CHAPTER THIRTEEN

Aggregate Demand and Aggregate Supply

In this chapter you will learn:

- About aggregate demand (AD) and the factors that cause it to change.
- About aggregate supply (AS) and the factors that cause it to change.
- How AD and AS determine an economy's equilibrium price level and level of real GDP.
- How the AD-AS model explains periods of demand-pull inflation, cost-push inflation, and recession.

In early 2000, Alan Greenspan, chair of the Federal Reserve, made the following statement:

> Through the so-called wealth effect, the [recent stock market gains] have tended to foster increases in aggregate demand beyond the increases in supply. It is this imbalance . . . that contains the potential seeds of rising inflationary . . . pressures that could undermine the current expansion. Our goal [at the Federal Reserve] is to extend the expansion by containing its imbalances and avoiding the very recession that would complete the business cycle.[1]

Although the Federal Reserve held inflation in check, it did not accomplish its goal of extending the decade-long economic expansion. In March 2001 the U.S. economy experienced its ninth recession since 1950. The economy has since recovered and returned to the expansion phase of the business cycle.

We will say more about the recession and expansion soon, but our immediate focus is the terminology in the Greenspan quotation. This is precisely the language of the **aggregate demand–aggregate supply model (AD-AS model).** The AD-AS model—the subject of this chapter—enables us to analyze changes in real GDP and the price level simultaneously. The AD-AS model therefore provides keen insights on inflation, recession, unemployment, and economic growth. In later chapters, we will also use it to show the logic of macroeconomic stabilization policies, such as those implied by Greenspan.

[1] Alan Greenspan, speech to the New York Economics Club, Jan. 13, 2000.

Aggregate Demand

aggregate demand–aggregate supply (AD-AS) model
The macroeconomic model that uses aggregate demand and aggregate supply to determine and explain the price level and level of real domestic output.

Aggregate demand is a schedule or curve that shows the quantities of real domestic output (real GDP) that buyers collectively want to purchase at each possible price level. The relationship between the price level (as measured by the GDP price index) and the amount of real output demanded is inverse or negative: When the price level rises, the quantity of real GDP demanded falls; when the price level falls, the quantity of real GDP demanded rises.

Figure 13.1 shows the inverse relationship between the price level and real GDP. The downward slope of the AD curve reflects the fact that higher U.S. price levels discourage domestic buyers (households and businesses) and foreign buyers from purchasing U.S. real GDP. Lower price levels encourage them to buy more U.S. real output.

aggregate demand
A schedule or curve that shows the total quantity of goods and services demanded (purchased) at different price levels.

Changes in Aggregate Demand

Other things equal, a change in the price level will change the amount of total spending and therefore change the amount of real GDP demanded by the economy. Movements along a fixed aggregate demand curve represent these changes in real GDP. However, if one or more of those "other things" change, the entire aggregate demand curve will shift. We call these other things **determinants of aggregate demand.** When they change, they shift the AD curve. These AD shifters are listed in the table in Figure 13.2. In that figure, the rightward shift of the curve from AD_1 to AD_2 shows an increase in aggregate demand. The leftward shift from AD_1 to AD_3 shows a decrease in aggregate demand. Notice that the categories of spending are the same as those in the national income and product accounts (Chapter 12). To provide a clear understanding of these AD shifters, we need to elaborate on them.

determinants of aggregate demand
Factors that shift the aggregate demand curve when they change.

Consumer Spending

If consumers decide to buy more output at each price level, the aggregate demand curve will shift to the right, as from AD_1 to AD_2 in Figure 13.2. If they decide to buy less output, the aggregate demand curve will shift to the left, as from AD_1 to AD_3.

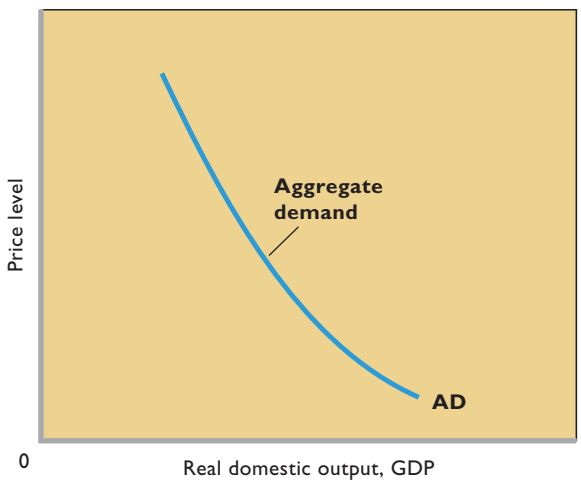
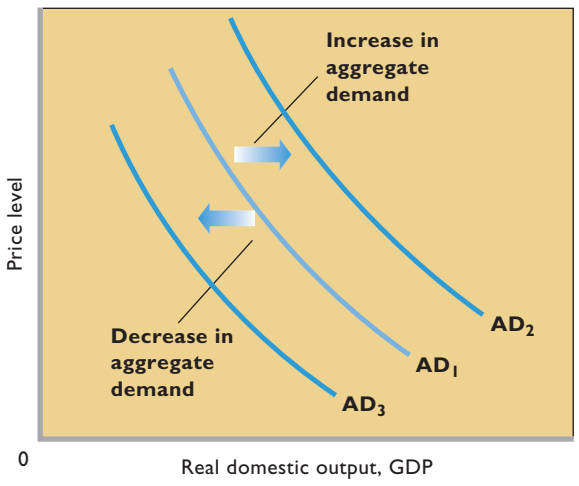


FIGURE 13.1
The aggregate demand curve. The downsloping aggregate demand curve AD indicates an inverse (or negative) relationship between the price level and the amount of real output purchased.

FIGURE 13.2
Changes in aggregate demand. A change in one or more of the listed determinants of aggregate demand will shift the aggregate demand curve. The rightward shift from AD_1 to AD_2 represents an increase in aggregate demand; the leftward shift from AD_1 to AD_3 shows a decrease in aggregate demand.



Determinants of Aggregate Demand: Factors That Shift the Aggregate Demand Curve

1. Change in consumer spending
   a. Consumer wealth
   b. Consumer expectations
   c. Household indebtedness
   d. Personal taxes
2. Change in investment spending
   a. Interest rates
   b. Expected returns
      - Expected future business conditions
      - Technology
      - Degree of excess capacity
      - Business taxes
3. Change in government spending
4. Change in net export spending
   a. National income abroad
   b. Exchange rates

Several factors can change consumer spending and therefore shift the aggregate demand curve. As the table in Figure 13.2 shows, those factors are real consumer wealth, consumer expectations, household indebtedness, and personal taxes.

Consumer Wealth Consumer wealth includes both financial assets such as stocks and bonds and physical assets such as houses and land. A sharp increase in the real value of consumer wealth (for example, because of a rise in stock market values) prompts people to save less and buy more products. The resulting increase in consumer spending—called the *wealth effect*—will shift the aggregate demand curve to the right. In contrast, a major decrease in the real value of consumer wealth at each price level will reduce consumption spending *(negative wealth effect)* and thus shift the aggregate demand curve to the left.

Consumer Expectations Changes in expectations about the future may alter consumer spending. When people expect their future real incomes to rise, they tend to spend more of their current incomes. Thus current consumption spending increases (current saving falls), and the aggregate demand curve shifts to the right. Similarly, a widely held expectation of surging inflation in the near future may increase aggregate demand today because consumers will want to buy products before their prices escalate. Conversely, expectations of lower future income or lower future prices may reduce current consumption and shift the aggregate demand curve to the left.

