CHAPTER THREE WEB APPENDIX

Additional Examples of Supply and Demand

Our discussion has clearly demonstrated that supply and demand analysis is a powerful tool for understanding equilibrium prices and quantities. The information provided in the main body of this chapter is fully sufficient for moving forward in the book, but you may find that additional examples of supply and demand are helpful. This optional appendix provides several concrete illustrations of changes in supply and demand.

Your instructor may assign all, some, or none of this appendix, depending on time availability and personal preference.

Changes in Supply and Demand

As Figure 3.7 of this chapter demonstrates, changes in supply and demand cause changes in price, quantity, or both. The following applications illustrate this fact in several real-world markets. The simplest situations are those in which either supply changes while demand remains constant or demand changes while supply remains constant. Let's consider two such simple cases first, before looking at more complex applications.

Lettuce

Every now and then we hear on the news that extreme weather has severely reduced the size of some crop. Suppose, for example, that a severe freeze destroys a sizable portion of the lettuce crop. This unfortunate situation implies a significant decline in supply, which we represent as a leftward shift of the supply curve from S_1 to S_2 in Figure 1. At each price, consumers desire as much lettuce as before, so the freeze does not affect the demand for lettuce. That is, demand curve D_1 does not shift.

What are the consequences of the reduced supply of lettuce for equilibrium price and quantity? As shown in Figure 1, the leftward shift of the supply curve disrupts the previous equilibrium in the market for lettuce and drives the equilibrium price upward from P_1 to P_2. Consumers respond to that price hike by reducing the quantity of lettuce demanded from Q_1 to Q_2. Equilibrium is restored at P_2 and Q_2.

Consumers who are willing and able to pay price P_2 obtain lettuce; consumers unwilling or unable to pay that price do not. Some consumers continue to buy as much lettuce as before, even at the higher price. Others buy some lettuce but not as much as before, and still others opt out of the market completely. The latter two groups use the money they would have spent on lettuce to obtain other products, say, carrots. (Because of our other-things-equal assumption, the prices of other products have not changed.)

Exchange Rates

Exchange rates are the prices at which one currency can be traded (exchanged) for another. Exchange rates are normally determined in foreign exchange markets. One of the largest foreign exchange markets is the euro-dollar market in which the currency used in most of Europe, the *euro*, is exchanged for U.S. dollars. In the United States, this market is set up so that euros are priced in dollars—that is, the "product" being traded is euros and the "price" to buy that product is quoted in dollars. Thus, the mar-

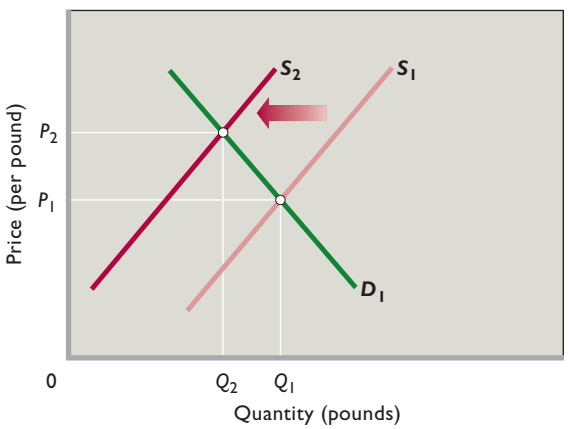


FIGURE 1
The market for lettuce. The decrease in the supply of lettuce, shown here by the shift from S_1 to S_2, increases the equilibrium price of lettuce from P_1 to P_2 and reduces the equilibrium quantity from Q_1 to Q_2.

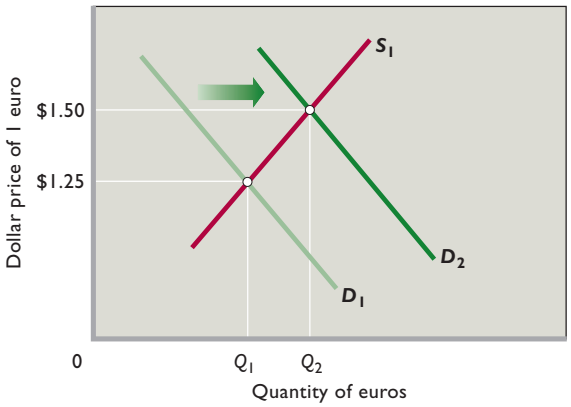


FIGURE 2
The market for euros. The increase in the demand for euros, shown here by the shift from D_1 to D_2, increases the equilibrium price of one euro from $1.25 to $1.50 and increases the equilibrium quantity of euros that are exchanged from Q_1 to Q_2. The dollar has depreciated.

ket equilibrium price one day might be $1.25 to buy 1 euro, while on another day it might be $1.50 to buy 1 euro.

