Chapter 2

Supply and Demand

1.1 To find demand as a function of p, plug in the typical values for p_b, p_c, and Y and simplify:

$$Q=276-20p.$$

1.2 The demand curve for pork is $Q = 171 - 20p - 20p_b - 3p_c - 2Y$, where quantity is measured in millions of kg per year and income is measured in thousands of dollars per year. Holding other variables constant we find: $\Delta Q = -2\Delta Y$. That is, a \$1000 increase in income ($Y = 1$) causes the quantity demanded to increase by 2 million kg per year, and a \$100 increase in income ($Y = 0.10$) causes the quantity demanded to increase by one-tenth as much, or 0.2 million kg per year.

1.3 The demand curve for pork in Canada is

$$Q = 171 - 20p + 20p_b - 3p_c + 2Y.$$

We can write the following, assuming the only change is in the price of beef:

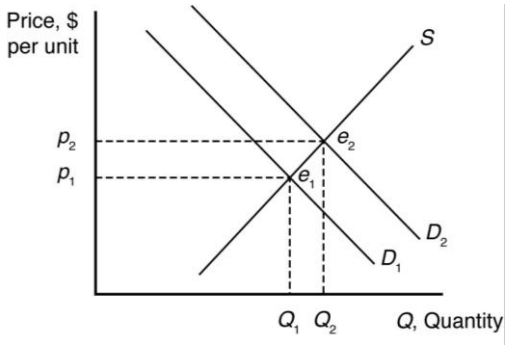
$$\Delta Q = 20\Delta P_b$$

$$\Delta Q = (20)(1.2) = 48.$$

Therefore, the quantity demanded for pork increases with increased beef prices ($\Delta Q/\Delta p_b$) > 0. This means that the demand for pork shifts to the right.

1.4 The inverse demand function is $p = 14.30 - 0.05Q$. We know that $\Delta p = -0.05\Delta Q$. If $\Delta Q = -2$ (a reduction of 2 million kg of pork per year), $\Delta p = -0.05 \times -2 = 0.10$. Thus, a 10 cent per kg increase in price will result in a 2 million kg drop in demand.

1.5 $\frac{\partial Q}{\partial Y} = 0.01$. An increase in Y shifts the demand curve to the right, from D_1 to D_2.



1.6 The total demand curve is the horizontal sum of the individual demand curves for food and feed:

$$Q=Q_{food}+Q_{feed}.$$

Since $Q_{feed} = 0$ at prices above \$27.56, for $p > 27.56$;

$$Q = 1{,}487 - 22.1p$$

and for $p < 27.56$

$$Q = 7{,}735 - 248.8p.$$

1.7 $Q = Q_1 + Q_2 = (120 – p) + (60 – 1/2p) = 180 – 1.5p$

1.8 The total demand function is $Q = Q_s + Q_l = 15.6p^{-0.563} + 16p^{-0.296}$.

2.1 Supply: $Q = 178 + 40p + 60p_h$. Replacing p_h with \$3 per kg gives us a supply function $Q = 178 + 40p + 60 \times \$3 = 40p + 2$. That is, the slope of the supply curve does not change from Equation 2.7, but the whole supply curve shifts to the left.

2.2 The effect of a change in p_f on Q is

$$\frac{\Delta Q}{\Delta p_f} = -20p_f$$

$$\frac{\Delta Q}{\Delta p_f} = -20(1.10)$$

$$\frac{\Delta Q}{\Delta p_f} = -22 \text{ units.}$$

Thus, an increase in the price of fertilizer will shift the avocado supply curve to the left.

2.3 The world supply is: $Q = Q_a + Q_r = (a + c) + (b + e)p$.

2.4 Let's say the U.S. domestic supply curve intersected the vertical axis at a price p' (above $\bar{p}$). The total supply curve would be the same as the foreign supply curve from a price of zero to p', both before and after the quota is imposed. Above the price p', the total supply curve would be the combined foreign and domestic quantity.

3.1 The statement "Talk is cheap because supply exceeds demand" makes sense if we interpret it to mean that the quantity supplied of talk exceeds the quantity demanded at a price of zero. Imagine a downward-sloping demand curve that hits the horizontal, quantity axis to the left of where the upward-sloping supply curve hits the axis. (The correct aphorism is "Talk is cheap until you hire a lawyer.")

