11

The Determination of Aggregate Output, the Price Level, and the Interest Rate

CHAPTER OUTLINE AND LEARNING OBJECTIVES

In the last three chapters we have been exploring the key elements of the macroeconomy one element at a time. In Chapters 8 and 9 we looked at how the output level in the economy is determined, keeping the interest rate and the price level fixed. In Chapter 10 we turned our attention to the interest rate, holding output and the price level fixed. We are now ready to bring together these key pieces of the economy—output, the price level, and the interest rate.

This chapter and the next one will give you the ability to think about the key issues policy makers face in trying to manage the economy. We will see how the output level is determined. We will see what forces push the overall price level up, creating inflation, in an economy. By the time you finish these two chapters, we hope you will be much better able to understand what lies behind many of the current policy debates in the United States.

As we complete the story in this chapter, we will focus on the behavior of two key players in the macroeconomy: firms, who make price and output decisions, and the Federal Reserve (the Fed), which controls the interest rate. We begin with the price and output decisions of firms, which will be summarized in an aggregate supply curve.

11.1 LEARNING OBJECTIVE

Define the aggregate supply curve and discuss shifts in the short-run *AS* curve.

aggregate supply The total supply of all goods and services in an economy.

aggregate supply (*AS*) curve A graph that shows the relationship between the aggregate quantity of output supplied by all firms in an economy and the overall price level.

The Aggregate Supply (*AS*) Curve

Aggregate supply is the total supply of goods and services in an economy. The **aggregate supply (*AS*) curve** shows the relationship between the aggregate quantity of output supplied by all the firms in an economy and the overall price level. To understand the aggregate supply curve, we need to understand something about the behavior of the individual firms that make up the economy.

Consider a situation in which all prices, including the price of labor (wages), simultaneously doubled. What would we expect to see happen to the level of output produced by the firms in this economy? Likely nothing. With all prices doubling, all costs double as well. In effect a firm is in exactly the same position it was in before the doubling. If wages and prices are both rising, firms get more for their products and pay proportionately more for workers and other inputs. The *AS* curve in this case would be vertical. Product prices would increase, but firms would not increase output because it would not be profitable to do so. Indeed, as we will see later in this chapter, many economists think this describes reasonably well the long-run relationship between the aggregate price level and aggregate output, arguing that given enough time, price adjustments across all inputs and outputs will fall into line. We will have more to say about this long-run situation a bit later in the chapter.

Suppose, on the other hand, that wages and prices do not move in tandem. What do we expect the firms in our macroeconomy to do? If wages respond more slowly to a demand change than do product prices, firms will increase output as product prices rise and the profitability of output increases. Here the *AS* curve will have an upward slope, rather than being vertical. Many economists believe that in the short run wages do respond more slowly than prices, particularly at some points in the business cycle, and that the short-run *AS* curve in fact slopes up.

Before looking further at the shape of the *AS* curve, it is worth pointing out that the *AS* curve is *not* the sum of individual supply curves. First, we note that imperfectly competitive firms, who make up a substantial part of the economy, do not have individual supply curves. Firms choose both output and price at the same time. To derive an individual supply curve, we need to imagine calling out a price to a firm and having the firm tell us how much output it will supply at that price. We cannot do this if firms are also setting prices. What this means is that you should not think of the *AS* curve as being the sum of individual supply curves. If individual supply curves do not exist, we certainly can't add them together!

So if the *AS* curve is *not* the sum of individual supply curves, what is it? The *AS* curve shows what happens to the aggregate price level and aggregate output as aggregate demand rises and falls. The *AS* curve traces out aggregate output and aggregate price level points corresponding to different levels of aggregate demand. Although it is called an aggregate *supply* curve, it is really misnamed. It is better thought of as a "price/output response" curve—a curve that traces out the price decisions and output decisions of all firms in the economy under different levels of aggregate demand.

Aggregate Supply in the Short Run MyLab Economics Concept Check

Consider what happens in an economy when there is a shift in the aggregate demand curve coming from, for example, an increase in government spending. How much, if at all, does the price level increase? How much does output increase? The shape of the AS curve (or price-output response curve) tells us the answer to these questions. The steeper the curve, the more the price level will rise with the demand increase; the flatter the curve, the more the output will rise with the demand increase.

Most economists believe that, at least for a period of time, an increase in aggregate demand will result in an increase in *both* the price level and output. Many economists also believe that how much a demand increase affects the price level versus output depends on the strength of the economy at the time the demand increase occurred. In other words, the AS curve changes its shape as the economy approaches its capacity level. Figure 11.1 shows a curve reflecting these ideas. At low levels of aggregate output—for example, when the economy is in a recession—the aggregate supply curve is fairly flat. The price level increases only slightly when demand increases. At high levels of output—for example, when the economy is experiencing a boom—the AS curve is vertical or nearly vertical. Here, output increases very little following a demand increase and the price level does most of the work.

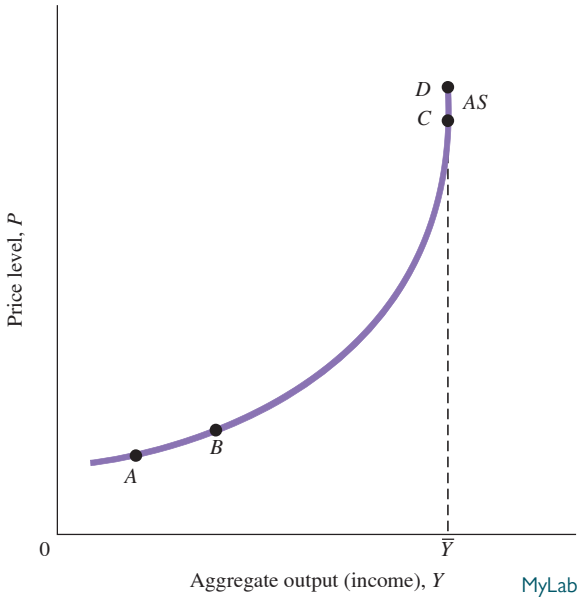

FIGURE 11.1 The Short-Run Aggregate Supply Curve
In the short run, the aggregate supply curve (the price/output response curve) has a positive slope. At low levels of aggregate output, the curve is fairly flat. As the economy approaches capacity, the curve becomes nearly vertical. At capacity, $\overline{Y}$, the curve is vertical.

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Why an Upward Slope? In our discussion so far, we noted that if all prices—including wages—move simultaneously, the *AS* curve will be vertical. All demand increases will be absorbed by price changes alone. A key determinant of whether the short run *AS* curve slopes up or is vertical is whether wages are "sticky," moving more slowly than other prices. With sticky wages, demand increases occur without proportional wage increases and so firms' marginal cost curves do not shift proportionally. Here increases in prices make output increases more attractive. The empirical evidence suggests that wages do in fact lag prices, that they are slower to change. We discuss in Chapter 13 various reasons that have been advanced for why wages might be sticky in the short run. Looking at the AS curve shows us why the stickiness of wages and the timing of wage responses are so important. Absent these sticky wages, the economy's response to demand increases by the government, for example, will be price increases without any increase in real output.

