always come true, then the factory will always produce and sell at its optimal output rate of 900 cars per week. This would mean that it would never experience any fluctuations in output—either in the short run or in the long run. At the same time, since producing a constant output of 900 cars each week will always require the same number of workers, the factory's labor demand and employment should never vary. So if everything always goes according to plan, Buzzer Auto will never have any effect on unemployment because it will always hire a constant number of workers.

These facts imply that the short-run fluctuations in output and unemployment that we do see in the real world must be the result of shocks and things *not* going according to plan. In particular, business cycle fluctuations typically arise because the actual demand that materializes ends up being either lower or higher than what people were expecting. When this occurs, some adjustments will be necessary to bring the quantity demanded and the quantity supplied back into alignment. As we are about to explain, the nature of these adjustments varies hugely depending upon whether prices are flexible or inflexible.

Demand Shocks and Flexible Prices

Figure 23.1a illustrates the case of adjusting to unexpected changes in demand *when prices are flexible*. Here, if demand is unexpectedly low at D_L, the market price can adjust downward to $35,000 per vehicle so that the quantity demanded at that price will still be equal to the factory's optimal output rate of 900 cars per week. On the other hand, if demand is unexpectedly high at D_H, the market price can adjust upward to $40,000 per vehicle so that the quantity demanded will still be equal to the factory's optimal output rate of 900 cars per week. These adjustments imply that *if* the price of Prions is free to quickly adjust to new equilibrium levels in response to unexpected changes in demand, the factory could always operate at its optimal output rate of 900 cars per week. Only the amount of profit or loss will vary with demand.

Applying this logic to the economy as a whole, *if* the prices of goods and services could always adjust quickly to unexpected changes in demand, then the economy could always produce at its optimal capacity since prices would adjust to ensure that the quantity demanded of each good and service would always equal the quantity supplied. Simply put, if prices were fully flexible, there would be no short-run fluctuations: output would remain constant and unemployment levels would not change because firms would always need the same number of workers to produce the same amount of output.

Demand Shocks and Sticky Prices

In reality, many prices in the economy are inflexible and are not able to change rapidly when demand changes unexpectedly. Consider the extreme case shown in Figure 23.1b, in which the price of Prions is totally inflexible, fixed at $37,000 per Prion. Here, if demand unexpectedly falls from D_M to D_L, the quantity demanded at the fixed price of $37,000 will only be 700 cars per week, which is 200 cars fewer than the factory's optimal output of 900 cars per week. On the other hand, if demand is unexpectedly high at D_H, the quantity demanded at the fixed price of $37,000 will be 1150 cars per week, which is 250 cars more than the factory's optimal output of 900 cars per week.

One way for companies to deal with these unexpected shifts in quantity demanded would be to try to adjust the factory's output to match them. That is, during weeks of low demand, Buzzer Auto could attempt to produce only 700 Prions, while during weeks of high demand it could try to produce 1150 Prions. But this sort of flexible output strategy is very expensive because factories operate at their lowest costs when they are producing constantly at their optimal output levels; operating at either a higher or a lower production rate results in higher per-unit production costs.[1]

Knowing this, manufacturing firms typically attempt to deal with unexpected changes in demand by maintaining an inventory. An **inventory** is a store of output that has been produced but not yet sold. Inventories are useful because they can be allowed to grow or decline in periods when demand is unexpectedly low or high—thereby allowing production to proceed smoothly even when demand is variable. In our example, Buzzer Auto would maintain an inventory of unsold Prions. In weeks when demand is unexpectedly low, the inventory will increase by 200 Prions as the quantity demanded falls 200 vehicles short of the factory's optimal output. By contrast, during weeks when demand is unexpectedly high, the inventory will decrease as the quantity demanded exceeds the factory's optimal output by 250 cars. By allowing inventory levels to fluctuate with changes in demand, Buzzer Auto can respond to unexpected changes in demand by adjusting inventory levels rather than output levels. In addition, with any luck, the overall inventory level will stay roughly constant over time as unexpected increases and decreases roughly cancel each other out.

[1] If you have studied microeconomics, you will recognize that the firm's optimal output level of 900 cars per week is the level that minimizes the factory's average total cost (ATC) per vehicle of producing the Prion. Producing either more or fewer Prions will result in higher per-vehicle production costs.