Household Indebtedness Households finance some of their spending by borrowing. If household indebtedness from past spending rises beyond normal levels,

consumers may be forced to cut current spending in order to pay the interest and principal on their debt. Consumption spending will then decline, and the aggregate demand curve will shift to the left. Alternatively, when household indebtedness is unusually low, consumers have considerable leeway to borrow and spend today. Then the aggregate demand curve may shift to the right.

Personal Taxes A reduction in personal income tax rates raises take-home income and increases consumer purchases at each possible price level. Tax cuts shift the aggregate demand curve to the right. Tax increases reduce consumption spending and shift the curve to the left.

Applying the Analysis

What Wealth Effect?

The consumption component of aggregate demand is usually relatively stable even during rather extraordinary times. Between March 2000 and July 2002, the U.S. stock market lost a staggering $3.7 trillion of value (yes, trillion). Yet consumption spending was greater at the end of that period than at the beginning. How can that be? Why didn't a negative wealth effect reduce consumption?

There are a number of reasons. Of greatest importance, the amount of consumption spending in the economy depends mainly on the *flow* of income, not the *stock* of wealth. Disposable income (after-tax income) in the United States is nearly $9 trillion annually, and consumers spend a large portion of it. Even though there was a mild recession in 2001, disposable income and consumption spending were both greater in July 2002 than in March 2000. Second, the Federal government cut personal income tax rates during this period, and that bolstered consumption spending. Third, household wealth did not fall by the full amount of the $3.7 trillion stock market loss because the value of houses increased dramatically over this period. Finally, lower interest rates during this period enabled many households to refinance their mortgages, reduce monthly loan payments, and increase their current consumption.

For all these offsetting reasons, the consumption component of aggregate demand held up in the face of the extraordinary loss of stock market value.

Question:
Which do you think will increase consumption more: a 10 percent increase in after-tax income or a 10 percent increase in stock market values? Explain.

Investment Spending

Investment spending (the purchase of capital goods) is a second major determinant of aggregate demand. Increases in investment spending at each price level boost aggregate demand, and decreases in investment spending reduce it.

The investment decision is a marginal-benefit–marginal-cost decision. The marginal benefit of the investment is a stream of higher profits that is expected to result from the investment. In percentage terms, economists call these higher profits (net of new operation expenses) the *expected return on the investment*, *r*. For example, suppose the owner of a small cabinetmaking shop is considering whether to invest in a new sanding machine that costs $1000, expands output, and has a useful life of only 1 year.

(Extending the life of the machine beyond 1 year complicates the economic calculation but does not change the fundamental analysis.) Suppose the net expected revenue from the machine (that is, after such operating costs as power, lumber, labor, and certain taxes have been subtracted) is $1100. Then the expected net revenue is sufficient to cover the initial $1000 cost of the machine and leave a profit of $100. Comparing this $100 to the $1000 initial cost of the machine, we find that the expected rate of return, r, on the investment is 10 percent (=$100/$1000).

It is important to note that the return just discussed is an *expected* rate of return, not a *guaranteed* rate of return. Investment involves risk, so the investment may or may not pay off as anticipated. Moreover, investment faces diminishing returns. As more of it occurs, the best investment projects are completed and the subsequent projects produce lower expected rates of return. So, the expected return, r, tends to fall as firms undertake more and more investment.

The marginal cost of the investment to a firm is reflected in either the explicit costs of borrowing money from others or the implicit cost of using its own retained earnings to make the investment. In percentage terms, and adjusted for expected inflation, this cost is the real interest rate, i.

The business firm compares the real interest rate (marginal cost) with the expected return on investment (marginal benefit). If the expected rate of return (for example, 6 percent) exceeds the interest rate (say, 5 percent), the investment is undertaken. The firm expects the investment to be profitable. But if the interest rate (for example, 7 percent) exceeds the expected rate of return (6 percent), the investment will not be undertaken. The firm expects the investment to be unprofitable. The profit-maximizing firm will undertake all investment that it thinks will be profitable. That means it will invest up to the point where $r = i$ in order to exhaust all investment possibilities for which r exceeds i.

13.1 Interest-rate–investment relationship

So real interest rates and expected returns are the two main determinants of investment spending.

Real Interest Rates We will discover that a nation's central bank—the Federal Reserve in the United States—can take monetary actions to increase and decrease interest rates. When it takes those actions, it shifts the nation's aggregate demand curve. Other things equal, increases in real interest rates will lower investment spending and reduce aggregate demand. Declines in interest rates will have the opposite effects.

Expected Returns Higher expected returns on investment projects will increase the demand for capital goods and shift the aggregate demand curve to the right. Alternatively, declines in expected returns will decrease investment and shift the curve to the left. Expected returns are influenced by several factors:

- ***Future business conditions*** If firms are generally optimistic about future business conditions, they are more likely to forecast high rates of return on current investment and therefore may invest more today. In contrast, if they think the economy will deteriorate in the future, they will forecast low rates of return and perhaps will invest less today.
- ***Technology*** New and improved technologies enhance expected returns on investment and thus increase aggregate demand. For example, recent advances in microbiology have motivated pharmaceutical companies to establish new labs and production facilities.

- ***Degree of excess capacity*** A rise in excess capacity—unused capital—will reduce the expected return on new investment and hence decrease aggregate demand. Other things equal, firms operating factories at well below capacity have little incentive to build new factories. But when firms realize that their excess capacity is dwindling or has completely disappeared, their expected returns on new investment in factories and capital equipment rise. Thus, they increase their investment spending, and the aggregate demand curve shifts to the right.
- ***Business taxes*** An increase in business taxes will reduce after-tax profits from capital investment and lower expected returns. So investment and aggregate demand will decline. A decrease in business taxes will have the opposite effects.

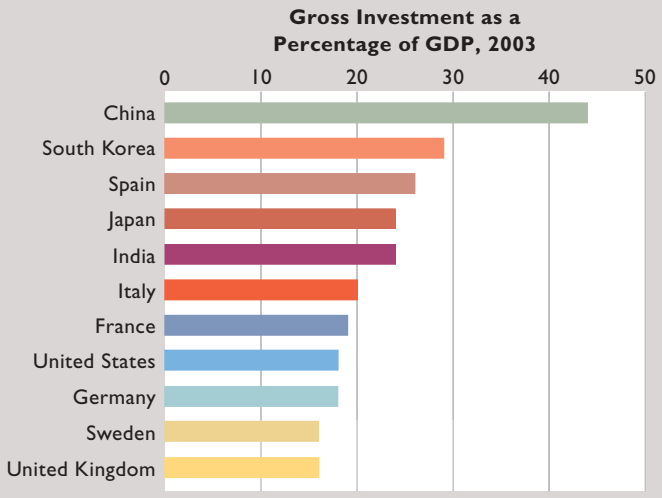
The variability of interest rates and investment expectations makes investment quite volatile. In contrast to consumption, investment spending rises and falls quite often, independent of changes in total income. Investment, in fact, is the least stable component of aggregate demand.

Global Snapshot 13.1 compares investment spending relative to GDP for several nations in a recent year.

Global Snapshot 13.1

Gross Investment Expenditures as a Percentage of GDP, Selected Nations

As a percentage of GDP, investment varies widely by nation. These differences, of course, can change from year to year.



