the original natural rate u_1^n. Next period, however, the natural rate will rise as a result of the cyclical unemployment. The new natural rate u_2^n will be

   $$\begin{aligned} u_2^n &= 0.5[u_1 + u_0] \\ &= 0.5[(u_1^n + 2) + u_1^n] \\ &= u_1^n + 1. \end{aligned}$$

   Hence, the natural rate of unemployment rises by 1 percentage point. If the Fed wants to keep inflation at its new level, then unemployment in period 2 must equal the new natural rate u_2^n. Hence,

   $$u_2 = u_1^n + 1.$$

   In every subsequent period, it remains true that the unemployment rate must equal the natural rate. This natural rate never returns to its original level: we can show this by deriving the sequence of unemployment rates:

   $$u_3 = (1/2)u_2 + (1/2)u_1 = u_1^n + 1\text{-}1/2$$

   $$u_4 = (1/2)u_3 + (1/2)u_2 = u_1^n + 1\text{-}1/4$$

   $$u_5 = (1/2)u_4 + (1/2)u_3 = u_1^n + 1\text{-}3/8.$$

Unemployment always remains above its original natural rate. In fact, we can show that it is always *at least* 1 percent above its original natural rate. Thus, to reduce inflation by 1 percentage point, unemployment rises above its original level by 2 percentage points in the first year, and by 1 or more percentage points in every year after that.

c. Because unemployment is always higher than it started, output is always lower than it would have been. Hence, the sacrifice ratio is infinite.

d. Without hysteresis, we found that there was a short-run tradeoff but no long-run tradeoff between inflation and unemployment. With hysteresis, we find that there *is* a long-run tradeoff between inflation and unemployment: to reduce inflation, unemployment must rise permanently.

7. a. The natural rate of output is determined by the production function, $\overline{Y} = F(\overline{K}, \overline{L})$. If a tax cut raises work effort, it increases $\overline{L}$ and, thus, increases the natural rate of output.

b. The tax cut shifts the aggregate demand curve outward for the normal reason that disposable income and, hence, consumption rise. It shifts the long-run aggregate supply curve outward because the natural rate of output rises.

   The effect of the tax cut on the short-run aggregate supply (*SRAS*) curve depends on which model you use. The labor supply curve shifts outward because workers are willing to supply more labor at any given real wage while the labor demand curve is unchanged. In the sticky-wage or sticky-price models the quantity of labor is demand-determined, so the *SRAS* curve does not move. By contrast, the imperfect-information model assumes that the labor market is always in equilibrium, so the greater supply of labor leads to higher employment immediately: the *SRAS* shifts out.

c. If you are using the sticky-wage or sticky-price model, the short-run analysis is the same as the conventional model without the labor-supply effect. That is, output and prices both rise because aggregate demand rises while short-run aggregate supply is unchanged. If you use the imperfect-information model, short-run aggregate supply shifts outward, so that the tax cut is more expansionary and less inflationary than the conventional model. Figure 13–2 shows the effects in both models. Point A is the original equilibrium, point SW is the new equilibrium in the sticky-wage model, and point II is the new equilibrium in the imperfect-information model.
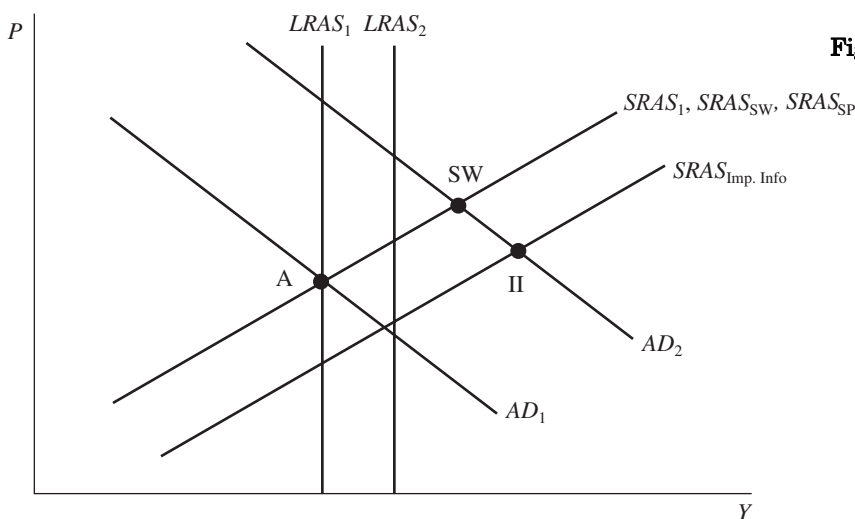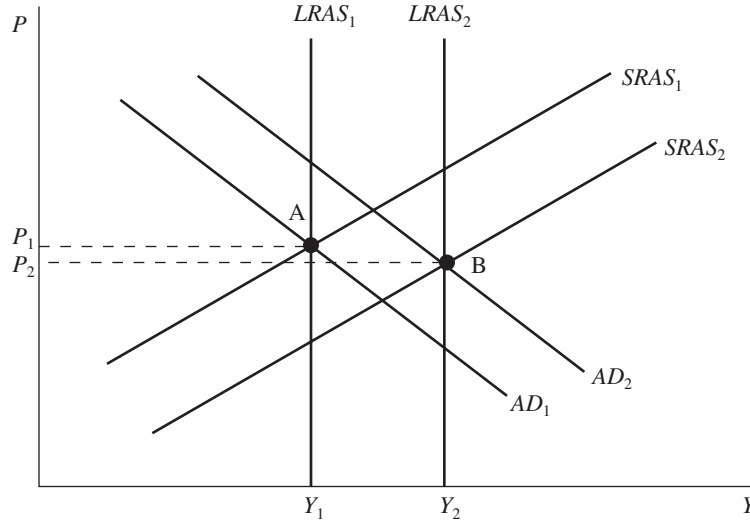