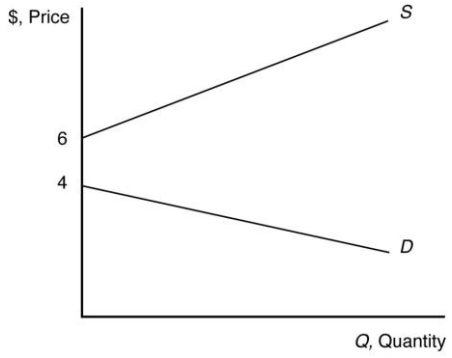
3.2

a. We know that the town consumes 9000 gallons per day at no cost, thus there is a point on the demand curve at $p = 0$, $q = 9{,}000$. By the "Law of Demand" the demand curve is weakly downward sloping (except in certain circumstances). Thus (since we assume there is no negative demand), a linear demand curve would be along the horizontal axis, where $p = 0$.

b. The supply curve is drawn along the horizontal axis from the point where $q = 0$ until $q = 10{,}000$. To the right of where $q = 10{,}000$, the supply curve is upward sloping.

c. Quantity supplied and demanded reach an equilibrium at any point under $q = 10{,}000$, where $p = 0$.

3.3 The supply curve is upward sloping and intersects the vertical price axis at \$6. The demand curve is downward sloping and intersects the vertical price axis at \$4. When all market participants are able to buy or sell as much as they want, we say that the market is in equilibrium: a situation in which no participant wants to change its behavior. Graphically, a market equilibrium occurs where supply equals demand. An equilibrium does not occur at a positive quantity because supply does not equal demand at any price.



3.4 Demand: $Q = 171 - 20p - 20p_b - 3p_c - 2Y$

Supply: $Q = 178 - 40p - 60p_h$

$p^* = [-7 + 20p_b - 3p_c + 2Y + 60p_h]/60$

$Q^* = 178 - 40[-7 + 20p_b + 3p_c + 2Y + 60p_h]/60$

If $p_h = 1.5$, $p_b = 4$, $p_c = 3.33$, and $Y = 12.5$

$286 - 20p = 88 - 40p$.

$p^* = \$3.3$

$Q^* = 220$

3.5 In equilibrium, the quantity demanded, $Q = a - bp$, equals the quantity supplied,

$$Q = c + ep, \text{ so}$$

$$a - bp = c + ep.$$

By solving this equation for p, we find that the equilibrium price is:

$$p = (a - c)/(b + e).$$

By substituting this expression for p into either the demand curve or the supply curve, we find that the equilibrium quantity is:

$$Q = (ae - bc)/(b + e).$$

3.6 The demand for processed tomatoes is:

$$\ln(Q) = 2.6 - 0.2\ln(p) + 0.15\ln(p_t) \quad \text{or} \quad Q^D = 13.46P^{-0.2}P_t^{0.15}.$$

When $P_t = 110$,

$$Q^D = 13.46P^{-0.2}(110)^{0.15} = 27.24P^{-0.2}$$

To find the equilibrium, we equate the right sides of the original logarithmic supply and demand functions and using algebra, we find:

$$0.75\ln(p) = 2.4 + 0.15\ln(p_t)$$

$$\ln(p) = 3.2 + 0.2\ln(p_t)$$

$$p = e^{3.2} * p_t^{0.2} = 24.53p_t^{0.2}.$$

We then set $p_t = 110$, solve for $p = \$62.80$/ton.

Or, we can find the supply function:

$$\ln(Q) = 0.2 + 0.55\ln(p) \quad \text{or} \quad Q^S = 1.22P^{0.55}$$

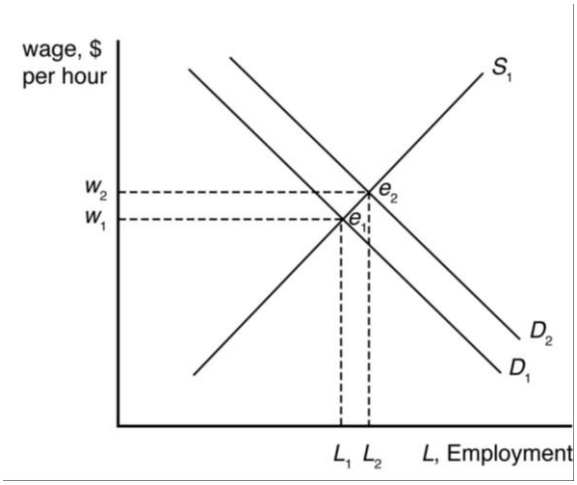
Equating the right side of the supply and demand functions, we find:

