

produced significant insights about aggregate supply, economic growth, and economic development. We will also see in the next chapter that it has renewed historical debates over the causes of macro instability and the effectiveness of stabilization policy.

Our goals in this chapter are to extend the analysis of aggregate supply to the long run, examine the inflation-unemployment relationship, and evaluate the effect of taxes on aggregate supply. The latter is a key concern of so-called *supply-side economics*.

From Short Run to Long Run

In Chapter 29, we noted that in macroeconomics the difference between the **short run** and the **long run** has to do with the flexibility of input prices. Input prices are inflexible or even totally fixed in the short run but fully flexible in the long run. (By contrast, output prices are assumed under these definitions to be fully flexible in both the short run and the long run.)

The assumption that input prices are flexible only in the long run leads to large differences in the shape and position of the short-run aggregate supply curve and the long-run aggregate supply curve. As explained in Chapter 29, the short-run aggregate supply curve is an upward-sloping line, whereas the long-run aggregate supply curve is a vertical line situated directly above the economy's full-employment output level, Q_f .

We will begin this chapter by studying how aggregate supply transitions *from* the short run *to* the long run. Once that is done, we will combine the long-run and short-run aggregate supply curves with the aggregate demand curve in order to form a single model that can give us insights into how the economy adjusts to both economic shocks as well as changes in monetary and fiscal policy in both the short run as well as the long run. That, in turn will lead us to discuss how long-run aggregate supply is affected by economic growth as well as how inflation and aggregate supply are related in both the long run and the short run. We will conclude with a discussion of economic policies that may help to increase aggregate supply in both the short run as well as the long run.

Short-Run Aggregate Supply

Our first objective is to demonstrate the relationship between short-run aggregate supply and long-run aggregate supply. We begin by briefly reviewing short-run aggregate supply.

Consider the short-run aggregate supply curve AS_1 in Figure 35.1a. This curve is based on three assumptions: (1) The initial price level is P_1 , (2) firms and workers have

established nominal wages on the expectation that this price level will persist, and (3) the price level is flexible both upward and downward. Observe from point a_1 that at price level P_1 the economy is operating at its full-employment output Q_f . This output is the real production forthcoming when the economy is operating at its natural rate of unemployment (or potential output).

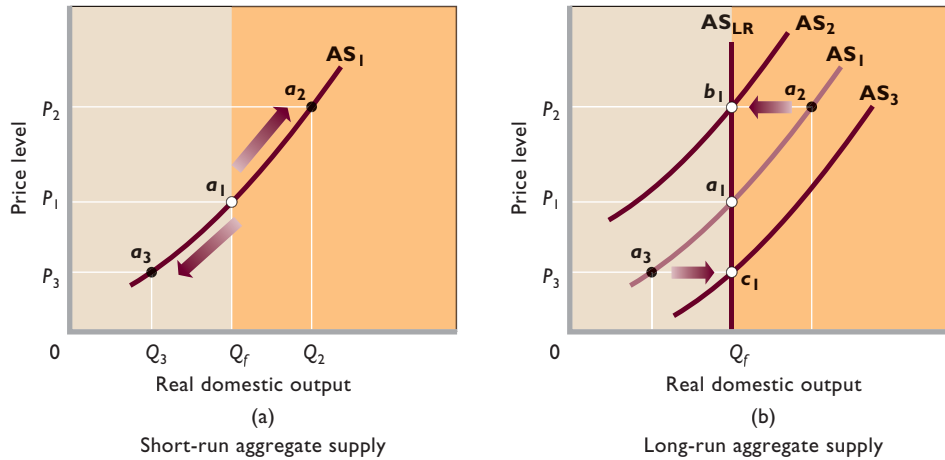
Now let's review the short-run effects of changes in the price level, say, from P_1 to P_2 in Figure 35.1a. The higher prices associated with price level P_2 increase firms' revenues, and because their nominal wages and other input prices remain unchanged, their profits rise. Those higher profits lead firms to increase their output from Q_f to Q_2 , and the economy moves from a_1 to a_2 on aggregate supply AS_1 . At output Q_2 the economy is operating beyond its full-employment output. The firms make this possible by extending the work hours of part-time and full-time workers, enticing new workers such as homemakers and retirees into the labor force, and hiring and training the structurally unemployed. Thus, the nation's unemployment rate declines below its natural rate.