Source: World Bank, www.worldbank.org.

Government Spending

Government purchases are the third determinant of aggregate demand. An increase in government purchases (for example, more military equipment) will shift the aggregate demand curve to the right, as long as tax collections and interest rates do not change as a result. In contrast, a reduction in government spending (for example, fewer transportation projects) will shift the curve to the left.

Net Export Spending

The final determinant of aggregate demand is net export spending. Other things equal, higher U.S. *exports* mean an increased foreign demand for U.S. goods. So a rise in net exports (higher exports relative to imports) shifts the aggregate demand curve to the right. In contrast, a decrease in U.S. net exports shifts the aggregate demand curve leftward.

What might cause net exports to change, other than the price level? Two possibilities are changes in national income abroad and changes in exchange rates.

National Income Abroad Rising national income abroad encourages foreigners to buy more products, some of which are made in the United States. So U.S. net exports rise, and the U.S. aggregate demand curve shifts to the right. Declines in national income abroad do the opposite: They reduce U.S. net exports and shift the U.S. aggregate demand curve to the left.

exchange rates
The prices of foreign currencies in terms of one's own currency.

Exchange Rates Changes in **exchange rates**—the prices of foreign currencies in terms of one's own currency—may affect U.S. net exports and therefore aggregate demand. When the dollar *depreciates* (declines in value) against foreign currencies, it takes more dollars to buy foreign goods. So foreign goods become more expensive in dollars terms, and Americans reduce their imports. On the opposite side, the depreciation of the dollar means that other currencies *appreciate* (rise in value) relative to the dollar. U.S. exports rise because those foreign currencies can buy more American goods. Conclusion: Dollar depreciation increases net exports (imports go down; exports go up) and therefore increases aggregate demand.

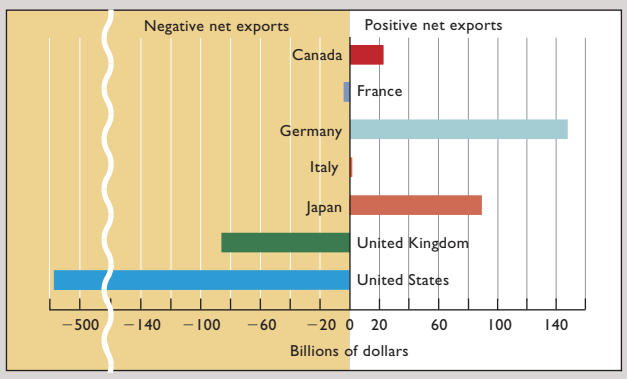
Dollar appreciation has the opposite effects: Net exports fall (imports go up; exports go down) and aggregate demand declines.

As shown in Global Snapshot 13.2, net exports vary greatly among the major industrial nations.

Global Snapshot 13.2

Net Exports of Goods, Selected Nations, 2003

Some nations, such as Germany and Japan, have positive net exports; other countries, such as the United States and the United Kingdom, have negative net exports.



Source: World Trade Organization, www.wto.org.

Aggregate Supply

Aggregate supply is a schedule or curve showing the level of real domestic output that firms will produce at each price level. The production responses of firms to changes in the price level differ in the *long run*, which in macroeconomics is a period in which nominal wages (and other resource prices) match changes in the price level, and the *short run*, a period in which nominal wages (and other resource prices) do not respond to price-level changes. So the long and short runs vary by degree of wage adjustment, not by a set length of time such as 1 month, 1 year, or 3 years.

aggregate supply
A schedule or curve that shows the total quantity of goods and services supplied (produced) at different price levels.

Aggregate Supply in the Long Run

In the long run, the aggregate supply curve is vertical at the economy's full-employment output (or its potential output), as represented by AS_{LR} in Figure 13.3. When changes in wages respond completely to changes in the price level, those price-level changes do not alter the amount of real GDP produced and offered for sale.

Consider a one-firm economy in which the firm's owners must receive a real profit of $20 in order to produce the full-employment output of 100 units. The real reward the owner receives, not the level of prices, is what really counts. Assume the owner's only input (aside from entrepreneurial talent) is 10 units of hired labor at $8 per worker, for a total wage cost of $80. Also assume that the 100 units of output sell for $1 per unit, so total revenue is $100. The firm's nominal profit is $20 (=$100 − $80), and using the $1 price to designate the base-price index of 100, its real profit is also $20 (=$20/1.00). Well and good—the full-employment output is produced.

Next, suppose the price level doubles. Would the owner earn more than the $20 of real profit and therefore boost production beyond the 100-unit full-employment output? The answer is no, given the assumption that nominal wages and the price level rise by the same amount, as is true in the long run. Once the product price has doubled to $2, total revenue will be $200 (=100 × $2). But the cost of 10 units of labor will double from $80 to $160 because the wage rate rises from $8 to $16. Nominal profit thus increases to $40 (=$200 − $160). What about real profit? By

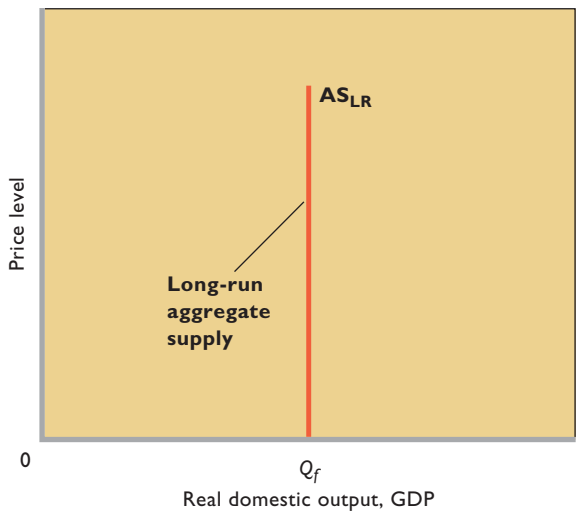


FIGURE 13.3
Aggregate supply in the long run. The long-run aggregate supply curve AS_{LR} is vertical at the full-employment level of real GDP (Q_f) because in the long run wages and other input prices rise and fall to match changes in the price level. So price-level changes do not affect firms' profits, and thus they create no incentive for firms to alter their output.

dividing the nominal profit of $40 by the new price index of 200 (expressed as a decimal), we obtain real profit of $20 (=$40/2.00). Because real profit does not change, the firm will not alter its production. Real GDP will remain at its full-employment level.

In the long run, wages and other input prices rise or fall to match changes in the price level. Changes in the price level therefore do not change real profit, and there is no change in real output. As shown in Figure 13.3, the **long-run aggregate supply curve** is vertical at the economy's potential output (or full-employment output). We will say more about long-run aggregate supply in Chapter 17 on economic growth.

long-run aggregate supply curve
The aggregate supply curve associated with a period of time in which wages and other input prices fully respond to changes in the price level.