We should add a word of caution at this point. It may be that some of a firm's input costs are rising even in the short run after the aggregate demand increase has taken place because some of a firm's inputs may be purchased from other firms who are raising prices. For example, one input to a Dell computer is a chip produced by Intel or AMD. The fact that some of a firm's input costs rise along with a shift in the demand for its product complicates the picture because it means that at the same time there is an outward shift in a firm's demand curve, there is some upward shift in its marginal cost curve. In deriving an upward-sloping *AS* curve, we are in effect assuming that these kinds of input costs are small relative to wage costs. It is the combination of sticky wages and the large fraction of those wages in firm costs that give us an upward-sloping short-run *AS* curve.

Why the Particular Shape? Notice the *AS* curve in Figure 11.1 begins with a flat section and ends with a more-or-less vertical section. Why might the *AS* curve have this shape? It should not surprise you that the shape of the *AS* curve reflects economists' views on when in an economy we might expect wages to be most and least sticky.

Consider the vertical portion first. At some level the overall economy is using all its capital and all the labor that wants to work at the market wage. The economy is running full tilt. At this level ($\overline{Y}$), increased demand for output can be met only by increased prices and similarly for increased demand for labor. Neither wages nor prices are likely to be sticky at this level of economic activity.

What about the flat portion of the curve? Here we are at levels of output that are low relative to historical levels. Many firms are likely to have excess capacity in terms of their plant and equipment and their workforce. With excess capacity, firms may be able to increase output from *A* to *B* without a proportionate cost increase. Small price increases may thus be associated with relatively large output responses. We may also observe relatively sticky wages upward at this point on the *AS* curve if firms have held any excess workers in the downturn as a way to preserve worker morale or for other reasons.

Shifts of the Short-Run Aggregate Supply Curve MyLab Economics Concept Check

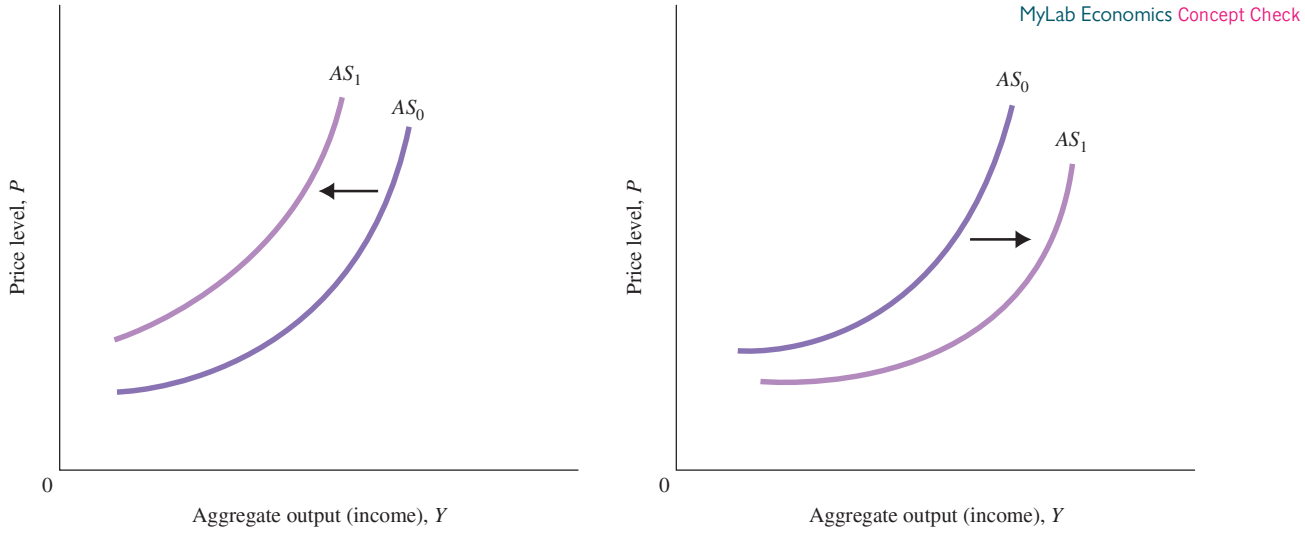
The *AS* curve shows how a change in aggregate demand will affect the overall price level and output. We have seen that the answer to whether the price level or output is more affected depends on where we are on the AS curve, or how the economy is doing at the time of the change. Now we can think about how other features of the economy might affect, or *shift*, the position of the *AS* curve.

What does a rightward shift of the *AS* curve mean? A rightward shift says that society can get a larger aggregate output at a given price level. What might cause such a shift? Clearly, if a society had an increase in labor or capital, the *AS* curve would shift to the right because the capacity of the economy would increase. Also, broad-based technical changes that increased productivity would shift the *AS* curve to the right by lowering marginal costs of production in the economy. With lower marginal costs, firms in the economy are willing to produce more for a given price level. Recall that the vertical part of the short-run *AS* curve represents the economy's maximum (capacity) output. This maximum output is determined by the economy's existing resources, like the size of its labor force, capital stock, and the current state of technology. The labor force grows naturally with an increase in the working-age population, but it can also increase for other reasons. Since the 1960s, for example, the percentage of women in the labor force has grown sharply. This increase in the supply of women workers has shifted the *AS* curve to the right. Immigration can also shift the *AS* curve. We discuss economic growth in more detail in Chapter 16.

We have focused on labor and capital as factors of production, but for a modern economy, energy is also an important input. New discoveries of oil or problems in the production of energy can also shift the *AS* curve through effects on the marginal cost of production in many parts of the economy.

cost shock, or supply shock
A change in costs that shifts the short-run aggregate supply (*AS*) curve.

Figures 11.2(a) and (b) show the effects of shifts in the short-run *AS* curve coming from changes in wage rates or energy prices. This type of shift is sometimes called a **cost shock *or* supply shock**. Oil has historically had quite volatile prices and has often been thought to contribute to shifts in the *AS* curve that, as we will shortly see, contribute to economy-wide fluctuations.



a. A decrease in aggregate supply

A leftward shift of the *AS* curve from AS_0 to AS_1 could be caused by an increase in costs—for example, an increase in wage rates or energy prices.

b. An increase in aggregate supply

A rightward shift of the *AS* curve from AS_0 to AS_1 could be caused by a decrease in costs—for example, a decrease in wage rates or energy prices or advances in technology.

▲ FIGURE 11.2 **Shifts of the Short-Run Aggregate Supply Curve**

The Aggregate Demand (*AD*) Curve

11.2 LEARNING OBJECTIVE

Derive the aggregate demand curve and explain why the *AD* curve is downward sloping.

The *AS* curve in Figure 11.1 shows us all possible combinations of aggregate output and the price level consistent with firms' output and price decisions. But where on the curve will an economy be? To answer this question we need to consider the demand side of the economy. In this section we will derive an aggregate demand (*AD*) curve. This curve is derived from the model of the goods market in Chapters 8 and 9 and from the behavior of the Fed. We begin with the goods market.