$$1.22P^{0.55} = 27.24P^{-0.2}$$

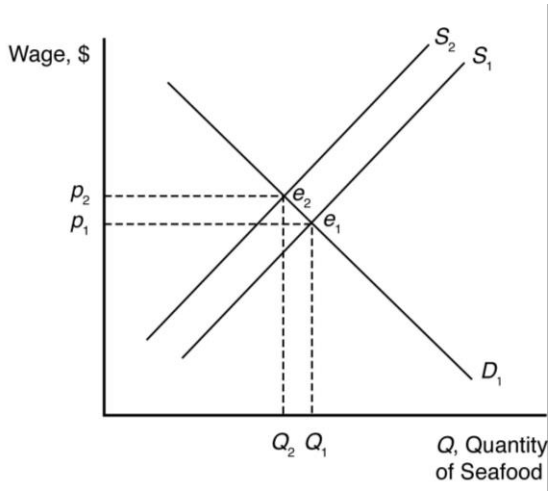
$$P^{0.75} = 22.33 \Rightarrow P = \$62.80$$

Substituting the price in either the supply or the demand function yields a quantity at equilibrium of about 11.9 million tons.

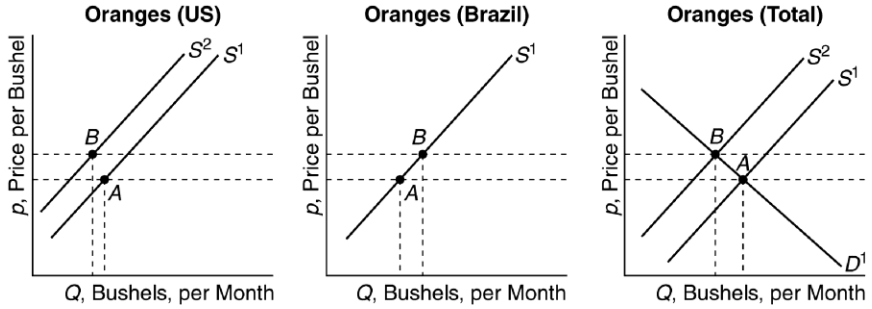
4.1 Outsourcing shifts the labor demand curve to the right because more Indian workers are demanded at each wage. The new market equilibrium is where the original supply curve intersects the new labor demand curve.



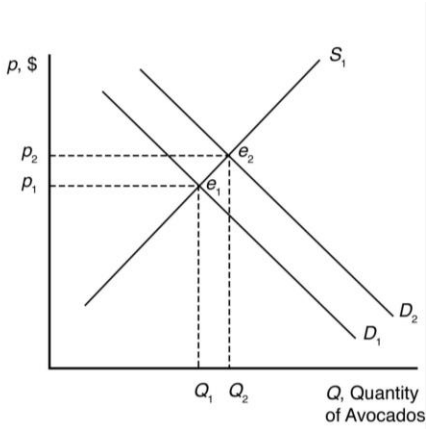
4.2 Suppose supply is initially S_1, but it decreases by a small amount to S_2 after the BP oil spill. When all market participants are able to buy or sell as much as they want, we say that the market is in equilibrium: a situation in which no participant wants to change its behavior. Graphically, a market equilibrium occurs where supply equals demand. The original market equilibrium is where the original demand curve intersects the original supply curve (e_1). The new market equilibrium is where the original demand curve intersects the new supply curve (e_2). When the supply curve shifts by a relatively small amount, the change in the equilibrium price is likely to be small.



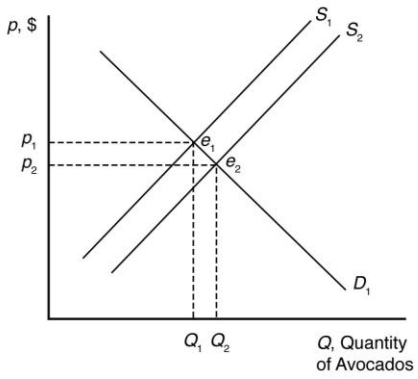
4.3 If the orange juice supply curve is the horizontal sum of the supply curves of U.S. and Brazilian firms, the damage to the U.S. orange crop would shift the total market supply curve to the left. Prices would increase, U.S. firms would sell less, and Brazilian firms would sell more juice at the new higher prices. (See figure below.)