Foreign exchange markets are used by individuals and companies that need to make purchases or payments in a different currency. U.S. companies exporting goods to Germany, for instance, wish to be paid in U.S. dollars. Thus, their German customers will need to convert euros into dollars. The euros that they bring to the euro-dollar market will become part of the overall market supply of euros. Conversely, an American mutual fund may wish to purchase some French real estate outside of Paris. But to purchase that real estate, it will need to pay in euros because the current French owners will only accept payment in euros. Thus, the American mutual fund has a demand to purchase euros that will form part of the overall market demand for euros. The fund will bring dollars to the euro-dollar foreign exchange market in order to purchase the euros it desires.

Sometimes, the demand for euros increases. This might be because a European product surges in popularity in foreign countries. For example, if a new German-made automobile is a big hit in the United States, American car dealers will demand more euros with which to pay for more units of that new model. This will shift the demand curve for euros to the right, as from D_1 to D_2 in Figure 2. Given the fixed euro supply curve S_1, the increase in demand raises the equilibrium exchange rate (the equilibrium number of dollars needed to purchase 1 euro) from $1.25 to $1.50. The equilibrium quantity of euros purchased increases from Q_1 to Q_2. Because a higher dollar amount is now needed to purchase one euro, economists say that the dollar has *depreciated*—gone down in value—relative to the euro. Alternatively, the euro has *appreciated*—gone up in value—relative to the dollar because one euro now buys $1.50 rather than $1.25.

Pink Salmon

Now let's see what happens when both supply and demand change at the same time. Several decades ago, people who caught salmon earned as much as $1 for each pound of pink salmon—the type of salmon most commonly used for canning. In Figure 3 that price is represented as P_1, at the intersection of supply curve S_1 and demand curve D_1. The corresponding quantity of pink salmon is shown as Q_1 pounds.

As time passed, supply and demand changed in the market for pink salmon. On the supply side, improved technology in the form of larger, more efficient fishing boats greatly increased the catch and lowered the cost of obtaining it. Also, high profits at price P_1 encouraged many new fishers to enter the industry. As a result of these changes, the supply of pink salmon greatly increased and the supply curve shifted to the right, as from S_1 to S_2 in Figure 3.

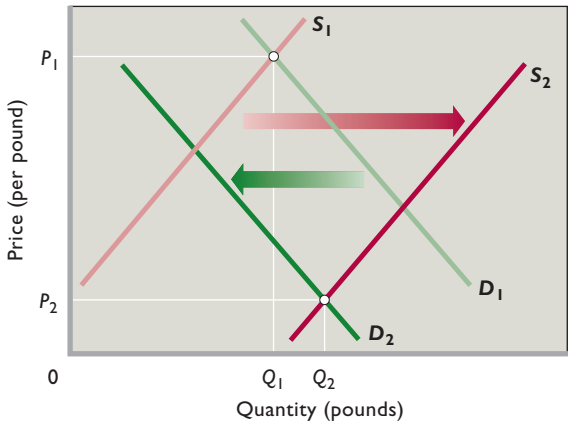


FIGURE 3
The market for pink salmon. In the last several decades, the supply of pink salmon has increased and the demand for pink salmon has decreased. As a result, the price of pink salmon has declined, as from P_1 to P_2. Because supply has increased by more than demand has decreased, the equilibrium quantity of pink salmon has increased, as from Q_1 to Q_2.

Over the same years, the demand for pink salmon declined, as represented by the leftward shift from D_1 to D_2 in Figure 3. That decrease was caused by increases in consumer income and reductions of the price of substitute products. As buyers' incomes rose, consumers shifted demand away from canned fish and toward higher-quality fresh or frozen fish, including more-valued Atlantic, chinook, sockeye, and coho salmon. Moreover, the emergence of fish farming, in which salmon are raised in ocean net pens, lowered the prices of these substitute species. That, too, reduced the demand for pink salmon.