Planned Aggregate Expenditure and the Interest Rate MyLab Economics Concept Check

We know from Chapter 8 that planned investment depends on the interest rate. What does this tell us about the relationship between planned aggregate expenditure (*AE*) and the interest rate? Recall that planned aggregate expenditure is the sum of consumption, planned investment, and government purchases. That is,

$$AE \equiv C + I + G$$

We know that there are many possible levels of planned investment, *I*, each corresponding to a different interest rate. When the interest rate rises, planned investment falls. Therefore, a rise in the interest rate (*r*) will '*ceteris paribus*' lead to a fall in total planned spending ($C + I + G$) as well.[1]

Figure 11.3 shows what happens to planned aggregate expenditure and output when the interest rate rises from 3 percent to 6 percent. At the higher interest rate, planned investment is lower; planned aggregate expenditure thus shifts *downward*. Recall from Chapters 8 and 9 that a fall in any component of aggregate spending has an even larger (or "multiplier") effect on output. When the interest rate rises, planned investment (and thus planned aggregate expenditure) falls and equilibrium output (income) falls by even more than the fall in planned investment. In Figure 11.3, equilibrium output falls from Y_0 to Y_1 when the interest rate rises from 3 percent to 6 percent.

We can summarize the effects of a change in the interest rate on the equilibrium level of output in the goods market. The effects of a change in the interest rate include:

- A high interest rate (*r*) discourages planned investment (*I*).
- Planned investment is a part of planned aggregate expenditure (*AE*).
- Thus, when the interest rate rises, planned aggregate expenditure (*AE*) at every level of income falls.
- Finally, a decrease in planned aggregate expenditure lowers equilibrium output (income) (*Y*) by a multiple of the initial decrease in planned investment.

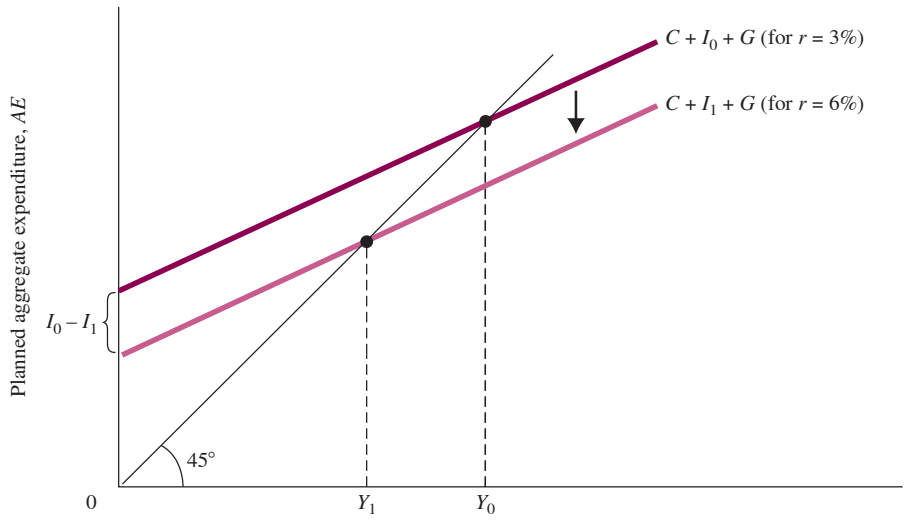


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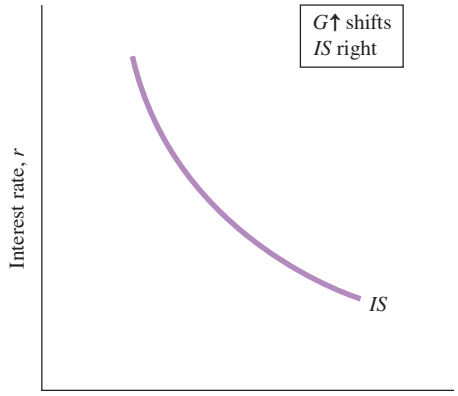
FIGURE 11.3 The Effect of an Interest Rate Increase on Planned Aggregate Expenditure and Equilibrium Output
An increase in the interest rate from 3 percent to 6 percent lowers planned aggregate expenditure and thus reduces equilibrium output from Y_0 to Y_1.

[1]When we look in detail in Chapter 16 at the behavior of households in the macroeconomy, we will see that consumption spending (*C*) is also stimulated by lower interest rates and discouraged by higher interest rates.

FIGURE 11.4 The *IS* Curve
In the goods market, there is a negative relationship between output and the interest rate because planned investment depends negatively on the interest rate. Any point on the *IS* curve is an equilibrium in the goods market for the given interest rate.



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Using a convenient shorthand:

$$r\uparrow \rightarrow I\downarrow \rightarrow AE\downarrow \rightarrow Y\downarrow$$

$$r\downarrow \rightarrow I\uparrow \rightarrow AE\uparrow \rightarrow Y\uparrow$$

***IS* curve** Relationship between aggregate output and the interest rate in the goods market.

This relationship between output and the interest rate is summarized in Figure 11.4. This curve is called the ***IS* curve**. Any point on the *IS* curve is an equilibrium in the goods market for the particular interest rate. The lower the interest rate, the more planned investment we have and the higher will be aggregate output. Equilibrium also means that planned investment equals saving, hence the *IS* notation.

As we note in Figure 11.4, an increase in government spending will shift the *IS* curve to the right. For any given interest rate, an increase in *G* increases planned aggregate expenditure, *AE*, and thus *Y* in equilibrium. (Remember that AE = C + I + G.) This shift in the *IS* curve is shown in Figure 11.5. If for a given interest rate, an increase in *G* increases output from Y_1 to Y_2, this is a shift of the *IS* curve from IS_1 to IS_2.

The Behavior of the Fed MyLab Economics Concept Check

The *IS* curve shows the relationship between the interest rate and output. When the interest rate is high, planned investment is low, so all else equal output is low. When the interest rate is low, planned investment is high, so output is high. But where on the curve is the actual economy? To answer this question we need to know the level of the interest rate. We know from Chapter 10 how the Fed controls the interest rate. Every six weeks, the Federal Open Market Committee (FOMC) meets. This committee is headed by the chair of the Fed, currently Jerome Powell. The FOMC decides on the value of the interest rate (the exact rate it sets is called the "federal funds" rate).

The FOMC usually announces the interest rate value at 2:15 P.M. eastern time on the day it meets. This is a key time for financial markets around the world. At 2:14 P.M., thousands of people are staring at their computer screens waiting from word on high. If the announcement is a surprise, it can have large and immediate effects on bond and stock markets.

How does the Fed decide on what interest rate value to choose? The Fed's stated mission is "to foster the stability, integrity and efficiency of the nation's monetary, financial and payment systems so as to promote optimal macroeconomic performance."[2] The Fed's main goals in achieving optimal macroeconomic performance are high levels of output and employment and a low rate of inflation. From the Fed's point of view, the best situation is a fully employed economy with a low inflation rate. The worst situation is stagflation—high unemployment and high inflation. In fact, the Humphrey-Hawkins Full Employment Act of 1978 mandated the Fed to aim for full employment and price stability, and when the bill was sunsetted in 2000, the expectation was that the Fed would continue to aim for full employment and price stability. In virtually all current announcements concerning the interest rate, the Fed makes reference to these two goals.