How will the firms respond when the price level *falls*, say, from P_1 to P_3 in Figure 35.1a? Because the prices they receive for their products are lower while the nominal wages they pay workers remain unchanged, firms discover that their revenues and profits have diminished or disappeared. So they reduce their production and employment, and, as shown by the movement from a_1 to a_3 , real output falls to Q_3 . Increased unemployment and a higher unemployment rate accompany the decline in real output. At output Q_3 the unemployment rate is greater than the natural rate of unemployment associated with output Q_f .

Long-Run Aggregate Supply

The outcomes are different in the long run. To see why, we need to extend the analysis of aggregate supply to account for changes in nominal wages that occur in response to changes in the price level. That will enable us to derive the economy's long-run aggregate supply curve.

FIGURE 35.1 Short-run and long-run aggregate supply. (a) In the short run, nominal wages and other input prices do not respond to price-level changes and are based on the expectation that price level P_1 will continue. An increase in the price level from P_1 to P_2 increases profits and output, moving the economy from a_1 to a_2 ; a decrease in the price level from P_1 to P_3 reduces profits and real output, moving the economy from a_1 to a_3 . The short-run aggregate supply curve therefore slopes upward. (b) In the long run, a rise in the price level results in higher nominal wages and other input prices and thus shifts the short-run aggregate supply curve to the left. Conversely, a decrease in the price level reduces nominal wages and shifts the short-run aggregate supply curve to the right. After such adjustments, the economy obtains equilibrium of points such as b_1 and c_1 . Thus, the long-run aggregate supply curve is vertical at the full-employment output.



We illustrate the implications for aggregate supply in Figure 35.1b. Again, suppose that the economy is initially at point a_1 (P_1 and Q_f). As we just demonstrated, an increase in the price level from P_1 to P_2 will move the economy from point a_1 to a_2 along the short-run aggregate supply curve AS_1 . At a_2 , the economy is producing at more than its potential output. This implies very high demand for productive inputs, so that input prices will begin to rise. In particular, the high demand for labor will drive up nominal wages. Because nominal wages are one of the determinants of aggregate supply (see Figure 29.6), the short-run supply curve then shifts leftward from AS_1 to AS_2 , which now reflects the higher price level P_2 and the new expectation that P_2 , not P_1 , will continue. The leftward shift in the short-run aggregate supply curve to AS_2 moves the economy from a_2 to b_1 . Real output falls back to its full-employment level Q_f , and the unemployment rate rises to its natural rate.

What is the long-run outcome of a *decrease* in the price level? Assuming eventual downward wage flexibility, a decline in the price level from P_1 to P_3 in Figure 35.1b works in the opposite way from a price-level increase. At first the economy moves from point a_1 to a_3 on AS_1 . Profits are squeezed or eliminated because prices have fallen and nominal wages have not. But this movement along AS_1 is the short-run supply response that results only while input prices remain constant. As time passes, input prices will

begin to fall because the economy is producing at below its full-employment output. With so little output being produced, the demand for inputs will be low and their prices will begin to decline. In particular, the low demand for labor will drive down nominal wages. Lower nominal wages shift the short-run aggregate supply curve rightward from AS_1 to AS_3 , and real output returns to its full-employment level of Q_f at point c_1 .

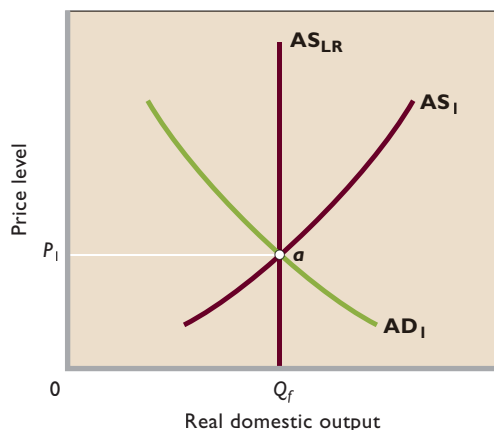
By tracing a line between the long-run equilibrium points b_1 , a_1 , and c_1 , we obtain a long-run aggregate supply curve. Observe that it is vertical at the full-employment level of real GDP. After long-run adjustments in nominal wages and other nominal input prices, real output is Q_f regardless of the specific price level. (**Key Question 3**)

Long-Run Equilibrium in the AD-AS Model

Figure 35.2 helps us understand the long-run equilibrium in the AD-AS model, now extended to include the distinction between short-run and long-run aggregate supply. (Hereafter, we will refer to this model as the extended AD-AS model, with “extended” referring to the inclusion of both the short-run and the long-run aggregate supply curves.)