The altered supply and demand reduced the price of pink salmon to as low as $.10 per pound, as represented by the drop in price from P_1 to P_2 in Figure 3. Both the supply increase and the demand decrease helped reduce the equilibrium price. However, in this particular case the equilibrium quantity of pink salmon increased, as represented by the move from Q_1 to Q_2. Both shifts reduced the equilibrium price, but equilibrium quantity increased because the increase in supply exceeded the decrease in demand.

Gasoline

The price of gasoline in the United States has increased rapidly several times during the past several years. For example, the average price of a gallon of gasoline rose from around $2.25 in January 2007 to about $4.10 in July 2008. What caused this 80 percent rise in the price of gasoline? How would we diagram this increase?

We begin in Figure 4 with the price of a gallon of gasoline at P_1, representing the $2.25 price. Simultaneous supply and demand factors disturbed this equilibrium. Supply uncertainties relating to Middle East politics and warfare and expanded demand for oil by fast-growing countries such as China pushed up the price of a barrel of oil from $50 per barrel in January 2007 to $145 per barrel in July 2008. Oil is the main input for producing gasoline, so any sustained rise in its price boosts the per-unit cost of producing gasoline. Such cost rises decrease the supply of gasoline, as represented by the leftward shift of the supply curve from S_1 to S_2 in Figure 4. At times refinery breakdowns in the United States also contributed to this reduced supply.

While the supply of gasoline declined between January 2007 and July 2008, the demand for gasoline increased, as depicted by the rightward shift of the demand curve from D_1 to D_2. Incomes in general were rising over this period because the U.S. economy was rapidly expanding. Rising incomes raise demand for all normal goods, including gasoline. An increased number of low-gas-mileage SUVs and light trucks on the road also contributed to growing gas demand.

The combined decline in gasoline supply and increase in gasoline demand boosted the price of gasoline from $2.25 to $4.10, as represented by the rise from P_1

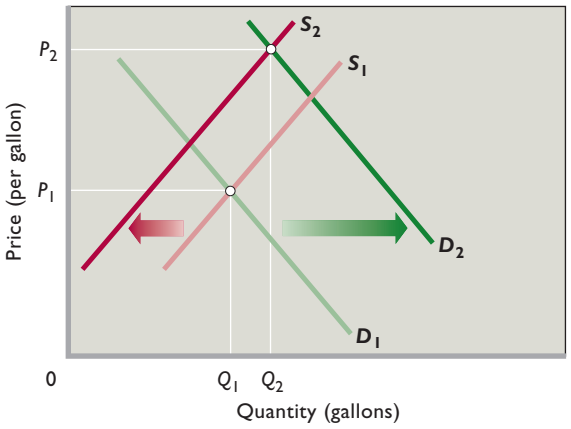


FIGURE 4
The market for gasoline. An increase in the demand for gasoline, as shown by the shift from D_1 to D_2, coupled with a decrease in supply, as shown by the shift from S_1 to S_2, boosts equilibrium price (here from P_1 to P_2). In this case, equilibrium quantity increases from Q_1 to Q_2 because the increase in demand outweighs the decrease in supply.

to P_2 in Figure 4. Because the demand increase outweighed the supply decrease, the equilibrium quantity expanded, here from Q_1 to Q_2.

In other periods the price of gasoline has *declined* as the demand for gasoline has increased. Test your understanding of the analysis by explaining how such a price decrease could occur.

Sushi

Sushi bars are springing up like Starbucks in American cities (well, maybe not that fast!). Consumption of sushi, the raw-fish delicacy from Japan, has soared in the United States in recent years. Nevertheless, the price of sushi has remained relatively constant.

Supply and demand analysis helps explain this circumstance of increased quantity and constant price. A change in tastes has increased the U.S. demand for sushi. Many consumers of sushi find it highly tasty when they try it. And, as implied by the growing number of sushi bars in the United States, the supply of sushi has also expanded.