[2]Board of Governors of the Federal Reserve System, "Government Performance and Results Act planning Document, page 9

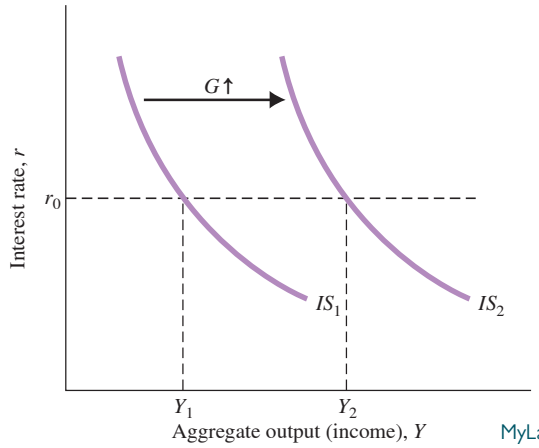

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FIGURE 11.5 Shift of the *IS* Curve
An increase in government spending (G) with the interest rate fixed increases output (Y), which is a shift of the *IS* curve to the right.

The Fed examines data on the current state of the economy, particularly output and inflation, and also considers the likely future course of the economy. In this setting, the Fed faces some hard choices. It knows—as we do from the *IS* curve in Figure 11.4—that increasing the interest rate will result in lower output, while reducing the interest rate will result in higher output. So one factor the Fed uses to choose the interest rate value is whether it believes output to be too low, too high, or about right. But we know that the Fed also cares about inflation. If the Fed finds inflation higher than it wishes, it will raise the interest rate, other things being equal, and vice versa if it finds inflation lower than it wishes.

The discussion so far has focused on output and inflation as the two main inputs into the Fed's interest rate decision. But the Fed is not just a mechanical calculator. The Fed chair brings to the FOMC meeting his or her own considerable expertise about the working of the economy. Janet Yellen and Ben Bernanke, the two most recent former Fed chairs are both distinguished researchers. Yellen also had experience running the San Francisco Fed. The current chair, Jerome Powell, served on the Fed for several years before becoming chair and has had high level experience both in government and in the private financial sector. Most of the other members of the FOMC have extensive experience in business and economics. As the Fed thinks about its interest rate setting, it considers factors other than current output and inflation. Levels of consumer confidence, possible fragility of the domestic banking sector, and possible financial problems abroad, say a potential euro crisis, may play a role in its interest rate decision. For our purposes we will label all these factors (all factors except output and inflation) as "Z" factors. These factors lie outside our model, and they are likely to vary from period to period in ways that are hard to predict.

If we put all of this together, we can describe the interest rate behavior of the Fed by using a simple linear equation, which we will call the **Fed rule**:

Fed rule Equation that shows how the Fed's interest rate decision depends on the state of the economy.

$$r = \alpha Y + \beta P + \gamma Z$$

Describing the Fed rule via an equation will allow us to incorporate Fed behavior formally into the *AS*/*AD* model we are building.[3] It is, of course, only an approximation as to how the Fed actually behaves.

[3]The Fed rule used here differs somewhat from that advocated for teaching purposes by David Romer, "Keynesian Macroeconomics without the LM Curve," *Journal of Economic Perspectives,* 14, Spring 2000, 149–169. First, the left-hand side variable is the nominal interest rate (r) rather than the real interest rate advocated by Romer. The Fed does in fact set the nominal rate at each FOMC meeting, so the use of the nominal rate is more realistic and easier to understand for students. Second, the price level, not the rate of inflation, is used in the rule. The *AS*/*AD* model is a static model. Introducing inflation brings in dynamics, which complicates the analysis. P is used here instead of the change in P. The insights still hold, and the story is much simpler. Third, the nominal interest rate is used in the (real) goods market in the determination of planned investment. Again, this is an approximation to avoid dynamics, and the insights still hold.

The research of one of the authors (Fair) actually supports the use of the nominal rate in the goods market. The results suggest that people (both consumers and investors) respond more to nominal rates than to real rates. Also, the left-hand side variable in Fair's price equation in his U.S. macroeconometric model is the (log) price level rather than the rate of inflation. This equation is consistent with the discussion behind the *AS* curve, where the two decision variables of a firm are taken to be the firm's price level and level of output, not the change in the price level and level of output.

ECONOMICS IN PRACTICE

Central Bankers: Does Personality Matter?

After being sworn in as Chairman of the U.S. Federal Reserve Board in 1979, Paul Vocker told a journalist in an informal encounter that he was "boring", and that "it's the job of all central bankers to be as boring as possible."[1] Three decades and a global financial crisis later, being boring does not seem to be a requisite to be a good central banker any more. On the contrary, the personality of central bankers is more than sufficiently scrutinized. Janet Yellen at the Federal Reserve, Mario Draghi at the European Central Bank, Raghuram Rajan at the Reserve Bank of India, and Mark Carney at the Bank of England are examples of "superstar" central bankers endowed by the financial press with the capacity to significantly influence monetary policy effectiveness. In particular, central bankers' education, training, and professional background seems to matter enormously.

But is this really true? In a recent study[2], two economists looked at the claim that "superstar" central bankers, such as those mentioned above, make an impact on economic performance. Comparing "superstars" with "average" central bankers (as defined by the financial press), the authors found that outstanding personalities at the helm of central banks indeed make a difference and can particularly obtain a better trade-off between inflation and unemployment through a positive effect on the confidence of various economic agents.

[1]Stanislaw, Joseph and Yergin, Daniel, "The Commanding Heights: The Battle for the World Economy", 1998.
[2]Neuenkirch, Matthias and Tillmann, Peter, "Does a Good Central Banker Make a Difference?", *Universität Trier Research Paper in Economics n.8/13*, 2014.

What does this equation tell us? We will assume that the three coefficients, α, β, and γ, are positive. When output is high, all else equal, the Fed favors a higher interest rate then it would in a low-output economy. Likewise, when the price level is high, all else equal, the Fed favors a higher interest rate then it would when price stability is not a problem. High interest rates will thus be associated with high output and price levels. Positive coefficients tell us that the Fed "leans against the wind." That is, when output and/or the price level are high, the Fed sets a high interest rate to try to rein the economy in. Note that we are using the price level, *P*, as the variable in the rule. In practice, the Fed cares about inflation, which is the change in *P*, rather than the level of *P*, and we are approximating this by using just the level of *P*.

Z in the rule stands for all the factors that affect the Fed's interest rate decision except for *Y* and *P*. Since we have taken γ to be positive, the factors in *Z* are defined to be such that a high value of a factor makes the Fed inclined to have a high interest-rate value, other things being equal. Strong consumer confidence, for example, might be a *Z* factor, reinforcing the Fed's belief that the economy is doing well on the output side. In 2015, it is clear that concerns about the economy in Europe and China had an influence on Fed interest rate-setting behavior; this would be included as a *Z* factor.