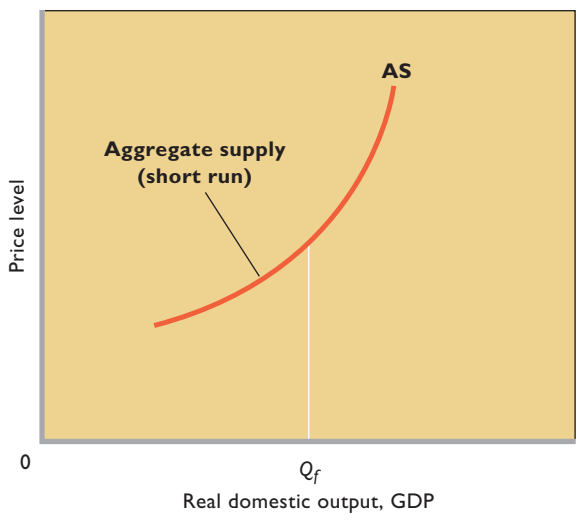
Aggregate Supply in the Short Run

In reality, nominal wages adjust only slowly to changes in the price level, and perfect adjustment may take several months or even a number of years. Reconsider our previous one-firm economy. If the $8 nominal wage for each of the 10 workers is unresponsive to the price-level change, the doubling of the price level will boost total revenue from $100 to $200 but leave total cost unchanged at $80. Nominal profit will rise from $20 (=$100 − $80) to $120 (=$200 − $80). Dividing that $120 profit by the new price index of 200 (=2.0 in hundredths), we find that the real profit is now $60. The rise in the real reward from $20 to $60 prompts firms to produce more output. Conversely, price-level declines reduce real profits and cause firms collectively to reduce their output. So, in the short run, there is a direct or positive relationship between the price level and real output.

short-run aggregate supply curve
An aggregate supply curve relevant to a time period in which wages and other input prices do not change in response to changes in the price level.

The **short-run aggregate supply curve** is upsloping, as shown in Figure 13.4. A rise in the price level increases real output; a fall in the price level reduces it. Per-unit production costs underlie the aggregate supply curve. In equation form,

FIGURE 13.4
The aggregate supply curve (short run). The upsloping aggregate supply curve AS indicates a direct (or positive) relationship between the price level and the amount of real output that firms will offer for sale. The AS curve is relatively flat below the full-employment output because unemployed resources and unused capacity allow firms to respond to price-level rises with large increases in real output. It is relatively steep beyond the full-employment output because resource shortages and capacity limitations make it difficult to expand real output as the price level rises.



$$\text{Per-unit production cost} = \frac{\text{total input cost}}{\text{units of output}}$$

The per-unit production cost of any specific level of output establishes that output's price level because the price level must cover all the costs of production, including profit "costs."

As the economy expands in the short run, per-unit production costs generally rise because of reduced efficiency and rising input prices. But the extent of that rise depends on where the economy is operating relative to its capacity. The aggregate supply curve in Figure 13.4 is relatively flat at outputs below the full-employment output Q_f and relatively steep at outputs above it. Why the difference?

When the economy is operating below its full-employment output, it has large amounts of unused machinery and equipment and unemployed workers. Firms can put these idle human and property resources back to work with little upward pressure on per-unit production costs. Workers unemployed for 2 or 3 months will hardly expect a wage increase when recalled to their jobs. And as output expands, few if any shortages of inputs or production bottlenecks will arise to raise per-unit production costs.

When the economy is operating beyond its full-employment output, the vast majority of its available resources are already employed. Adding more workers to a relatively fixed number of highly used capital resources such as plant and equipment creates congestion in the workplace and reduces the efficiency (on average) of workers. Adding more capital, given the limited number of available workers, leaves equipment idle and reduces the efficiency of capital. Adding more land resources when capital and labor are highly constrained reduces the efficiency of land resources. Under these circumstances, total output rises less rapidly than total input cost. So per-unit production costs increase.

Moreover, individual firms may try to expand their own production by bidding resources away from other firms. But the resources and additional production that one firm gains will be largely lost by the other firms. The bidding will raise input prices, but real output will rise very little, if at all. That is a prescription for higher per-unit production costs.

Unless stated otherwise, all our references to "aggregate supply" will be to aggregate supply in the short run. When we bring long-run aggregate supply into the picture, we will add the adjective "long-run."

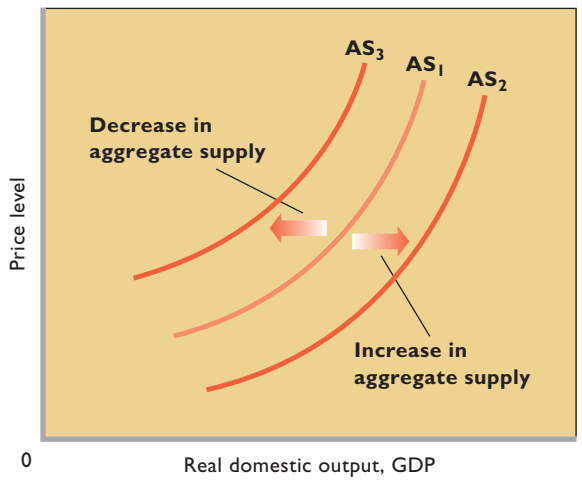
Changes in Aggregate Supply

An existing aggregate supply curve identifies the relationship between the price level and real output, other things equal. But when other things change, the curve itself shifts. The rightward shift of the curve from AS_1 to AS_2 in Figure 13.5 represents an increase in aggregate supply, indicating that firms are willing to produce and sell more real output at each price level. A decrease in aggregate supply is shown by the leftward shift of the curve from AS_1 to AS_3. At each price level, firms produce less output than before.

The table in Figure 13.5 lists the factors that collectively position the aggregate supply curve. They are called the **determinants of aggregate supply,** and shift the curve when they change. Changes in these determinants raise or lower per-unit production costs *at each price level (or each level of output)*. These changes in per-unit

determinants of aggregate supply
Factors that shift the aggregate supply curve when they change.

FIGURE 13.5
Changes in aggregate supply. A change in one or more of the listed determinants of aggregate supply will shift the aggregate supply curve. The rightward shift of the aggregate supply curve from AS_1 to AS_2 represents an increase in aggregate supply; the leftward shift of the curve from AS_1 to AS_3 shows a decrease in aggregate supply.



Determinants of Aggregate Supply: Factors That Shift the Aggregate Supply Curve

1. Change in input prices
   a. Domestic resource prices
   b. Prices of imported resources
   c. Market power
2. Change in productivity
3. Change in legal-institutional environment
   a. Business taxes
   b. Government regulations

production costs affect profits, thereby leading firms to alter the amount of output they are willing to produce *at each price level*. For example, firms may collectively offer $7 trillion of real output at a price level of 1.0 (=100 in index-value terms), rather than $6.8 trillion. Or they may offer $6.5 trillion rather than $7 trillion. The point is that when one of the determinants listed in Figure 13.5 changes, the aggregate supply curve shifts to the right or left. Changes that reduce per-unit production costs shift the aggregate supply curve to the right, as from AS_1 to AS_2; changes that increase per-unit production costs shift it to the left, as from AS_1 to AS_3. *When per-unit production costs change for reasons other than changes in real output, the aggregate supply curve shifts.*

The aggregate supply determinants listed in Figure 13.5 are very important and therefore require more discussion.

Input Prices

Input or resource prices—to be distinguished from the output prices that make up the price level—are a major ingredient of per-unit production costs and therefore a key determinant of aggregate supply. These resources can either be domestic or imported.

Domestic Resource Prices Wages and salaries make up about 75 percent of all business costs. Other things equal, decreases in wages reduce per-unit production costs. So the aggregate supply curve shifts to the right. Increases in wages shift the curve to the left. Examples:

- Labor supply increases because of substantial immigration. Wages and per-unit production costs fall, shifting the AS curve to the right.

- Labor supply decreases because of a rapid rise in pension income and early retirements. Wage rates and per-unit production costs rise, shifting the AS curve to the left.