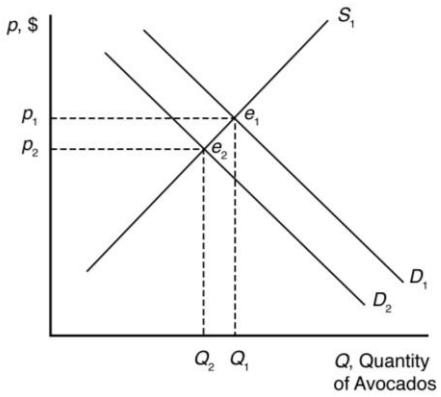
4.4 Health benefits from eating avocados shift the demand curve for avocados to the right because more avocados are now demanded at each price. The new market equilibrium is where the original supply curve intersects the new avocado demand curve, at a higher price and larger quantity.



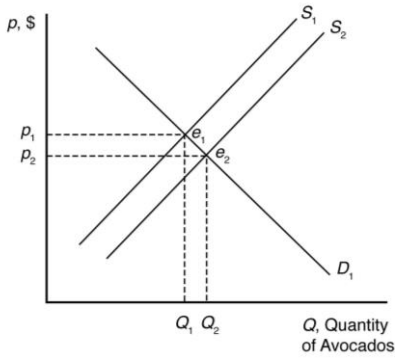
Imports shift the supply curve for avocados to the right because more avocados are now supplied at each price. The new market equilibrium is where the original demand curve intersects the new avocado supply curve, at a lower price and higher quantity.



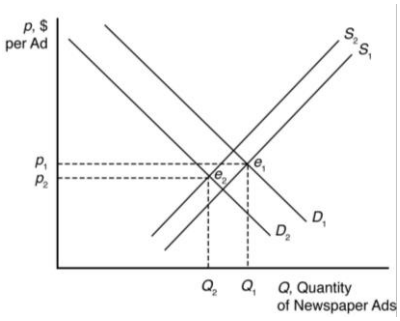
A recession shifts the demand curve for avocados to the left because fewer avocados are now demanded at each price. The new market equilibrium is where the original supply curve intersects the new avocado demand curve, at a lower price and lower quantity.



New technologies increasing yields shift the supply curve for avocados to the right because more avocados are now supplied at each price. The new market equilibrium is where the original demand curve intersects the new avocado supply curve, at a lower price and higher quantity.



4.5 The Internet shifts the demand curve for newspaper advertising to the left because fewer companies demand newspaper advertising with online advertising available. The Internet may force some newspapers out of business, so the supply curve for newspaper advertising will shift to the left some. The new market equilibrium is where the new demand curve intersects the new supply curve. At the new equilibrium, there is less newspaper advertising.



4.6 The increased use of corn for producing ethanol will shift the demand curve for corn to the right. This increases the price of corn overall, reducing the consumption of corn as food.

4.7 Because the temperature enters the supply function with a positive constant, increases in temperature will shift the supply curve rightward, increasing the equilibrium quantity at each price. To calculate the change in price at equilibrium, solve the equations simultaneously for price:

$$Q^D = a - bP \quad \text{and} \quad Q^S = c + eP + ft.$$

Given our equilibrium condition:

$$Q^D = Q^S,$$

we can solve for P:

$$a - bP = c + eP + ft$$

or

$$P^* = (a - c - ft)/(b + e) \quad \text{and} \quad Q^* = (cb - ae - bft)/(b + e).$$

Therefore:

$$\Delta P^* = [-f/(b + e)]\Delta t \quad \text{and} \quad \Delta Q^* = [bf/(b + e)]\Delta t.$$

4.8 The supply for processed tomatoes is:

$$\ln(Q) = 0.2 + 0.55\ln(p) \quad \text{or} \quad Q^S = 1.22P^{0.55}.$$

The demand for processed tomatoes is:

$$\ln(Q) = 2.6 - 0.2\ln(p) + 0.15\ln(p_t) \quad \text{or} \quad Q^D = 13.46P^{-0.2}P_t^{0.15}.$$