In the short run, equilibrium occurs wherever the downsloping aggregate demand curve and upsloping short-run aggregate supply curve intersect. This can be at

FIGURE 35.2 Equilibrium in the extended AD-AS model. The long-run equilibrium price level P_1 and level of real output Q_f occur at the intersection of the aggregate demand curve AD_1 , the long-run aggregate supply curve AS_{LR} , and the short-run aggregate supply curve AS_1 .



any level of output, not simply the full-employment level. Either a negative GDP gap or a positive GDP gap is possible in the short run.

INTERACTIVE GRAPHS

G 35.1

Extended AD-AS model

But in the long run, the short-run aggregate supply curve adjusts as we just described. After those adjustments, long-run equilibrium occurs where the aggregate demand curve, vertical long-run aggregate supply curve, and short-run aggregate supply curve all intersect. Figure 35.2 shows the long-run outcome. Equilibrium occurs at point a , where AD_1 intersects both AS_{LR} and AS_1 , and the economy achieves its full-employment (or potential) output, Q_f . At long-run equilibrium price level P_1 and output level Q_f , there is neither a negative GDP gap nor a positive GDP gap.

QUICK REVIEW 35.1

- The short-run aggregate supply curve has a positive slope because nominal wages and other input prices are fixed while output prices change.
- The long-run aggregate supply curve is vertical because input prices eventually rise in response to changes in output prices.
- The long-run equilibrium GDP and price level occur at the intersection of the aggregate demand curve, the long-run aggregate supply curve, and the short-run aggregate supply curve.

Applying the Extended AD-AS Model

The extended AD-AS model helps clarify the long-run aspects of demand-pull inflation, cost-push inflation, and recession.

Demand-Pull Inflation in the Extended AD-AS Model

Recall that demand-pull inflation occurs when an increase in aggregate demand pulls up the price level. Earlier, we depicted this inflation by shifting an aggregate demand curve rightward along a stable aggregate supply curve (see Figure 29.8).

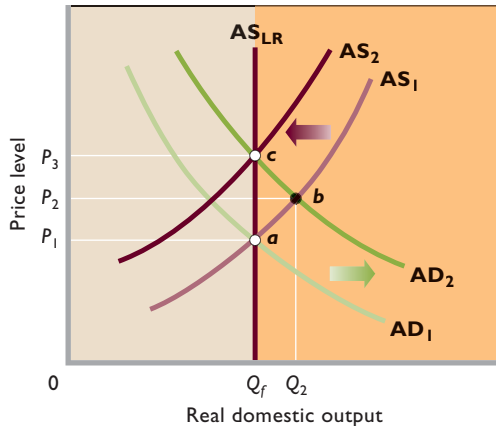
In our more complex version of aggregate supply, however, an increase in the price level eventually leads to an increase in nominal wages and thus a leftward shift of the short-run aggregate supply curve. This is shown in Figure 35.3, where we initially suppose the price level is P_1 at the intersection of aggregate demand curve AD_1 , short-run supply curve AS_1 , and long-run aggregate supply curve AS_{LR} . Observe that the economy is achieving its full-employment real output Q_f at point a .

Now consider the effects of an increase in aggregate demand as represented by the rightward shift from AD_1 to AD_2 . This shift might result from any one of a number of factors, including an increase in investment spending or a rise in net exports. Whatever its cause, the increase in aggregate demand boosts the price level from P_1 to P_2 and expands real output from Q_f to Q_2 at point b . There, a positive GDP gap of $Q_2 - Q_f$ occurs.

So far, none of this is new to you. But now the distinction between short-run aggregate supply and long-run aggregate supply becomes important. With the economy producing above potential output, inputs will be in high demand. Input prices including nominal wages will rise. As they do, the short-run aggregate supply curve will ultimately shift leftward such that it intersects long-run aggregate supply at point c .¹ There, the economy has reestablished long-run equilibrium, with the price level and real output now P_3 and Q_f , respectively. Only at point c does the new aggregate demand curve

¹We say “ultimately” because the initial leftward shift in short-run aggregate supply will intersect the long-run aggregate supply curve AS_{LR} at price level P_2 (review Figure 35.1b). But the intersection of AD_2 and this new short-run aggregate supply curve (that is not shown in Figure 35.3) will produce a price level above P_2 . (You may want to pencil this in to make sure that you understand this point.) Again nominal wages will rise, shifting the short-run aggregate supply curve farther leftward. The process will continue until the economy moves to point c , where the short-run aggregate supply curve is AS_2 , the price level is P_3 , and real output is Q_f .