Similarly, the aggregate supply curve shifts when the prices of land and capital inputs change. Examples:

- The price of machinery and equipment falls because of declines in the prices of steel and electronic components. Per-unit production costs decline, and the AS curve shifts to the right.
- Land resources expand through discoveries of mineral deposits, irrigation of land, or technical innovations that transform "nonresources" (say, vast desert lands) into valuable resources (productive lands). The price of land declines, per-unit production costs fall, and the AS curve shifts to the right.

Prices of Imported Resources Just as foreign demand for U.S. goods contributes to U.S. aggregate demand, resources imported from abroad (such as oil, tin, and copper) add to U.S. aggregate supply. Added supplies of resources—whether domestic or imported—typically reduce per-unit production costs. A decrease in the price of imported resources increases U.S. aggregate supply, while an increase in their price reduces U.S. aggregate supply.

Exchange-rate fluctuations are one factor that may alter the price of imported resources. Suppose that the dollar appreciates, enabling U.S. firms to obtain more foreign currency with each dollar. This means that domestic producers face a lower *dollar* price of imported resources. U.S. firms will respond by increasing their imports of foreign resources, thereby lowering their per-unit production costs at each level of output. Falling per-unit production costs will shift the U.S. aggregate supply curve to the right.

A depreciation of the dollar will have the opposite set of effects.

Market Power A change in the degree of market power—the ability to set prices above competitive levels—held by sellers of major inputs also can affect input prices and aggregate supply. An example is the fluctuating market power held by the Organization of Petroleum Exporting Countries (OPEC) over the past several decades. The 10-fold increase in the price of oil that OPEC achieved during the 1970s drove up per-unit production costs and jolted the U.S. aggregate supply curve leftward. Then a steep reduction in OPEC's market power during the mid-1980s resulted in a sharp decline in oil prices and a rightward shift of the U.S. aggregate supply curve. In 1999 OPEC temporarily reasserted its market power, raising oil prices and therefore per-unit production costs for some U.S. producers (for example, airlines and truckers).

Productivity

The second major determinant of aggregate supply is **productivity,** which is a measure of the relationship between a nation's level of real output and the amount of resources used to produce that output. Thus productivity is a measure of average real output, or of real output per unit of input:

productivity
A measure of real output per unit of input.

$$\text{Productivity} = \frac{\text{total output}}{\text{total inputs}}$$

With no change in resource prices, increases in productivity reduce the per-unit production cost of output. Recall that this cost is determined by dividing the total cost of production by the dollar amount of output. For example, if the total cost of production is $20 billion and total output is $40 billion, per-unit production cost is $.50. If productivity rises such that output increases from $40 billion to $60 billion, the per-unit production cost will fall from $.50 (=$20/$40) to $.33 (=$20/$60).

The generalization is this: By reducing per-unit production costs, increases in productivity shift the aggregate supply curve to the right. The main source of productivity advance is improved production technology, often embodied within new plant and equipment that replaces old plant and equipment. Other sources of productivity increases are a better-educated and -trained workforce, improved forms of business enterprises, and the reallocation of labor resources from lower- to higher-productivity uses.

Much rarer, decreases in productivity increase per-unit production costs and therefore reduce aggregate supply (shift the AS curve to the left.)

Legal-Institutional Environment

Changes in the legal-institutional setting in which businesses operate are the final determinant of aggregate supply. Such changes may alter the per-unit costs of output and, if so, shift the aggregate supply curve. Two changes of this type are (1) changes in business taxes and (2) changes in the extent of regulation.

Business Taxes Higher business taxes, such as sales, excise, and payroll taxes, increase per-unit costs and reduce short-run aggregate supply in much the same way as a wage increase does. An increase in such taxes paid by businesses will increase per-unit production costs and shift aggregate supply to the left.

Government Regulation It is usually costly for businesses to comply with government regulations. More regulation therefore tends to increase per-unit production costs and shift the aggregate supply curve to the left. "Supply-side" proponents of deregulation of the economy have argued forcefully that, by increasing efficiency and reducing the paperwork associated with complex regulations, deregulation will reduce per-unit costs and shift the aggregate supply curve to the right. Other economists are less certain. Deregulation that results in accounting manipulations, monopolization, and business failures is likely to shift the AS curve to the left rather than to the right.

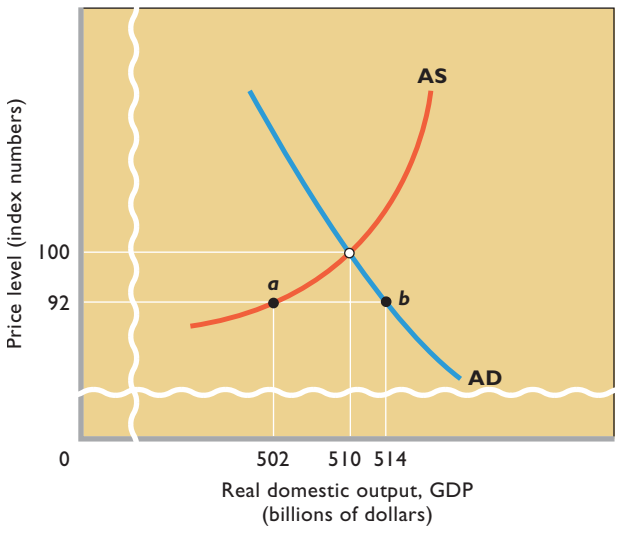
equilibrium price level
The price level at which the aggregate demand curve and the aggregate supply curve intersect.

equilibrium real output
The level of real GDP at which the aggregate demand curve and aggregate supply curve intersect.

Equilibrium Price Level and Real GDP

Of all the possible combinations of price levels and levels of real GDP, which combination will the economy gravitate toward, at least in the short run? Figure 13.6 and its accompanying table provide the answer. Equilibrium occurs at the price level that equalizes the amounts of real output demanded and supplied. The intersection of the aggregate demand curve AD and the aggregate supply curve AS establishes the economy's **equilibrium price level** and **equilibrium real output.** So aggregate demand and aggregate supply jointly establishes the price level and level of real GDP.

FIGURE 13.6
The equilibrium price level and equilibrium real GDP. The intersection of the aggregate demand curve and the aggregate supply curve determines the economy's equilibrium price level. At the equilibrium price level of 100 (in index-value terms) the $510 billion of real output demanded matches the $510 billion of real output supplied. So equilibrium real GDP is $510 billion.



Real Output Demanded (Billions)	Price Level (Index Number)	Real Output Supplied (Billions)
$506	108	$513
508	104	512
510	***100***	***510***
512	96	507
514	92	502

In Figure 13.6 the equilibrium price level and level of real output are 100 and $510 billion, respectively. To illustrate why, suppose the price level is 92 rather than 100. We see from the table that the lower price level will encourage businesses to produce real output of $502 billion. This is shown by point *a* on the AS curve in the graph. But, as revealed by the table and point *b* on the aggregate demand curve, buyers will want to purchase $514 billion of real output at price level 92. Competition among buyers to purchase the lesser available real output of $502 billion will eliminate the $12 billion (=$514 billion − $502 billion) shortage and pull up the price level to 100.

As the table and graph show, the rise in the price level from 92 to 100 encourages producers to increase their real output from $502 billion to $510 billion and causes buyers to scale back their purchases from $514 billion to $510 billion. When equality occurs between the amounts of real output produced and purchased, as it does at price level 100, the economy has achieved equilibrium (here, at $510 billion of real GDP).