We are now ready to add the Fed rule to our model. Figure 11.6 adds the Fed rule to the *IS* curve from Figure 11.4. The line depicting the Fed rule in the graph shows the relationship between the Fed's choice of the interest rate and aggregate output, holding the price level and the *Z* factors constant. The slope is positive because the coefficient α in the Fed rule is positive: When output is high, the interest rate that the Fed sets is high, other things being equal. The intersection of the *IS* curve and the Fed rule determines the equilibrium values of output and the interest rate. At this point there is equilibrium in the goods market *and* the value of the interest rate is what the Fed rule calls for.

Figure 11.6 shows the equilibrium values of output and the interest rate for given values of government spending (*G*), the price level (*P*), and all factors in *Z*. Suppose the government decides

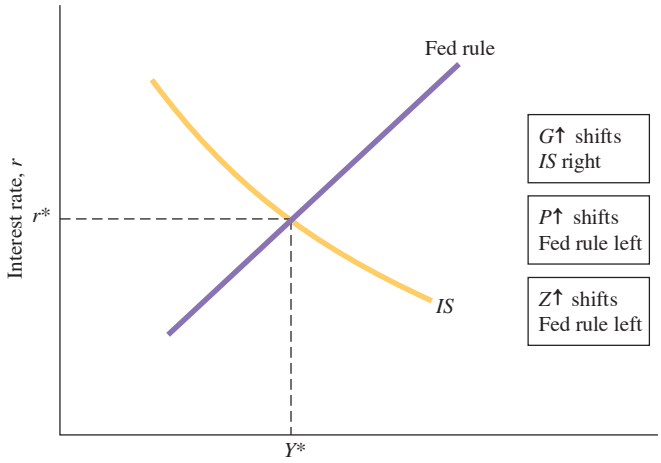

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FIGURE 11.6
Equilibrium Values of the Interest Rate and Output
In the Fed rule, the Fed raises the interest rate as output increases, other things being equal. Along the *IS* curve, output falls as the interest rate increases because planned investment depends negatively on the interest rate. The intersection of the two curves gives the equilibrium values of output and the interest rate for given values of government spending (G), the price level (P), and the factors in Z.

to increase its spending. How do the equilibrium values of the interest rate and output change? Remember that an increase in government spending shifts the *IS* curve to the right. Figure 11.6 shows the increase in the equilibrium values of both the interest rate and output. Now what happens if instead of a change in government spending, we have an increase in the price level, say from an economy-wide cost shock? Remember that the price level is in the Fed rule—the Fed cares about price stability. The Fed would thus respond to an increase in the price level by raising the interest rate. This means that in Figure 11.6 an increase in the price level shifts the Fed rule to the left—for a given value of output, the interest rate is higher for a higher value of the price level. Finally, if any of the "Z" factors we described increase, like an increase in consumer confidence, this leads the Fed to increase the interest rate, which also shifts the Fed rule to the left in Figure 11.6.

Deriving the *AD* Curve MyLab Economics Concept Check

We can now derive the *AD* curve. The *AD* curve (like the *AS* curve) is a relationship between the overall price level (P) and aggregate output (income) (Y). We know from Figure 11.6 that an increase in P shifts the Fed rule to the left (and has no effect on the *IS* curve). When the Fed rule shifts to the left along an unchanged *IS* curve, the new equilibrium is at a higher interest rate and a lower level of output. Be sure you understand why output is lower when P is higher. When P increases, the Fed, according to the rule, responds by raising the interest rate, other things being equal. The higher interest rate has a negative effect on planned investment and thus on *AE* and thus on Y. This is the relationship reflected in the *IS* curve. Conversely, a decrease in P shifts the Fed rule to the right, resulting in a new equilibrium with a lower interest rate and higher level of output. There is thus a negative relationship between P and Y in the goods market with the Fed rule, and this is the *AD* curve. The *AD* curve is presented in Figure 11.7.

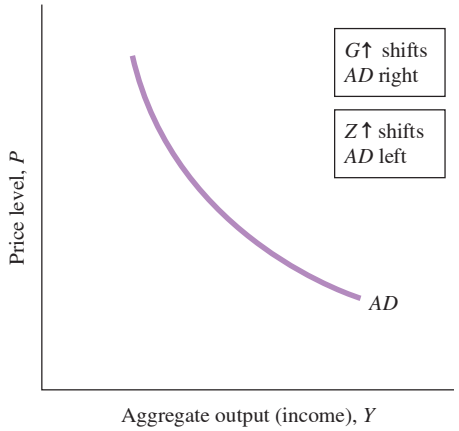

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FIGURE 11.7 The Aggregate Demand (*AD*) Curve
The *AD* curve is derived from Figure 11.6. Each point on the *AD* curve is an equilibrium point in Figure 11.6 for a given value of P. When P increases, the Fed raises the interest rate (the Fed rule in Figure 11.6 shifts to the left), which has a negative effect on planned investment and thus on Y. The *AD* curve reflects this negative relationship between P and Y.

ECONOMICS IN PRACTICE

Central Banks and Price Stability: Which Prices to Look At?

Many central banks share the key policy objective of keeping inflation low. For instance, price stability is a core part of the mandate of the Federal Reserve in the United States and the European Central Bank, of which the latter defines price stability as a "year-on-year increase in the Harmonized Index of Consumer Prices (HICP) for the euro area of below 2%."

While the overall objective of price stability is widely shared by central banks, they often differ in terms of the measures of inflation that they use to formulate their monetary policy objectives. While some central banks particularly target overall inflation, others prefer to focus on what is called core inflation. Core inflation excludes food and energy prices, which are more volatile than other items and may, therefore, mislead policy makers in seeing an inflationary trend where the increase in the price level may have resulted from exogenous shocks with only temporary effects on the economy. Some central banks formally follow an overall inflation target while closely monitoring core inflation. This is the case, for instance, of Chile's central bank, whose mission is to keep Consumer Price Index inflation at around 3 percent a year, but its annual reports contain extensive analyses of changes in the Consumer Price Index Excluding Food and Energy (CPIEFE).

Another problem frequently discussed by economists is whether to include import prices in the indicators used in monetary policy formulation. In particular, some economists argue that central banks should not use a price indicator that includes the prices of goods and services whose production is not affected by domestic monetary policy since imported goods are, by definition, produced abroad. As an alternative, these economists propose the use of production price indexes, such as the GDP deflator. However, this alternative is also problematic as it does not reflect the inflation perceived by consumers when they spend their income.

This problem is compounded by the variation of economic situations that countries find themselves in. In emerging market economies, for instance, inflation often reflects Rapid productivity growth in tradable goods industries. Not only is inflation not undesirable in this context, but also the price level indicators used by central banks in advanced industrial countries might not be appropriate for the measurement of inflation necessary to formulate an effective monetary policy. In monetary policy, as in all other areas of economic policy, as far as price indicators are concerned, no size fits all.