Given our equilibrium condition, $Q^S = Q^D$ and solving for P:

$$1.22P^{0.55} = 13.46P^{-0.2}P_t^{0.15}$$

$$P^{0.75} = 11.033P_t^{0.15}$$

$$P^* = 24.56P_t^{0.2}$$

and

$$Q^* = 7.095P_t^{0.11}.$$

If the price of tomato paste falls by 10%, the new price will be $P_t = 99$. Therefore:

$$P^* = 24.56(99)^{0.2} \quad \text{and} \quad Q^* = 7.095(99)^{0.11}$$

or

$$P^* = 61.59 \quad \text{and} \quad Q^* = 11.76.$$

4.9 When all traders are able to buy and sell as much as they want, the market is in equilibrium, which is a situation in which no one wants to change his or her behavior. A price at which consumers can buy as much as they want and sellers can sell as much as they want is called an equilibrium price. The quantity that is bought and sold at the equilibrium price is called the equilibrium quantity.

The market equilibrium price is that price where market demand equals market supply:

$$Q_d = Q_s$$

$$160 - 40p = 50 + 15p$$

$$110 = 55p$$

$$p = 2 \text{ per pound.}$$

Substitute the equilibrium price back into either the demand or supply equation to find the equilibrium quantity. For example, using the demand equation, the equilibrium quantity is

$$Q = 160 - 40p$$

$$Q = 160 - 40(2)$$

$$Q = 80 \text{ million pounds.}$$

5.1 An increase in demand due to higher quality professionals will shift the demand curve to the right, further raising prices. The equilibrium quantity could be more, less, or the same as before the licensing restriction, depending on whether the supply or the demand effect is greatest. However, it will be more than the quantity would be with only the licensing change in place.

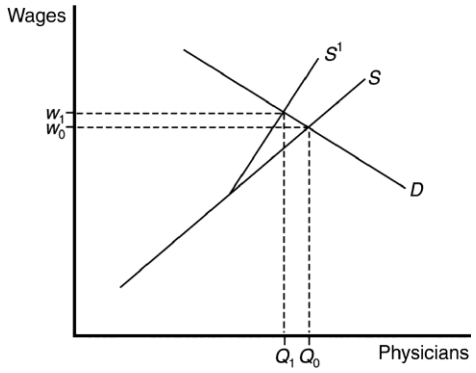
5.2 A ban has no effect if foreigners supply nothing at the pre-ban equilibrium price. Thus, if imports occur only at prices above those actually observed, a ban has no practical effect.

5.3 When the ban on legal imports went into effect, the demand for imports in the United States fell to zero. Given that the United States represents 60% of the market, it would have caused a dramatic drop in prices. If the drop in prices made caviar harvesting unprofitable and fishermen turned to other activities, it would help the fish population. If a black market developed, price and quantity sold would not drop as much as with a totally effective ban. If exporters simply shipped the caviar to other countries, but at lower prices, it could make problems with the sturgeon population even worse as exporters increase output to maintain income levels.

5.4 The quota causes the supply curve to become steeper at the price where foreign imports are impacted by the quota, above which foreign imports cannot be increased and the foreign supply curve becomes vertical. Below that price, the supply curve is unaffected. If the demand curve intersects the supply curve at a price below the kink, the equilibrium

is unaffected, and the quota does not bind. If the quota is binding (the demand curve intersects supply above the kink), the equilibrium price will be higher and the quantity will be lower than without the quota.

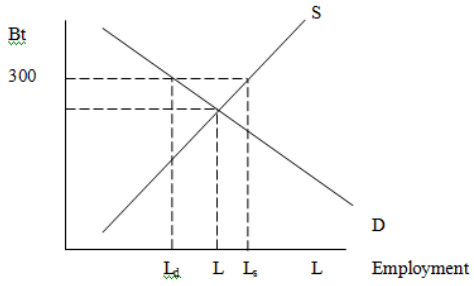
5.5 The quota on foreign-trained physicians would alter the supply curve. In the figure below, the unregulated supply curve, *S*, becomes more inelastic once the quota on foreign doctors is reached. The new supply curve, S^1, results in higher prices for medical services due to higher salaries for physicians if the demand curve intersects the supply curve above the "kink." In that case, American physicians are better off with the quota because of the increase in wages. Consumers are harmed because of the increase in price and decrease in quantity. If demand intersects supply below the kink, a quota will have no effect on equilibrium supply and demand.