13.1 Aggregate demand–aggregate supply

Changes in the Price Level and Real GDP

Aggregate demand and aggregate supply typically change from one period to the next. If aggregate demand and aggregate supply increase proportionately over time, real GDP will expand and neither demand-pull inflation nor cyclical unemployment will occur. But we know from our discussion of the business cycle that macroeconomic stability is not always certain. A number of less desirable situations can confront the economy. Let's apply the model to several such situations. For simplicity we will use *P* and *Q* symbols, rather than actual numbers. Remember that these symbols represent price index values and amounts of real GDP.

Applying the Analysis

Demand-Pull Inflation

Suppose the economy is operating at its full-employment output and businesses and government increase their spending—actions that shift the aggregate demand curve to the right. Our list of determinants of aggregate demand (Figure 13.2) provides several reasons why this shift might occur. Perhaps firms boost their investment spending because they anticipate higher future profits from investments in new capital. Those profits are predicated on having new equipment and facilities that incorporate a number of new technologies. And perhaps government increases spending to expand national defense.

As shown by the rise in the price level from P_1 to P_2 in Figure 13.7, the increase in aggregate demand beyond the full-employment level of output moves the economy from *a* to *b* and causes inflation. This is *demand-pull inflation*, because the price level is being pulled up by the increase in aggregate demand. Also, observe that the increase in demand expands real output from Q_f to Q_1. The distance between Q_1 and Q_f is a positive *GDP gap:* Actual GDP exceeds potential GDP.*

A classic American example of demand-pull inflation occurred in the late 1960s. The escalation of the war in Vietnam resulted in a 40 percent increase in defense spending between 1965 and 1967 and another 15 percent increase in 1968. The rise in government spending, imposed on an already growing economy, shifted the economy's aggregate demand curve to the right, producing the worst inflation in two decades. Actual GDP exceeded potential GDP, and inflation jumped from 1.6 percent in 1965 to 5.7 percent by 1970.

A more recent example of demand-pull inflation occurred in the late 1980s. As aggregate demand expanded beyond its full-employment level between 1986 and 1990, the price level rose at an increasing rate. Specifically, the annual rate of inflation increased from 1.9 percent in 1986 to 3.6 percent in 1987 to 4.1 percent in 1988 to 4.8 percent in 1989. In terms of Figure 13.7, the aggregate demand

* This positive GDP gap cannot last forever because eventually the price of labor and other inputs will increase and therefore shift the short-run AS curve leftward. The economy will eventually return to its full-employment output, Q_f, along its vertical long-run aggregate supply curve (not shown) that is located there.

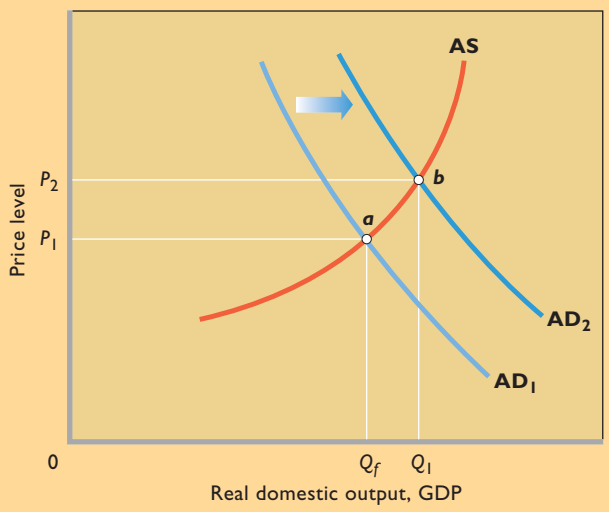


FIGURE 13.7
Demand-pull inflation. The increase of aggregate demand from AD_1 to AD_2 moves the economy from *a* to *b*, causing demand-pull inflation of P_1 to P_2. It also causes a positive GDP gap of Q_1 minus Q_f.

curve moved rightward from year to year, raising the price level and the size of the positive GDP gap. The gap closed and the rate of inflation fell as the expansion gave way to the recession of 1990–1991.

Question:
How is the upward slope of the aggregate supply curve important in explaining demand-pull inflation?

Applying the Analysis

Cost-Push Inflation

Inflation can also arise on the aggregate supply side of the economy. Suppose that warfare in the Middle East severely disrupts world oil supplies and drives up oil prices by some huge amount, say, 300 percent. Higher energy prices would spread through the economy, driving up production and distribution costs on a wide variety of goods. The U.S. aggregate supply curve would spring to the left, say, from AS_1 to AS_2 in Figure 13.8. The resulting increase in the price level would be *cost-push inflation.*

The effects of a leftward shift in aggregate supply are doubly bad. When aggregate supply shifts from AS_1 to AS_2, the economy moves from *a* to *b*. The price level rises from P_1 to P_2 and real output declines from Q_f to Q_1. Along with the cost-push inflation, a recession (and negative GDP gap) occurs. That is exactly what happened in the United States in the mid-1970s when the price of oil rocketed upward.

Today, the effect of oil prices on the U.S. economy has weakened relative to earlier periods. In the mid-1970s, oil expenditures were about 10 percent of U.S. GDP, compared to only 3 percent today. So the U.S. economy is now less vulnerable to cost-push inflation arising from oil-related "aggregate supply shocks."

Question:
Which is costlier to an economy in terms of lost real output, an equal degree of demand-pull inflation or cost-push inflation?

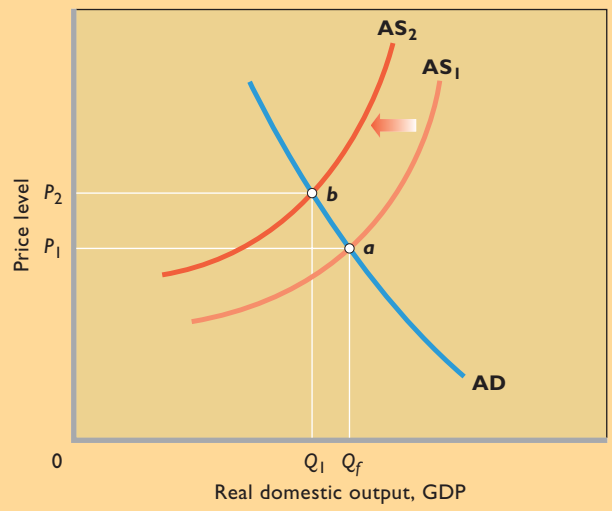


FIGURE 13.8
Cost-push inflation. A leftward shift of aggregate supply from AS_1 to AS_2 moves the economy from *a* to *b*, raises the price level from P_1 to P_2, and produces cost-push inflation. Real output declines and a negative GDP gap (of Q_1 minus Q_f) occurs.

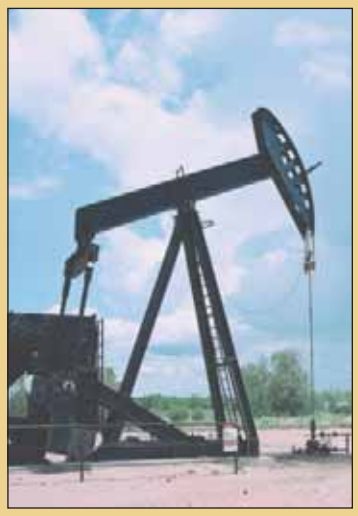


Photo Op Demand-Pull versus Cost-Push Inflation

A boom in investment spending, such as that for new construction, can cause demand-pull inflation. Soaring prices of key resources, such as oil, can cause cost-push inflation.