It is noted in Figure 11.7 that an increase in government spending (G) shifts the AD curve to the right. We can see this from Figure 11.6. When G increases, the IS curve shifts to the right since AE and thus Y are larger for a given value of the interest rate. (Remember that $AE = C + I + G$.) The new equilibrium for the G increase has a higher interest rate and a higher level of output. The higher level of output means that the AD curve shifts to the right when G increases.

It is also noted in Figure 11.7 that an increase in Z shifts the AD curve to the left. Remember that an increase in Z means that the Fed is raising the interest rate, other things being equal: The coefficient γ is positive. We can see why the AD curve shifts to the left when Z increases from Figure 11.6. When Z increases, the Fed rule shifts to the left in Figure 11.6, which results in a higher interest rate and a lower level of output. The lower level of output means that the AD curve shifts to the left when Z increases.

It is important to realize that the AD curve is *not* a market demand curve, and it is *not* the sum of all market demand curves in the economy. To understand why, recall the logic behind a simple downward-sloping household demand curve. A demand curve shows the quantity of output demanded (by an individual household or in a single market) at every possible price, *ceteris paribus*. In drawing a simple demand curve, we are assuming that *other prices* and *income* are fixed. From these assumptions, it follows that one reason the quantity demanded of a particular

good falls when its price rises is that other prices do *not* rise. The good in question therefore becomes more expensive relative to other goods, and households respond by substituting other goods for the good whose price increased. In addition, if income does not rise when the price of a good does, real income falls. This may also lead to a lower quantity demanded of the good whose price has risen.

Things are different when the *overall price level* rises. When the overall price level rises, many prices rise together. For this reason, we cannot use the *ceteris paribus* assumption to draw the *AD* curve. The logic that explains why a simple demand curve slopes downward fails to explain why the *AD* curve also has a negative slope. Aggregate demand falls when the price level increases because the higher price level leads the Fed to raise the interest rate, which decreases planned investment and thus aggregate output. *It is the higher interest rate that causes aggregate output to fall.*

The Final Equilibrium

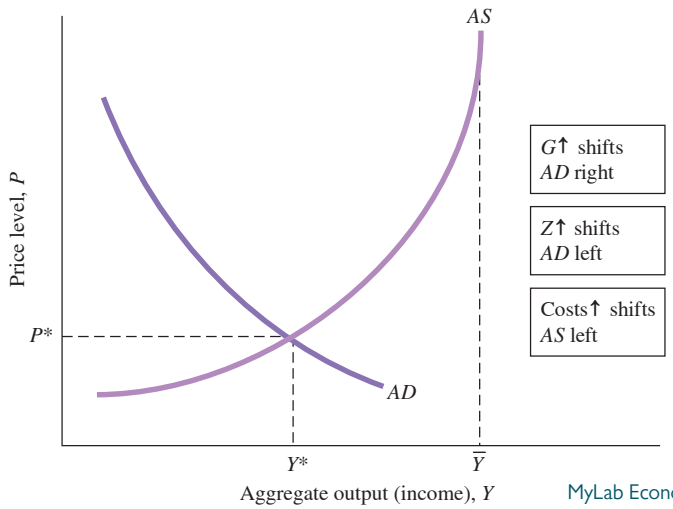
11.3 LEARNING OBJECTIVE

Explain why the intersection of the *AD* and *AS* curves is an equilibrium point.

Figure 11.8 combines the *AS* curve from Figure 11.1 and the *AD* curve from Figure 11.7. Consider for a moment what these two curves have embedded in them. Every point on the *AS* curve is one in which firms make output and price decisions to maximize their profits. Every point on the *AD* curve reflects equilibrium in the goods market with the Fed behaving according to the Fed rule. The intersection of these two curves is the final equilibrium. The equilibrium values of aggregate output *(Y)* and the price level *(P)* are determined. Behind the scenes, equilibrium values of the interest rate *(r)*, consumption *(C)*, and planned investment *(I)* are determined.

The variables that are exogenous to the *AS*/*AD* model (i.e., not explained by the model) are government spending *(G)*, the factors in *Z*, and exogenous costs, like oil prices, that shift the *AS* curve. Net taxes *(T)*, which have not been discussed in this chapter but are discussed in Chapter 9, are also exogenous. (Net taxes are part of the expanded model of the goods market in Chapter 9.) It is noted in Figure 11.8 that an increase in *G* shifts the *AD* curve to the right and that an increase in *Z* shifts the *AD* curve to the left. These shifts have already been discussed. The figure also notes that an increase in costs shifts the *AS* curve to the left. These costs are best thought of as costs like oil prices.

The rest of this chapter discusses the *AD* and *AS* curves in a little more detail, and then Chapter 12 uses the *AS*/*AD* framework to analyze monetary and fiscal policy effects and other macroeconomic issues. Chapter 12 shows the power of the *AS*/*AD* model as we use it to analyze a number of interesting and important questions in macroeconomics.



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▲ **FIGURE 11.8 Equilibrium Output and the Price Level**

Aggregate output and the aggregate price level are determined by the intersection of the *AS* and *AD* curves. These two curves embed within them decisions of households, firms, and the government.

11.4 LEARNING OBJECTIVE

Give two additional reasons why the *AD* curve may slope down.

Other Reasons for a Downward-Sloping *AD* Curve

The *AD* curve slopes down in the preceding analysis because the Fed raises the interest rate when *P* increases and because planned investment depends negatively on the interest rate. It is also the case in practice that consumption depends negatively on the interest rate, so planned investment depending on the interest rate is not the only link between the interest rate and planned aggregate expenditure. We noted briefly in Chapter 8 that consumption depends on the interest rate, and we will discuss this in more detail in Chapter 15. The main point here is that planned investment does not bear the full burden of linking changes in the interest rate to changes in planned aggregate expenditure and thus the downward-sloping *AD* curve.

There is also a real wealth effect on consumption that contributes to a downward-sloping *AD* curve. We noted in Chapter 8 and will discuss in detail in Chapter 15 that consumption depends on wealth. Other things being equal, the more wealth households have, the more they consume. Wealth includes holdings of money, shares of stock, bonds, and housing, among other things. If household wealth decreases, the result will be less consumption now and in the future. The price level has an effect on some kinds of wealth. Suppose you are holding $1,000 in a checking account or in a money market fund and the price level rises by 10 percent. Your holding is now worth 10 percent less because the prices of the goods that you could buy with your $1,000 have all increased by 10 percent. The purchasing power (or "real value") of your holding has decreased by 10 percent. An increase in the price level may also lower the real value of stocks and housing, although whether it does depends on what happens to stock prices and housing prices when the overall price level rises. If stock prices and housing prices rise by the same percentage as the overall price level, the real value of stocks and housing will remain unchanged. If an increase in the price level does lower the real value of wealth, this is another reason for the downward slope of the *AD* curve. If real wealth falls, this leads to a decrease in consumption, which leads to a decrease in planned aggregate expenditure. So if real wealth falls when there is an increase in the price level, there is a negative relationship between the price level and output through this **real wealth effect**.

real wealth effect The change in consumption brought about by a change in real wealth that results from a change in the price level.