But consider what will happen if the firm experiences many successive weeks of unexpectedly low demand. For each such week, the firm's inventory of unsold Prions will increase by 200 cars. The firm's managers will not mind if this happens for a few weeks, but if it continues for many weeks, then the managers will be forced to cut production because, among other things, there will simply be no place to park so many unsold vehicles. More importantly, holding large numbers of unsold cars in inventory is unprofitable because while costs must be incurred to build an unsold car, an unsold car obviously brings in no revenue. Constantly rising inventories hurt firm profits and the management will want to reduce output if it sees inventories rising week after week due to unexpectedly low demand.

This simplified story about a single car company explains why economists believe that a combination of unexpected changes in demand and inflexible prices are the key to understanding the short-run fluctuations that affect real-world economies. If prices were flexible, then the firm could always operate at the factory's optimal output level because prices would always adjust to ensure that it could sell its optimal output of 900 cars per week no matter what happens to demand. But if prices are inflexible, then an unexpected decline in demand that persists for any length of time will result in increasing inventories that will eventually force the firm's management to cut production to less than the optimal output level of 900 cars per week. When this happens, not only will output fall, but unemployment will also rise. The firm will lay off workers because fewer employees will be needed to produce fewer cars.

Generalizing this story to the economy as a whole, if demand falls off for many goods and services across the entire economy for an extended period of time, then the firms that make those goods and services will be forced to cut production. Manufacturing firms that maintain inventories will do so as they find inventories piling up due to sluggish sales. And services firms will do so as they encounter slow sales for their services. As both manufacturing and service output declines, the economy will go into recession, with GDP falling and unemployment rising.

On the other hand, if demand is unexpectedly high for a prolonged period of time, the economy will boom and unemployment will fall. In the case of our Prion example, for each week that demand is unexpectedly high, inventories will fall by 250 cars. If this keeps happening week after week, inventories will start to run out and the firm will have to react by increasing production to more than the optimal output rate of 900 cars per week so that orders do not go unfilled. When this happens, GDP will increase as more cars per week are produced and unemployment will fall because the factory will have to hire more workers in order to produce the larger number of cars. **(Key Question 7)**

How Sticky Are Prices?

We have just shown that **inflexible prices**—or "**sticky prices**" as economists are fond of saying—help to explain how unexpected changes in demand lead to the fluctuations in GDP and employment that occur over the course of the business cycle. Of course, not all prices are sticky. Indeed, the markets for many commodities and raw materials such as corn, oil, and natural gas feature extremely **flexible prices** that react within seconds to changes in supply and demand. By contrast, the prices of most of the final goods and services that people consume are quite sticky, with the average good or service going 4.3 months between price changes. To get a better appreciation for the fact that price stickiness varies greatly by product or service, look at Table 23.1, which gives the average number of months between price changes for various common goods and services. The prices of some products like gasoline and airline tickets change very rapidly—about once a month or even less

TABLE 23.1 Average Number of Months between Price Changes for Selected Goods and Services

Item	Months
Coin-operated laundry machines	46.4
Newspapers	29.9
Haircuts	25.5
Taxi fare	19.7
Veterinary services	14.9
Magazines	11.2
Computer software	5.5
Beer	4.3
Microwave ovens	3.0
Milk	2.4
Electricity	1.8
Airline tickets	1.0
Gasoline	0.6

Source: Mark Bils and Peter J. Klenow, "Some Evidence on the Importance of Sticky Prices." *Journal of Political Economy,* October 2004, pp. 947–985.

LAST Word

Will Better Inventory Management Mean Fewer Recessions?

Computerized Inventory Tracking Has Greatly Accelerated How Quickly Companies Can Respond to Unexpected Changes in Demand

Before computers made it possible to track inventory changes in real time, firms could only react to unexpected shifts in demand very slowly. This was true because before computers, tracking inventory was a painful, slow process that basically involved having to hire people to physically count the items held in inventory—one at a time. Since this process was both costly and annoying, firms typically counted their inventories only a few times per year.

An unfortunate side effect of counting inventory so infrequently was that unexpected shifts in demand could cause large changes in inventory levels before anyone could find out about them. To see why this is true, consider a firm that counts its inventory just twice per year, for example, once in January and once in July. If the demand for its product suddenly falls in February and then remains low, the decline in demand will not be discovered until the July inventory count is taken. Only then will a high inventory level inform the firm's management that the demand for its product must have unexpectedly declined.

The long delay between when the shift in demand happens and when it is discovered means that the firm will very likely feel pressed to sharply reduce its production of new output since the fastest way to reduce its high inventory level will be to sharply reduce its output rate (so that new sales will exceed the reduced output rate). Following this policy, however, implies not only a large cut in output but also a substantial increase in unemployment since fewer workers will be needed to produce less output. As a result, infrequent inventory counting leads to strong fluctuations in output *and* employment because by the time an unexpected change in demand is discovered, it will have had plenty of time to cause a large change in inventory levels that will very likely be rectified by a large change in production levels.