Downward Price-Level Inflexibility

We have just seen that the price level is readily flexible upward. But in the U.S. economy, deflation (a decline in the price level) rarely occurs even though the rate of inflation rises and falls. Why is the price level "sticky" or inflexible on the downside? Economists have offered several possible reasons for this:

- ***Fear of price wars*** Some oligopolists may be concerned that if they reduce their prices, rivals not only will match their price cuts but may retaliate by making even deeper cuts. An initial price cut may touch off an unwanted *price war:* successively deeper and deeper rounds of price cuts. In such a situation, all the firms end up with far less profit or higher losses than would be the case if they had simply maintained their prices. For this reason, each firm may resist making the initial price cut, choosing instead to reduce production and lay off workers.
- ***Menu costs*** Firms that think a recession will be relatively short-lived may be reluctant to cut their prices. One reason is what economists metaphorically call *menu costs*, named after their most obvious example: the cost of printing new menus when a restaurant decides to reduce its prices. But lowering prices also creates other costs. There are the costs of (1) estimating the magnitude and duration of the shift in demand to determine whether prices should be lowered, (2) repricing items held in inventory, (3) printing and mailing new catalogs, and (4) communicating new prices to customers, perhaps through advertising. When menu costs are present, firms may choose to avoid them by retaining current prices. That is, they may wait to see if the decline in aggregate demand is permanent.

- ***Wage contracts*** It usually is not profitable for firms to cut their product prices if they cannot also cut their wage rates. Wages are usually inflexible downward because large parts of the labor force work under contracts prohibiting wage cuts for the duration of the contract. (It is not uncommon for collective bargaining agreements in major industries to run for 3 years.) Similarly, the wages and salaries of nonunion workers are usually adjusted once a year, rather than quarterly or monthly.
- ***Morale, effort, and productivity*** Wage inflexibility downward is reinforced by the reluctance of many employers to reduce wage rates. If worker productivity (output per hour of work) remains constant, lower wages *do* reduce labor costs per unit of output. But lower wages might impair worker morale and work effort, thereby reducing productivity. Considered alone, lower productivity raises labor costs per unit of output because less output is produced. If the higher labor costs resulting from reduced productivity exceed the cost savings from the lower wage, then wage cuts will increase rather than reduce labor costs per unit of output. In such situations, firms will resist lowering wages when they are faced with a decline in aggregate demand.
- ***Minimum wage*** The minimum wage imposes a legal floor under the wages of the least skilled workers. Firms paying those wages cannot reduce that wage rate when aggregate demand declines.

Conclusion: In the United States, the price level readily rises but only reluctantly falls.

Illustrating the Idea

The Ratchet Effect

A *ratchet analogy* is a good way to think about the asymmetry of price-level changes. A ratchet is a tool or mechanism such as a winch, car jack, or socket wrench that cranks a wheel forward but does not allow it to go backward. Properly set, each allows the operator to move an object (boat, car, or nut) in one direction while preventing it from moving in the opposite direction.

The price level, wage rates, and per-unit production costs readily rise when aggregate demand increases along the aggregate supply curve. In the United States, the price level has increased in every year but one since 1950.

But the price level, wage rates, and per-unit production costs are inflexible downward when aggregate demand declines. The U.S. price level has fallen in only a single year (1955) since 1950, even though aggregate demand and real output have declined in a number of years.

In terms of our analogy, increases in aggregate demand ratchet the U.S. price level upward. Once in place, the higher price level remains until it is ratcheted up again. The higher price level tends to remain even with declines in aggregate demand. Inflation rates *do* rise and fall in the United States, but the price level mainly rises.

Question:
Does the ratchet analogy also apply to changes in real GDP? Why or why not?

Applying the Analysis

Recession and Cyclical Unemployment

Decreases in aggregate demand, combined with downward price-level inflexibility, can create recessions. For example, suppose that for some reason investment spending sharply declines. In Figure 13.9 we show the resulting decline in aggregate demand as a leftward shift from AD_1 to AD_2.

With the price level inflexible downward at P_1, the decline in aggregate demand moves the economy from *a* to *b* and reduces real output from Q_f to Q_1. The distance between Q_1 and Q_f measures the negative GDP gap—the amount by which actual output falls short of potential output. Because fewer workers are needed to produce the lower output, *cyclical unemployment* arises.

All recent demand-caused recessions in the United States have mimicked the "GDP gap but no deflation" scenario shown in Figure 13.9. Consider the recession of 2001, which resulted from a significant decline in investment spending. Because of the resulting decline of aggregate demand, GDP fell short of potential output by an average of $67 billion for each of the last three quarters of the year. Between February 2001 and December 2001, unemployment increased by 1.8 million workers, and the nation's unemployment rate rose from 4.2 percent to 5.8 percent. Although the rate of inflation fell (an outcome called *disinflation*), the price level did not decline. That is, deflation did not occur.

Question:
How can an increase in the real interest rate, combined with a decline in expected investment returns, jointly contribute to a recession?

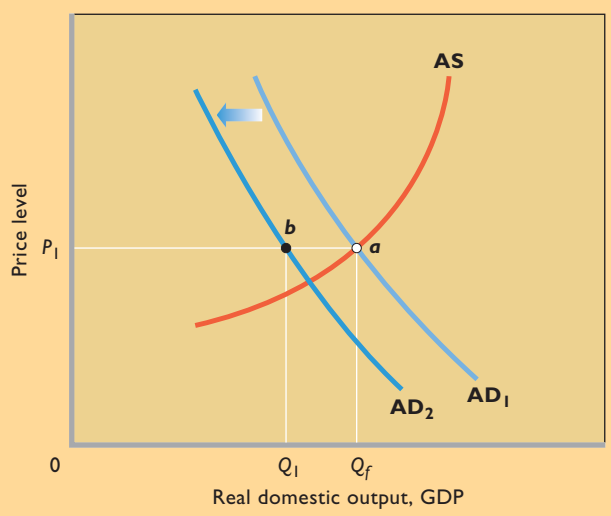


FIGURE 13.9
A recession. If the price level is downwardly inflexible, a decline of aggregate demand from AD_1 to AD_2 will move the economy from *a* to *b* and reduce real GDP from Q_f to Q_1. Idle production capacity, cyclical unemployment, and a negative GDP gap (of Q_1 minus Q_f) will result.

An Important Caution

There is some evidence that the price level and average level of wages are becoming more flexible downward in the United States. Intense international competition and declining power of unions in the United States seem to be undermining the ability of firms and workers to resist price and wage cuts when faced with falling aggregate demand. This increased flexibility of some prices and wages may be one reason the

recession of 2001 was relatively mild. The U.S. auto manufacturers, for example, maintained output in the face of falling demand by offering zero-interest loans on auto purchases. This, in effect, was a disguised price cut.

In theory, fully flexible downward prices and wages would automatically "self-correct" a recession. Reduced aggregate demand, with its accompanying negative GDP gap and greater unemployment, would reduce the price level and level of (nominal) wages. In Figure 13.9, the lower wages would reduce per-unit production costs and shift the AS curve rightward. Eventually the economy would return to its full-employment output, but at a considerably lower price level than before. That is, the economy would move back to its long-run aggregate supply curve (not shown), which is a vertical line running upward at the economy's full-employment level of output.