We represent these supply and demand changes in Figure 5 as the rightward shift of the demand curve from D_1 to D_2 and the rightward shift of the supply curve from S_1 to S_2. Observe that the equilibrium quantity of sushi increases from Q_1 to Q_2 and equilibrium price remains constant at P_1. The increase in supply, which taken alone would reduce price, has perfectly offset the increase in demand, which taken alone would raise price. The price of sushi does not change, but the equilibrium quantity greatly increases because both the increase in demand and the increase in supply expand purchases and sales.

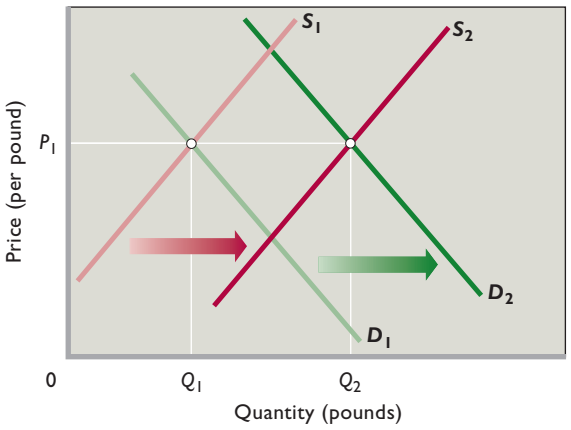


FIGURE 5
The market for sushi. Equal increases in the demand for sushi, as from D_1 to D_2, and in the supply of sushi, as from S_1 to S_2, expand the equilibrium quantity of sushi (here from Q_1 to Q_2) while leaving the price of sushi unchanged at P_1.

Simultaneous increases in demand and supply can cause price to either rise, fall, or remain constant, depending on the relative magnitudes of the supply and demand increases. In this case, price remained constant.

Preset Prices

In the body of this chapter, we saw that an effective government-imposed price ceiling (legal maximum price) causes quantity demanded to exceed quantity supplied—a shortage. An effective government-imposed price floor (legal minimum price) causes quantity supplied to exceed quantity demanded—a surplus. Put simply: Shortages result when prices are set below, and surpluses result when prices are set above, equilibrium prices.

We now want to establish that shortages and surpluses can occur in markets other than those in which government imposes price floors and ceilings. Such market imbalances happen when the seller or sellers set prices in advance of sales and the prices selected turn out to be below or above equilibrium prices. Consider the following two examples.

Olympic Figure Skating Finals

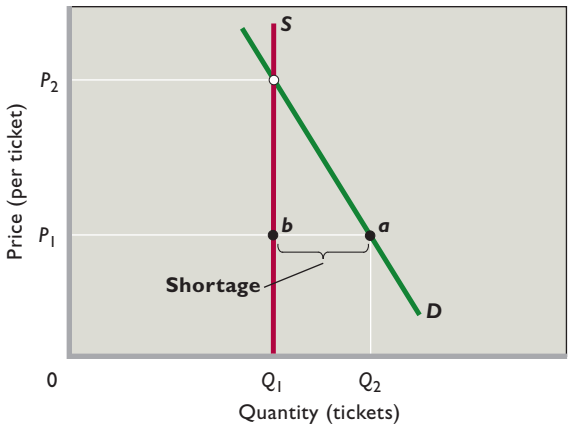
Tickets for the women's figure skating championship at the Olympics are among the world's "hottest tickets." The popularity of this event and the high incomes of buyers translate into tremendous ticket demand. The Olympic officials set the price for the tickets in advance. Invariably, the price, although high, is considerably below the equilibrium price that would equate quantity demanded and quantity supplied. A severe shortage of tickets therefore occurs in this *primary market*—the market involving the official ticket office.

The shortage, in turn, creates a *secondary market* in which buyers bid for tickets held by initial purchasers rather than the original seller. Scalping tickets—selling them above the original ticket price—may be legal or illegal, depending on local laws.

Figure 6 shows how the shortage in the primary ticket market looks in terms of supply and demand analysis. Demand curve *D* represents the strong demand for tickets

FIGURE 6

The market for tickets to the Olympic women's figure skating finals. The demand curve *D* and supply curve *S* for the Olympic women's figure skating finals produce an equilibrium price that is above the P_1 price printed on the ticket. At price P_1 the quantity of tickets demanded, Q_2, greatly exceeds the quantity of tickets available (Q_1). The resulting shortage of *ab* ($= Q_2 - Q_1$) gives rise to a legal or illegal secondary market.