By contrast, many economists believe that economic fluctuations may have become much less severe during the last 20 years because of the introduction of computerized inventory tracking systems that allow companies to track their inventory levels in real time. These systems keep continuous track of inventory levels by means of technologies like bar codes and laser scanners. This allows firms to tell almost immediately if demand has changed unexpectedly. As a result, the firms that have adopted these systems can make much more subtle changes to output and

than once a month. By contrast, haircuts and newspapers average more than two years between price changes. And coin-operated laundry machines average nearly four years between price changes!

In later chapters, we will discuss several factors that increase short-run price stickiness. But to keep the current discussion brief, let us focus on just two factors here. One factor is that companies selling final goods and services know that consumers prefer stable, predictable prices that do not fluctuate rapidly with changes in demand. Consumers would be annoyed if the same bottle of soda or shampoo cost one price one day, a different price the next day, and yet another price a week later. Volatile prices make planning more difficult, and, in addition, consumers who come in to buy the product on a day when the price happens to be high will likely feel that they are being taken advantage of. To avoid this, most firms try to maintain stable prices that do not change very often. Firms do have occasional sales where they lower prices, but on the whole they tend to try to keep prices stable and predictable—the result being price inflexibility.

Another factor that causes sticky prices has to do with the fact that in certain situations, a firm may be afraid that cutting its price may be counterproductive because its rivals might simply match the price cut—a situation often referred to as a "price war." This possibility is common among firms that only have one or two major rivals. Consider Coca-Cola and Pepsi. If Coca-Cola faces unexpectedly low demand for its product, it might be tempted to reduce its price in the hope that it can steal business away from Pepsi. But such a strategy would only work if Pepsi left its price alone when Coca-Cola cut its price. That, of course, is not likely. If Coca-Cola cuts its price, Pepsi will very likely cut its price in retaliation, doing its best to make sure that Coca-Cola doesn't steal away any of its customers. Thus, if Pepsi retaliates, Coca-Cola will only be made worse off by its decision to cut its price: It will not pick up much more business (because Pepsi also cut its price) and it will also be receiving less money for each bottle of Coke that it sells (because it lowered its own price.) Thus, firms that have to deal with the possibility of price wars often have sticky prices.

employment because they can discover the unexpected changes in demand before those unexpected changes have caused large shifts in inventory levels.

While it is not possible to "prove" that inventory management systems have led to smaller business cycle fluctuations, the behavior of the U.S. economy over the past 30 years is suggestive. The last severe recession happened in 1981–1982. Up to that point, recessions appeared to happen in the United States every five or so years and were often quite punishing, with high levels of unemployment and significant declines in output. But computerized inventory management systems began to be widely adopted during the 1980s and since that time the U.S. economy has only experienced two mild recessions, one in 1991–1992 and another in 2000–2001. Since these recessions were not only mild but about 10 years apart, some economists have taken this behavior as evidence that from now on recessions will be less frequent and less severe due to the recent improvements in inventory management.

Opinions vary, however, as to how much credit computerized inventory management should be given for the apparent reduction in the frequency and severity of the business cycle. Indeed, several other explanations have been put forward to explain why things seem to have improved. One hypothesis is that we may have just been lucky in recent years in that there have simply not been that many significant demand shocks. Another explanation is that governments may have learned from past mistakes and shifted to better economic policies. Taking the various competing explanations into account, it is safe to say that while no economist would give *all* the credit for the more moderate business cycle fluctuations of the past 25 years to computerized inventory management systems, nearly all would give at least some of the credit to these systems and the fact that they allow firms to rapidly react to unexpected changes in demand.

Categorizing Macroeconomic Models Using Price Stickiness

We have now demonstrated why price stickiness is believed to have such a large role in short-run economic fluctuations. It should be noted, however, that price stickiness moderates over time. This is true because firms that choose to use a fixed-price policy in the short run do not have to stick with that policy permanently. In particular, if unexpected changes in demand begin to look permanent, many firms will allow their prices to change so that price changes (in addition to quantity changes) can help to equalize quantities supplied with quantities demanded.