FIGURE 35.3 Demand-pull inflation in the extended AD-AS model. An increase in aggregate demand from AD_1 to AD_2 drives up the price level and increases real output in the short run. But in the long run, nominal wages rise and the short-run aggregate supply curve shifts leftward, as from AS_1 to AS_2 . Real output then returns to its prior level, and the price level rises even more. In this scenario, the economy moves from a to b and then eventually to c .



AD_2 intersect both the short-run aggregate supply curve AS_2 and the long-run aggregate supply curve AS_{LR} .

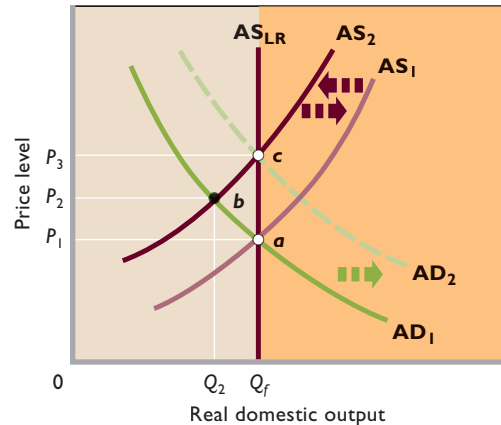
In the short run, demand-pull inflation drives up the price level and increases real output; in the long run, only the price level rises. In the long run, the initial increase in aggregate demand moves the economy along its vertical aggregate supply curve AS_{LR} . For a while, an economy can operate beyond its full-employment level of output. But the demand-pull inflation eventually causes adjustments of nominal wages that return the economy to its full-employment output Q_f .

Cost-Push Inflation in the Extended AD-AS Model

Cost-push inflation arises from factors that increase the cost of production at each price level, shifting the aggregate supply curve leftward and raising the equilibrium price level. Previously (Figure 29.10), we considered cost-push inflation using only the short-run aggregate supply curve. Now we want to analyze that type of inflation in its long-run context.

Analysis Look at Figure 35.4, in which we again assume that the economy is initially operating at price level P_1 and output level Q_f (point a). Suppose that international oil producers agree to reduce the supply of oil to boost its price by, say, 100 percent. As a result, the per-unit production cost of producing and transporting goods and services rises substantially in the economy represented by Figure 35.4. This increase in per-unit production costs shifts the

FIGURE 35.4 Cost-push inflation in the extended AD-AS model. Cost-push inflation occurs when the short-run aggregate supply curve shifts leftward, as from AS_1 to AS_2 . If government counters the decline in real output by increasing aggregate demand to the broken line, the price level rises even more. That is, the economy moves in steps from a to b to c . In contrast, if government allows a recession to occur, nominal wages eventually fall and the aggregate supply curve shifts back rightward to its original location. The economy moves from a to b and eventually back to a .



short-run aggregate supply curve to the left, as from AS_1 to AS_2 , and the price level rises from P_1 to P_2 (as seen by comparing points a and b). In this case, the leftward shift of the aggregate supply curve is *not a response* to a price-level increase, as it was in our previous discussions of demand-pull inflation; it is the *initiating cause* of the price-level increase.

Policy Dilemma Cost-push inflation creates a dilemma for policymakers. Without some expansionary stabilization policy, aggregate demand in Figure 35.4 remains in place at AD_1 and real output declines from Q_f to Q_2 . Government can counter this recession, negative GDP gap, and attendant high unemployment by using fiscal policy and monetary policy to increase aggregate demand to AD_2 . But there is a potential policy trap here: An increase in aggregate demand to AD_2 will further raise inflation by increasing the price level from P_2 to P_3 (a move from point b to point c).

Suppose the government recognizes this policy trap and decides not to increase aggregate demand from AD_1 to AD_2 (you can now disregard the dashed AD_2 curve) and instead decides to allow a cost-push-created recession to run its course. How will that happen? Widespread layoffs, plant shutdowns, and business failures eventually occur. At some point the demand for oil, labor, and other inputs will decline so much that oil prices and nominal wages will decline. When that happens, the initial leftward shift of the short-run aggregate supply curve will reverse itself. That is, the declining per-unit production costs caused by the

recession will shift the short-run aggregate supply curve rightward from AS_2 to AS_1 . The price level will return to P_1 , and the full-employment level of output will be restored at Q_f (point a on the long-run aggregate supply curve AS_{LR}).