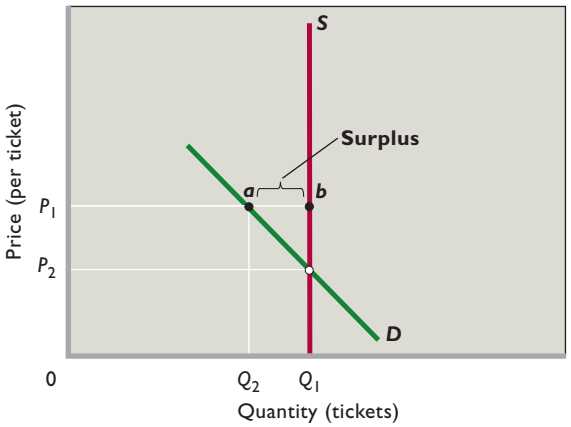


FIGURE 7
The market for tickets to the Olympic curling preliminaries. The demand curve *D* and supply curve *S* for the Olympic curling preliminaries produce an equilibrium price below the P_1 price printed on the ticket. At price P_1 the quantity of tickets demanded is less than the quantity of tickets available. The resulting surplus of *ba* ($= Q_1 - Q_2$) means the event is not sold out.

and supply curve *S* represents the supply of tickets. The supply curve is vertical because a fixed number of tickets are printed to match the capacity of the arena. At the printed ticket price of P_1, the quantity of tickets demanded, Q_2, exceeds the quantity supplied, Q_1. The result is a shortage of *ab*—the horizontal distance between Q_2 and Q_1 in the primary market.

If the printed ticket price had been the higher equilibrium price P_2, no shortage of tickets would have occurred. But at the lower price P_1, a shortage and secondary ticket market will emerge among those buyers willing to pay more than the printed ticket price and those sellers willing to sell their purchased tickets for more than the original price. Wherever there are shortages and secondary markets, it is safe to assume the original price was set below the equilibrium price.

Olympic Curling Preliminaries

Contrast the shortage of tickets for the women's figure skating finals at the Olympics to the surplus of tickets for one of the preliminary curling matches. For the uninitiated, curling is a sport in which participants slide a heavy round object called a "stone" down the ice toward a target while teammates called "sweepers" use brooms to alter the course of the stone when desired.

Curling is a popular spectator sport in a few nations such as Canada, but it does not draw many fans in most countries. So the demand for tickets to most of the preliminary curling events is not very strong. We demonstrate this weak demand as *D* in Figure 7. As in our previous example, the supply of tickets is fixed by the size of the arena and is shown as vertical line *S*.

We represent the printed ticket price as P_1 in Figure 7. In this case the printed price is much higher than the equilibrium price of P_2. At the printed ticket price, quantity supplied is Q_1 and quantity demanded is Q_2. So a surplus of tickets of *ba* ($= Q_1 - Q_2$) occurs. No ticket scalping occurs and there are numerous empty seats. Only if the Olympic officials had priced the tickets at the lower price P_2 would the event have been a sellout. (Actually, the Olympic officials try to adjust to demand realities for curling contests by holding them in smaller arenas and by charging less for tickets. Nevertheless, the stands are rarely full for the preliminary contests, which compete against final events in other winter Olympic sports.)

Appendix Summary

1. A decrease in the supply of a product increases its equilibrium price and reduces its equilibrium quantity. In contrast, an increase in the demand for a product boosts both its equilibrium price and its equilibrium quantity.
2. Simultaneous changes in supply and demand affect equilibrium price and quantity in various ways, depending on the relative magnitudes of the changes in supply and demand. Equal increases in supply and demand, for example, leave equilibrium price unchanged.
3. Sellers set prices of some items such as tickets in advance of the event. These items are sold in the primary market that involves the original seller and buyers. If preset prices turn out to be below the equilibrium prices, shortages occur and scalping in legal or illegal secondary markets arises. The prices in the secondary market then rise above the preset prices. In contrast, surpluses occur when the preset prices happen to exceed the equilibrium prices.