Figure 13–2

d. In contrast to the normal model, the tax cut raises long-run output by increasing the supply of labor. The policy's long-run effect on price is indeterminate, depending, in part on whether *SRAS* does, in fact, shift out. The change in the long-run equilibrium is shown in Figure 13–3.

Figure 13–3

8. In this quote, Alan Blinder argues that in low-inflation countries like the United States, the benefits of disinflation are small whereas the costs are large. That is, menu costs, shoeleather costs, and tax distortions simply do not add up to much, so eliminating inflation offers only small benefits. By contrast, the costs in terms of unemployment and lost output that are associated with lowering inflation are easily quantifiable and very large.

The basic policy implication of these beliefs about the relative benefits and costs of disinflation is that policymakers should not tighten policy in order to lower inflation rates that are already relatively low. The statement leaves two other issues ambiguous. First, should policymakers concern themselves with rising inflation? Second, should policymakers concern themselves with making inflation more predictable around the level it has inherited? Blinder may feel that these issues should have little weight relative to output stabilization.

9. From the BLS web site (www.bls.gov), there are various ways to get the CPI data. The approach I took (in February 2002) was to follow the links to the Consumer Price Index, then I followed the links to the most recent (current) economic news release. This led me to a table of contents, and I followed the first link to Consumer Price Index Summary (the direct web address for that link was http://www.bls.gov/news.release/cpi.nr0.htm). Midway through that release was a table showing the "percentage change [for the] 12 months ending in December" for recent years. For the years 1996–2001, the table shows:

Year	1996	1997	1998	1999	2000	2001
Overall CPI	3.3	1.7	1.6	2.7	3.4	1.6
CPI excluding food and energy	2.6	2.2	2.4	1.9	2.6	2.7

The overall CPI was clearly more volatile than the CPI excluding food and energy. For example, the overall CPI rose sharply from 1998 to 1999, and fell sharply from 2000 to 2001 (patterns that were not evident in the CPI excluding food and energy). The difference reflects shocks to the price of food and energy-especially energy prices, which are highly variable.

When energy prices, say, go down, the total CPI will rise less than the CPI excluding food and energy. This represents a supply shock, which shifts the aggregate supply curve and Phillips curve downward. In 1997 and 1998, for example, when the overall CPI rose less than the CPI excluding food and energy, we would expect that the decline in inflation did not necessarily require unemployment to rise above its natural rate. Indeed, unemployment was falling over that period.

More Problems and Applications to Chapter 13

1. a. The classical large open economy model (from the Appendix to Chapter 5) is similar to special case 2 in the text, except that it allows the interest rate to deviate from the world interest rate. That is, this is the special case where $P^e=P$, $L(i,Y)=(1/V)Y$, and CF=CF(r-r^*), with a non-infinitely elastic international capital flow. Because capital flows do not respond overwhelmingly to any differences between the domestic and world interest rates, these rates can, in fact, vary in this case.

    b. The Keynesian cross model of Chapter 10 is the special case where (i) the economy is closed, so that CF(r-r^*)=0 ; (ii) $I(r) = I$, so that investment is given exogenously; and (iii) α is infinite, so that the short-run aggregate-supply curve is horizontal. In this special case, output depends solely on the demand for goods and services.

    c. The IS-LM model for the large open economy (from the appendix to Chapter 12) is the special case where α is infinite and CF=CF(r-r^*) is not infinitely elastic. In this case, the short-run aggregate supply curve is horizontal, and capital flows do not respond too much to differences between the domestic and world interest rates.