In reality, the government and monetary authorities have been reluctant to wait for these slow and uncertain "corrections." Instead, they focus on trying to move the aggregate demand curve to its prerecession location. For example, throughout 2001 the Federal Reserve lowered interest rates to try to halt the recession and promote recovery. Those Fed actions, along with large Federal tax cuts, increased military spending, and strong demand for new housing, helped increase aggregate demand and spur recovery. Real GDP grew by 1.9 percent in 2002, 3.0 percent in 2003, and 4.4 percent in 2004. The unemployment rate remained stubbornly high during this period. It rose from 4.7 percent in 2001 to 6.0 percent in 2003, before declining to 5.5 percent in 2004. We will examine stabilization policies, such as those undertaken by the Federal government and the Federal Reserve, in the following chapter.

Summary

1. The aggregate demand–aggregate supply model (AD-AS model) enables analysis of simultaneous changes of real GDP and the price level.
2. The aggregate demand curve shows the level of real output that the economy will purchase at each price level. It slopes downward because higher price levels dissuade U.S. businesses and households, along with foreign buyers, from purchasing as much output as before.
3. The determinants of aggregate demand consist of spending by domestic consumers, businesses, and government and by foreign buyers. Changes in the factors listed in Figure 13.2 alter the spending by these groups and shift the aggregate demand curve.
4. The aggregate supply curve shows the levels of real output that businesses will produce at various possible price levels. The long-run aggregate supply curve assumes that nominal wages and other input prices fully match any change in the price level. The curve is vertical at the full-employment output.
5. The short-run aggregate supply curve (or simply "aggregate supply curve") assumes nominal wages and other input prices do not respond to price-level changes. The aggregate supply curve is generally upsloping because per-unit production costs, and hence the prices that firms must receive, rise as real output expands. The aggregate supply curve is relatively steep to the right of the full-employment output and relatively flat to the left of it.
6. Figure 13.5 lists the determinants of aggregate supply: input prices, productivity, and the legal-institutional environment. A change in any one of these factors will change per-unit production costs at each level of output and therefore will shift the aggregate supply curve.
7. The intersection of the aggregate demand and aggregate supply curves determines an economy's equilibrium price level and real GDP. At the intersection, the quantity of real GDP demanded equals the quantity of real GDP supplied.
8. Increases in aggregate demand beyond the full-employment output cause inflation and positive

GDP gaps (actual GDP exceeds potential GDP). Such gaps eventually evaporate as wages and other input prices rise to match the increase in the price level.

9. Leftward shifts of the aggregate supply curve reflect increases in per-unit production costs at each level of output and cause cost-push inflation, with accompanying negative GDP gaps.
10. Shifts of the aggregate demand curve to the left of the full-employment output cause recession, negative GDP gaps, and cyclical unemployment. The price level typically does not fall during U.S. recessions because of downwardly inflexible prices and wages. This inflexibility results from fear of price wars, menu costs, wage contracts, morale concerns, and minimum wages.
11. In theory, price and wage flexibility would allow the economy automatically to self-correct from a recession. In reality, downward price and wage flexibility make the process slow and uncertain. Recessions usually prompt the Federal government and the Federal Reserve to take actions to try to increase aggregate demand.
12. Following the recession of 2001, the U.S. economy entered the expansion phase of the business cycle. Real GDP expanded by 1.9 percent in 2002, 3.0 percent in 2003, and 4.4 percent in 2004.

Terms and Concepts

aggregate demand–aggregate supply (AD-AS) model

aggregate demand

determinants of aggregate demand

exchange rates

aggregate supply

long-run aggregate supply curve

short-run aggregate supply curve

determinants of aggregate supply

productivity

equilibrium price level

equilibrium real output

Study Questions

1. What is the general relationship between a country's price level and the quantity of its domestic output (real GDP) demanded? Who are the buyers of U.S. real GDP?
2. Why is the long-run aggregate supply curve vertical? Explain the shape of the short-run aggregate supply curve. Why is the short-run curve relatively flat to the left of the full-employment output and relatively steep to the right?
3. Suppose that the aggregate demand and supply schedules for a hypothetical economy are as shown below:

Amount of Real GDP Demanded, Billions	Price Level (Price Index)	Amount of Real GDP Supplied, Billions
$100	300	$450
200	250	400
300	200	300
400	150	200
500	100	100

   a. Use these sets of data to graph the aggregate demand and aggregate supply curves. What are the equilibrium price level and the equilibrium level of real output in this hypothetical economy? Is the equilibrium real output also necessarily the full-employment real output? Explain.
   b. Why will a price level of 150 not be an equilibrium price level in this economy? Why not 250?
   c. Suppose that buyers desire to purchase $200 billion of extra real output at each price level. Sketch in the new aggregate demand curve as AD_1. What factors might cause this change in aggregate demand? What are the new equilibrium price level and level of real output?
4. Suppose that a hypothetical economy has the following relationship between its real output and the input quantities necessary for producing that output:

Input Quantity	Real GDP
150.0	$400
112.5	300
75.0	200

a. What is productivity in this economy?
b. What is the per-unit cost of production if the price of each input unit is $2?
c. Assume that the input price increases from $2 to $3 with no accompanying change in productivity. What is the new per-unit cost of production? In what direction would the $1 increase in input price push the economy's aggregate supply curve? What effect would this shift of aggregate supply have on the price level and the level of real output?
d. Suppose that the increase in input price does not occur but, instead, that productivity increases by 100 percent. What would be the new per-unit cost of production? What effect would this change in per-unit production cost have on the economy's aggregate supply curve? What effect would this shift of aggregate supply have on the price level and the level of real output?

5. Other things equal, what effects would each of the following have on aggregate demand or aggregate supply? In each case use a diagram to show the expected effects on the equilibrium price level and the level of real output.
a. A reduction in the economy's real interest rate.
b. A major increase in Federal spending for health care (with no increase in taxes).
c. The complete disintegration of OPEC, causing oil prices to fall by one-half.
d. A 10 percent reduction in personal income tax rates (with no change in government spending).
e. A sizable increase in labor productivity (with no change in nominal wages).
f. A 12 percent increase in nominal wages (with no change in productivity).
g. A sizable depreciation in the international value of the dollar.

6. Other things equal, what effect will each of the following have on the equilibrium price level and level of real output?
a. An increase in aggregate demand in the steep portion of the aggregate supply curve.
b. An increase in aggregate supply, with no change in aggregate demand (assume that prices and wages are flexible upward and downward).
c. Equal increases in aggregate demand and aggregate supply.
d. A reduction in aggregate demand in the relatively flat portion of the aggregate supply curve.
e. An increase in aggregate demand and a decrease in aggregate supply.

7. Why does a reduction in aggregate demand tend to reduce real output, rather than the price level?

8. Explain: "Unemployment can be caused by a decrease of aggregate demand or a decrease of aggregate supply." In each case, specify the price-level outcomes.

9. In early 2001 investment spending sharply declined in the United States. In the 2 months following the September 11, 2001, attacks on the United States, consumption also declined. Use AD-AS analysis to show the two impacts on real GDP.

Website Questions

At the text's Web site, www.brueonline.com, you will find three multiple-choice quizzes on this chapter's content. We encourage you to take the quizzes to see how you do. Also, you will find one or more Web-based questions that require information from the Internet to answer.