Appendix Questions

1. Why are shortages or surpluses more likely with preset prices, such as those on tickets, than flexible prices, such as those on gasoline? **LO5**
2. Most scalping laws make it illegal to sell—but not to buy—tickets at prices above those printed on the tickets. Assuming that is the case, use supply and demand analysis to explain why the equilibrium ticket price in an illegal secondary market tends to be higher than in a legal secondary market. **LO4**
3. Go to the website of the Energy Information Administration, **www.eia.doe.gov**, and follow the links to find the current retail price of gasoline. How does the current price of regular gasoline compare with the price a year ago? What must have happened to either supply, demand, or both to explain the observed price change? **LO4**
4. Suppose the supply of apples sharply increases because of perfect weather conditions throughout the growing season. Assuming no change in demand, explain the effect on the equilibrium price and quantity of apples. Explain why quantity demanded increases even though demand does not change. **LO4**
5. Assume the demand for lumber suddenly rises because of a rapid growth of demand for new housing. Assume no change in supply. Why does the equilibrium price of lumber rise? What would happen if the price did not rise under the demand and supply circumstances described? **LO4**
6. Suppose both the demand for olives and the supply of olives decline by equal amounts over some time period. Use graphical analysis to show the effect on equilibrium price and quantity. **LO4**
7. Assume that both the supply of bottled water and the demand for bottled water rise during the summer but that supply increases more rapidly than demand. What can you conclude about the directions of the impacts on equilibrium price and equilibrium quantity? **LO4**

Appendix Problems

1. Demand and supply often shift in the retail market for gasoline. Here are two demand curves and two supply curves for gallons of gasoline in the month of May in a small town in Maine. Some of the data are missing. **LO4**

	Quantities Demanded		Quantities Supplied	
Price	D_1	D_2	S_1	S_2
$4.00	5000	7500	9000	9500
___	6000	8000	8000	9000
2.00	___	8500	___	8500
___	___	9000	5000	___

   a. Use the following facts to fill in the missing data in the table. If demand is D_1 and supply is S_1, the equilibrium quantity is 7000 gallons per month. When demand is D_2 and supply is S_1, the equilibrium price is $3.00 per gallon. When demand is D_2 and supply is S_1, there is an excess demand of 4000 gallons per month at a price of $1.00 per gallon. If demand is D_1 and supply is S_2, the equilibrium quantity is 8000 gallons per month.
   b. Compare two equilibriums. In the first, demand is D_1 and supply is S_1. In the second, demand is D_1 and supply is S_2. By how much does the equilibrium quantity change? By how much does the equilibrium price change?
   c. If supply falls from S_2 to S_1 while demand declines from D_2 to D_1, does the equilibrium price rise, fall, or stay the same? What if only supply falls? What if only demand falls?
   d. Suppose that supply is fixed at S_1 and that demand starts at D_1. By how many gallons per month would demand have to increase at each price level such that the equilibrium price per gallon would be $3.00? $4.00?

2. The table below shows two demand schedules for a given style of men's shoe—that is, how many pairs per month will be demanded at various prices at a men's clothing store in Seattle called Stromnord.

Price	D_1 Quantity Demanded	D_2 Quantity Demanded
$75	53	13
70	60	15
65	68	18
60	77	22
55	87	27

Suppose that Stromnord has exactly 65 pairs of this style of shoe in inventory at the start of the month of July and will not receive any more pairs of this style until at least August 1. **LO3**

a. If demand is D_1, what is the lowest price that Stromnord can charge so that it will not run out of this model of shoe in the month of July? What if demand is D_2?
b. If the price of shoes is set at $75 for both July and August and demand will be D_2 in July and D_1 in August, how many pairs of shoes should Stromnord order if it wants to end the month of August with exactly zero pairs of shoes in its inventory? What if the price is set at $55 for both months?

3. Use the table below to answer the questions that follow: **LO5**

a. If this table reflects the supply of and demand for tickets to a particular World Cup soccer game, what is the stadium capacity?
b. If the preset ticket price is $45, would we expect to see a secondary market for tickets? Would the price of a ticket in the secondary market be higher than, the same as, or lower than the price in the primary (original) market?
c. Suppose for some other World Cup game the quantity of tickets demanded is 20,000 lower at each ticket price than shown in the table. If the ticket price remains $45, would the event be a sellout?

Quantity Demanded, Thousands	Price	Quantity Supplied, Thousands
80	$25	60
75	35	60
70	45	60
65	55	60
60	65	60
55	75	60
50	85	60