This analysis yields two generalizations:

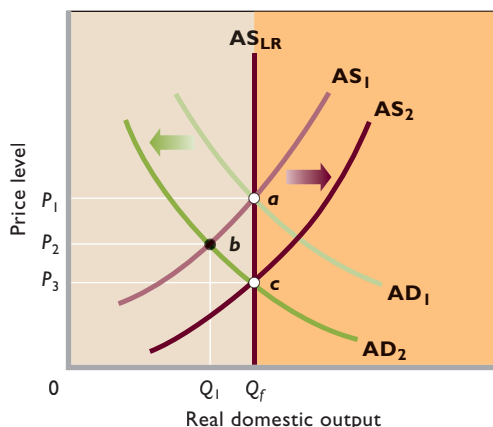
- If the government attempts to maintain full employment when there is cost-push inflation, even more inflation will occur.
- If the government takes a hands-off approach to cost-push inflation, the recession will linger. Although falling input prices will eventually undo the initial rise in per-unit production costs, the economy in the meantime will experience high unemployment and a loss of real output.

Recession and the Extended AD-AS Model

By far the most controversial application of the extended AD-AS model is its application to recession (or depression) caused by decreases in aggregate demand. We will look at this controversy in detail in Chapter 36; here we simply identify the key point of contention.

Suppose in Figure 35.5 that aggregate demand initially is AD_1 and that the short-run and long-run aggregate supply curves are AS_1 and AS_{LR} , respectively. Therefore, as shown by point a , the price level is P_1 and output is Q_f . Now suppose that investment spending declines dramatically, reducing aggregate demand to AD_2 . Observe that real output declines from Q_f to Q_1 , indicating that

FIGURE 35.5 Recession in the extended AD-AS model. A recession occurs when aggregate demand shifts leftward, as from AD_1 to AD_2 . If prices and wages are downwardly flexible, the price level falls from P_1 to P_2 as the economy moves from point a to point b . With the economy in recession at point b , wages eventually fall, shifting the aggregate supply curve from AS_1 to AS_2 . The price level declines to P_3 , and real output returns to Q_f . The economy moves from a to b to c .



a recession has occurred. But if we make the controversial assumption that prices and wages are flexible downward, the price level falls from P_1 to P_2 . With the economy producing below potential output at point b , demand for inputs will be low. Eventually, nominal wages themselves fall to restore the previous real wage; when that happens, the short-run aggregate supply curve shifts rightward from AS_1 to AS_2 . The negative GDP gap evaporates without the need for expansionary fiscal or monetary policy since real output expands from Q_1 (point b) back to Q_f (point c). The economy is again located on its long-run aggregate supply curve AS_{LR} , but now at lower price level P_3 .

There is much disagreement about this hypothetical scenario. The key point of dispute revolves around the degree to which both input and output prices may be downwardly inflexible and how long it would take in the real world for the necessary downward price and wage adjustments to occur to regain the full-employment level of output. For now, suffice it to say that most economists believe that if such adjustments are forthcoming, they will occur only after the economy has experienced a relatively long-lasting recession with its accompanying high unemployment and large loss of output. Therefore, economists recommend active monetary policy, and perhaps fiscal policy, to counteract recessions. (**Key Question 4**)

Ongoing Inflation in the Extended AD-AS Model

In our analysis so far, we have seen how demand and supply shocks can cause, respectively, demand-push inflation and cost-push inflation. But in all the cases analyzed up to now, the extent of the inflation was *finite* because the size of the initial movement in either the AD curve or the AS curve was *limited*. For instance, in Figure 35.3, the aggregate demand curve shifts right by a limited amount, from AD_1 to AD_2 . As the economy's equilibrium moves from a , to b , to c , the price level rises from P_1 , to P_2 , to P_3 . During this transition, inflation obviously occurs since the price level is rising. But once the economy reaches its new equilibrium at point c , the price level remains constant at P_3 and there is no further inflation. That is, the limited movement in aggregate demand causes a limited amount of inflation that ends when the economy returns to full employment.

This fact is crucial to understanding why modern economies experience ongoing positive rates of inflation. Simply put, there must be ongoing shifts in either the aggregate demand or aggregate supply curves since any single, finite shift in either curve will only cause an inflation of limited duration. In this section, we explore this idea, pointing out two facts. First, ongoing economic growth causes continuous rightward shifts of the aggregate supply curve that, by