11.5 LEARNING OBJECTIVE

Discuss the shape of the long-run aggregate supply curve and explain long-run market adjustment to potential GDP.

The Long Run *AS* Curve

We derived the short-run *AS* curve under the assumption that wages were sticky. This does not mean, however, that stickiness persists forever. Over time, wages adjust to higher prices. When workers negotiate with firms over their wages, they take into account what prices have been doing in the recent past. If wages fully adjust to prices in the long run, then the long-run *AS* curve will be vertical. We can see why in Figure 11.9. Initially, the economy is in equilibrium at a price level of P_0 and aggregate output of Y_0 (the point *A* at which AD_0 and AS_0 intersect). Now imagine a shift of the *AD* curve from AD_0 to AD_1. In response to this shift, both the price level and aggregate output rise in the short run, to P_1 and Y_1, respectively (the point *B* at which AD_1 and AS_0 intersect). The movement along the upward-sloping AS_0 curve as *Y* increases from Y_0 to Y_1 assumes that wages lag prices. At point *B* real wages (nominal wages divided by prices) are lower than they are at point *A*.

Now, as wages increase, the short-run *AS* curve shifts to the left. If wages fully adjust, the *AS* curve will over time have shifted from AS_0 to AS_1 in Figure 11.9, and output will be back to Y_0 (the point *C* at which AD_1 and AS_1 intersect). So when wages fully adjust to prices, the long-run *AS* curve is vertical. At point *C* real wages are back to where they were at point *A*. The price level is, of course, higher.

By looking at Figure 11.9, you can begin to see why arguments about the shape of the *AS* curve are so important in policy debates. If the long-run *AS* curve is vertical as we have drawn it, factors that shift the *AD* curve to the right—such as increasing government spending—simply end up increasing the price level. If the short-run *AS* curve also is quite steep, even in the short run most of the effect of any shift in the *AD* curve will be felt in an increase in the price level rather than an increase in aggregate output. If the *AS* curve, on the other hand, is flat, *AD* shifts can have a large effect on aggregate output, at least in the short run. We discuss these effects of policy in more detail in the next chapter.

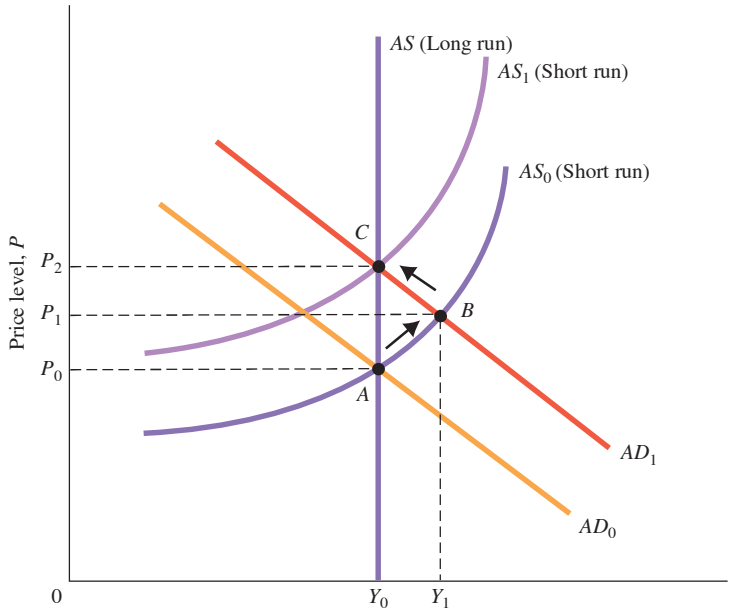

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FIGURE 11.9 The Long-Run Aggregate Supply Curve
When the *AD* curve shifts from AD_0 to AD_1, the equilibrium price level initially rises from P_0 to P_1 and output rises from Y_0 to Y_1. Wages respond in the longer run, shifting the *AS* curve from AS_0 to AS_1. If wages fully adjust, output will be back to Y_0. Y_0 is sometimes called *potential GDP*.

Potential GDP MyLab Economics Concept Check

Recall that even the short-run *AS* curve becomes vertical at some particular level of output. The vertical portion of the short-run *AS* curve exists because there are physical limits to the amount that an economy can produce in any given time period. At the physical limit, all plants are operating around the clock, many workers are on overtime, and there is no cyclical unemployment.

Note that the vertical portions of the short-run *AS* curves in Figure 11.9 are to the right of Y_0. If the vertical portions of the short-run *AS* curves represent "capacity," what is the nature of Y_0, the level of output corresponding to the long-run *AS* curve? Y_0 represents the level of aggregate output that can be *sustained* in the long run without inflation. It is sometimes called **potential output *or* potential GDP**. Output can be pushed above Y_0 under a variety of circumstances, but when it is, there is upward pressure on wages. (Remember that real wages are lower at point *B* than at point *A* in Figure 11.9.) As the economy approaches short-run capacity, wage rates tend to rise as firms try to attract more people into the labor force and to induce more workers to work overtime. Rising wages shift the short-run *AS* curve to the left (in Figure 11.9 from AS_0 to AS_1) and drive output back to Y_0.

potential output, *or* potential GDP The level of aggregate output that can be sustained in the long run without inflation.

Short-Run Equilibrium Below Potential Output Thus far, we have argued that if the short-run *AS* and *AD* curves intersect to the right of Y_0 in Figure 11.9, wages will rise, causing the short-run *AS* curve to shift to the left and pushing aggregate output back down to Y_0. Although different economists have different opinions on how to determine whether an economy is operating at or above potential output, there is general agreement that there is a maximum level of output (below the vertical portion of the short-run *AS* curve) that can be sustained without inflation.

What about short-run equilibria that occur to the *left* of Y_0? If the short-run *AS* and *AD* curves intersect at a level of output below potential output, what will happen? Here again economists disagree. Those who believe the *AS* curve is vertical in the long run believe that when short-run equilibria exist below Y_0, output will tend to rise—just as output tends to fall when short-run equilibria exist above Y_0. The argument is that when the economy is operating below full employment with excess capacity and high unemployment, wages are likely to *fall*. A decline in wages shifts the *AS* curve to the *right*, causing the price level to fall and the level of aggregate output to rise back to Y_0. This automatic adjustment works only if wages fall quickly when excess capacity and unemployment exist. We will discuss wage adjustment during periods of unemployment in detail in Chapter 13.