For this reason, economists speak of "sticky prices" rather than "stuck prices." Only in the very short run are prices totally inflexible. As time passes and prices are revised, the world looks much more like Figure 23.1a, in which prices are fully flexible, rather than Figure 23.1b, in which prices are totally inflexible. Indeed, the totally inflexible case shown in the right graph can be thought of as the extremely short-run response to an unexpected change in demand, while the fully flexible case shown in the left graph can be thought of as a longer-run response to an unexpected change in demand. In terms of time durations, the extreme short run can be thought of as the first few weeks and months after a demand shock, while the long run can be thought of as extending from many months to several years after a demand shock happens.

This realization is very useful in categorizing and understanding the differences between the various macroeconomic models that we will be presenting in subsequent chapters. For instance, the aggregate expenditures model presented in Chapter 28 assumes perfectly inflexible prices (and wages) and thus is a model in which prices are not just sticky but completely stuck. By contrast, the aggregate demand–aggregate supply model presented in Chapter 29 allows for flexible prices (with or without flexible wages) and is therefore useful for understanding how the economy behaves over longer periods of time.

As you study these various models, keep in mind that we need different models precisely because the economy

behaves so differently depending on how much time has passed after a demand shock. The differences in behavior result from the fact that prices go from stuck in the extreme short run to fully flexible in the long run. Using different models for different stages in this process gives us much better insights into not only how economies actually behave but also how various government and central bank policies may have different effects in the short run when prices are fixed versus the long run when prices are flexible.

Where will we go from here? In the remainder of Part 6, we examine how economists measure GDP and why GDP has expanded over time. Then, we discuss the terminology of business cycles and explore the measurement and types of unemployment and inflation. At that point you will be well-prepared to examine the economic models, monetary considerations, and stabilization policies that lie at the heart of macroeconomics.

Summary

1. Macroeconomics studies long-run economic growth and short-run economic fluctuations.
2. Macroeconomists focus their attention on three key economic statistics: real GDP, unemployment, and inflation. Real GDP measures the value of all final goods and services produced in a country during a given period of time. The unemployment rate measures the percentage of all workers who are not able to find paid employment despite being willing and able to work at currently available wages. The inflation rate measures the extent to which the overall level of prices is rising in the economy.
3. Before the Industrial Revolution, living standards did not show any sustained increases over time. Economies grew, but any increase in output tended to be offset by an equally large increase in the population, so that the amount of output per person did not rise. By contrast, since the Industrial Revolution began in the late 1700s, many nations have experienced modern economic growth in which output grows faster than population—so that standards of living rise over time.
4. Macroeconomists believe that one of the keys to modern economic growth is the promotion of savings and investment (for economists, the purchase of capital goods). Investment activities increase the economy's future potential output level. But investment must be funded by saving, which is only possible if people are willing to reduce current consumption. Consequently, individuals and society face a trade-off between current consumption and future consumption since the only way to fund the investment necessary to increase future consumption is by reducing current consumption in order to gather the savings necessary to fund that investment. Banks and other financial institutions help to convert saving into investment by taking the savings generated by households and lending it to businesses that wish to make investments.
5. Expectations have an important effect on the economy for two reasons. First, if people and businesses are more positive about the future, they will save and invest more. Second, individuals and firms must make adjustments to shocks—situations in which expectations are unmet and the future does not turn out the way people were expecting. In particular, shocks often imply situations where the quantity supplied of a given good or service does not equal the quantity demanded of that good or service.
6. If prices were always flexible and capable of rapid adjustment, then dealing with situations in which quantities demanded did not equal quantities supplied would always be easy since prices could simply adjust to the market equilibrium price at which quantities demanded equal quantities supplied. Unfortunately, real-world prices are often inflexible (or "sticky") in the short run so that the only way for the economy to adjust to such situations is through changes in output levels.
7. Sticky prices combine with shocks to drive short-run fluctuations in output and employment. Consider a negative demand shock in which demand is unexpectedly low. Because prices are fixed, the lower-than-expected demand will result in unexpectedly slow sales. This will cause inventories to increase. If demand remains low for an extended period of time, inventory levels will become too high and firms will have to cut output and lay off workers. Thus, when prices are inflexible, the economy adjusts to unexpectedly low demand through changes in output and employment rather than through changes in prices (which are not possible when prices are inflexible).
8. Prices are inflexible in the short run for various reasons, two of which are discussed in this chapter. First, firms often attempt to set and maintain stable prices in order to please customers who like predictable prices because they make for easy planning (and who might become upset if prices were volatile). Second, a firm with just a few competitors may be reluctant to cut its price due to the fear of starting a price war, a situation in which its competitors retaliate by cutting their prices as well—thereby leaving the firm worse off than it was to begin with.