ECONOMICS IN PRACTICE

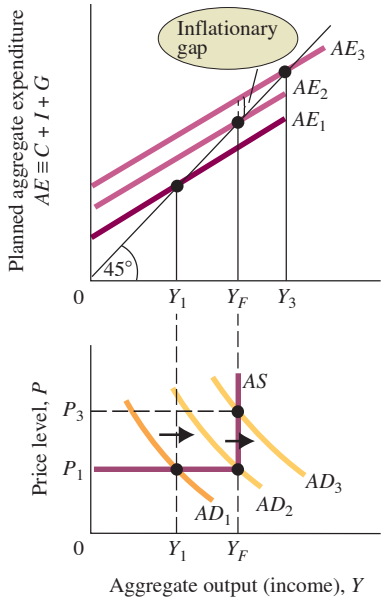
The Simple "Keynesian" Aggregate Supply Curve

There is a great deal of disagreement concerning the shape of the *AS* curve. One view of the aggregate supply curve, the simple "Keynesian" view, holds that at any given moment, the economy has a clearly defined capacity, or maximum, output. This maximum output, denoted by Y_F, is defined by the existing labor force, the current capital stock, and the existing state of technology. If planned aggregate expenditure increases when the economy is producing *below* this maximum capacity, this view holds, inventories will be lower than planned, and firms will increase output, but the price level will not change. Firms are operating with underutilized plants (excess capacity), and there is cyclical unemployment. Expansion does not exert any upward pressure on prices. However, if planned aggregate expenditure increases when the economy is producing near or at its maximum (Y_F), inventories will be lower than planned, but firms cannot increase their output. The result will be an increase in the price level, or inflation.

This view is illustrated in the figure. In the top half of the diagram, aggregate output (income) (Y) and planned aggregate expenditure ($C + I + G \equiv AE$) are initially in equilibrium at AE_1, Y_1, and price level P_1. Now suppose an increase in government spending increases planned aggregate expenditure. If such an increase shifts the *AE* curve from AE_1 to AE_2 and the corresponding aggregate demand curve from AD_1 to AD_2, the equilibrium level of output will rise from Y_1 to Y_F. (Remember, an expansionary policy shifts the *AD* curve to the right.) Because we were initially producing below capacity output (Y_1 is lower than Y_F), the price level will be unaffected, remaining at P_1.

Now consider what would happen if *AE* increased even further. Suppose planned aggregate expenditure shifted from AE_2 to AE_3, with a corresponding shift of AD_2 to AD_3. If the economy were producing below capacity output, the equilibrium level of output would rise to Y_3. However, the output of the economy cannot exceed the maximum output of Y_F. As inventories fall below what was planned, firms encounter a fully employed labor market and fully utilized plants. Therefore, they cannot increase their output. The result is that the aggregate supply curve becomes vertical at Y_F, and the price level is driven up to P_3.

The difference between planned aggregate expenditure and aggregate output at full capacity is sometimes referred to as an *inflationary gap*. You can see the inflationary gap in the top half of the figure. At Y_F (capacity output), planned aggregate expenditure (shown by AE_3) is greater than Y_F. The price level rises to P_3 until the aggregate quantity supplied and the aggregate quantity demanded are equal.



With planned aggregate expenditure of AE_1 and aggregate demand of AD_1, equilibrium output is Y_1. A shift of planned aggregate expenditure to AE_2, corresponding to a shift of the *AD* curve to AD_2, causes output to rise but the price level to remain at P_1. If planned aggregate expenditure and aggregate demand exceed Y_F, however, there is an inflationary gap and the price level rises to P_3.

Despite the fact that the kinked aggregate supply curve provides some insights, most economists find it unrealistic. It does not seem likely that the whole economy suddenly runs into a capacity "wall" at a specific level of output. As output expands, some firms and industries will hit capacity before others.

CRITICAL THINKING

1. Why is the distance between AE_3 and AE_2 called an *inflationary gap*?

SUMMARY

11.1 THE AGGREGATE SUPPLY (*AS*) CURVE *p. 244*

1. *Aggregate supply* is the total supply of goods and services in an economy. The *aggregate supply (AS) curve* shows the relationship between the aggregate quantity of output supplied by all the firms in the economy and the overall price level. The *AS* curve is *not* a market supply curve, and it is *not* the simple sum of individual supply curves. For this reason, it is helpful to think of the *AS* curve as a "price/output response" curve—that is, a curve that traces out the price and output decisions of all firms in the economy under a given set of circumstances.
2. The shape of the short-run *AS* curve is a source of much controversy in macroeconomics. Many economists believe that at low levels of aggregate output, the *AS* curve is fairly flat and that at high levels of aggregate output, the *AS* curve is vertical or nearly vertical.
3. Anything that affects an individual firm's marginal cost curve can shift the *AS* curve. The two main factors are wage rates and energy prices.

11.2 THE AGGREGATE DEMAND (*AD*) CURVE *p. 247*

4. The *IS* curve summarizes the relationship between the interest rate and equilibrium output in the goods market. Government spending *(G)* shifts the *IS* curve.
5. Fed behavior is described by an interest rate rule, the *Fed rule*. The Fed's choice of the interest rate value depends on the state of the economy, approximated in the rule by output *(Y)*, the price level *(P)*, and other factors *(Z)*. The Fed uses open market operations to achieve the interest rate value that it wants.
6. Each point on the *AD* curve is, for a given value of *P*, an equilibrium in the goods market with the Fed rule. Increases in *G* shift the *AD* curve to the right, and increases in *Z* shift the *AD* curve to the left.

11.3 THE FINAL EQUILIBRIUM *p. 253*

7. The final equilibrium is the point of intersection of the *AS* and *AD* curves. Determined at this point are equilibrium values of output, the price level, the interest rate, consumption, planned investment, the demand for money, and the supply of money. Exogenous variables (variables not explained by the model) are government spending, the factors in *Z*, net taxes (used in the next chapter), and cost shocks.

11.4 OTHER REASONS FOR A DOWNWARD-SLOPING *AD* CURVE *p. 254*

8. Consumption as well as planned investment depends on the interest rate. This is another reason for a downward-sloping *AD* curve. Another reason is that consumption also depends on real wealth.

11.5 THE LONG-RUN *AS* CURVE *p. 254*

9. The long-run *AS* curve is vertical if wages adjust completely to prices in the long run.

REVIEW TERMS AND CONCEPTS

aggregate supply, *p. 244*
aggregate supply (*AS*) curve, *p. 244*
cost shock, or supply shock, *p. 246*
Fed rule, *p. 249*
IS curve, *p. 248*
potential output, or potential GDP, *p. 255*
real wealth effect, *p. 254*
Equations:
$AE \equiv C + I + G$, *p. 247*
$r = \alpha Y + \beta P + \gamma Z$, *p. 249*

PROBLEMS

All problems are available on MyLab Economics.

11.1 THE AGGREGATE SUPPLY (*AS*) CURVE

LEARNING OBJECTIVE: Define the aggregate supply curve and discuss shifts in the short-run *AS* curve.

1.1 Illustrate each of the following situations with a graph showing short-run aggregate supply:
- **a.** A decrease in the size of the labor force
- **b.** An increase in available capital
- **c.** An increase in productivity as a result of a technological change
- **d.** A decrease in the price of oil

11.2 THE AGGREGATE DEMAND (*AD*) CURVE

LEARNING OBJECTIVE: Derive the aggregate demand curve and explain why the *AD* curve is downward sloping.

2.1 In March 2009, the Official Bank Rate (interest rate) in the United Kingdom was reduced to 0.5 percent, where it stayed for a few years. In August 2016, it was reduced to 0.25 percent. By November 2017, however, the interest rate had started to increase and by August 2018 it was as high as 0.75 percent. What effect did the bank hope the