5.6 With a binding price ceiling, such as a ceiling on the rate that can be charged on loans, some consumers who demand loans at the rate ceiling will be unable to obtain them. This is because the demand for bank loans is greater than the supply of bank loans to low-income households with the usury law.

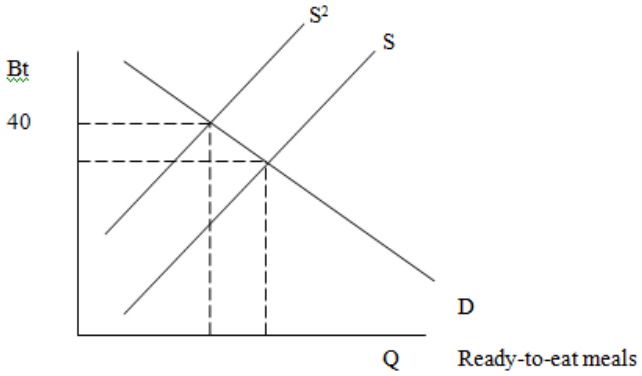
5.7

a. The minimum wage raises the wage above the equilibrium level. This reduces the quantity of labor demanded (where the Bt300 minimum wage intersects the labor demand curve) and increases the quantity of labor supplied (where the Bt300 minimum wage intersects the labor supply curve).



Unemployment equals excess labor. That is, unemployment equals the quantity of labor supplied minus the quantity of labor demanded: $L_s - L_d$.

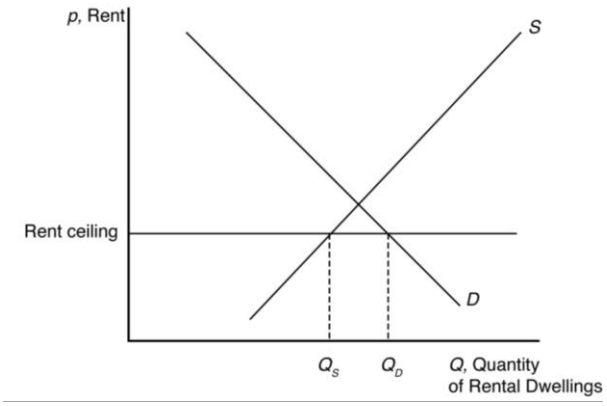
b. The minimum wage shifts the supply curve up, as production costs increase, until the point where the demand curve intersects the new supply curve is at a price of Bt40 for ready-to-eat meals.



c. The price controls lower the price of meals below the equilibrium level. This increases the quantity demanded (where the maximum price with the price controls intersects the demand curve) and decreases the quantity supplied (where the maximum price intersects the supply curve).

d. As the price of meals demanded decreases, owners of restaurants will demand fewer workers, shifting the labor demand curve to the left.

5.8 With the binding rent ceiling, the quantity of rental dwellings demanded is that quantity where the rent ceiling intersects the demand curve (Q_D). The quantity of rental dwellings supplied is that quantity where the rent ceiling intersects the supply curve (Q_S). With the rent control laws, the quantity supplied is less than the quantity demanded, so there is a shortage of rental dwellings.



5.9 The law would create a price ceiling (at 110% of the pre-emergency price). Because the supply curve shifts substantially to the left during the emergency, the price control will create a shortage: A smaller quantity will be supplied at the ceiling price than will be demanded.

5.10 At \$65 per ton, calculate the firm's supply curve: $\ln(Q) = 0.2 + (0.55)\ln(65) = 2.5$,

$$Q = 12.18 \text{ million tons.}$$

The demand for tomatoes is,

$$\ln(Q) = 2.6 + (0.2)\ln(65) + (0.15)\ln(110) = 2.47.$$

$$Q = \exp(2.47) = 11.82 \text{ million tons.}$$

Therefore, the government buys $12.18 - 11.82 = 0.36$ million tons.

6.1 The supply-and-demand model is useful for making predictions in perfectly competitive markets. That is, the supply-and-demand model is applicable in markets in which everyone is a price taker, firms sell identical products, everyone has full information about the price and quantity of goods, and the costs of trading are low.

Markets in which the supply-and-demand model has proved useful include agriculture, finance, labor, construction, services, wholesale, and retail--markets with many firms and consumers and where firms sell identical products.

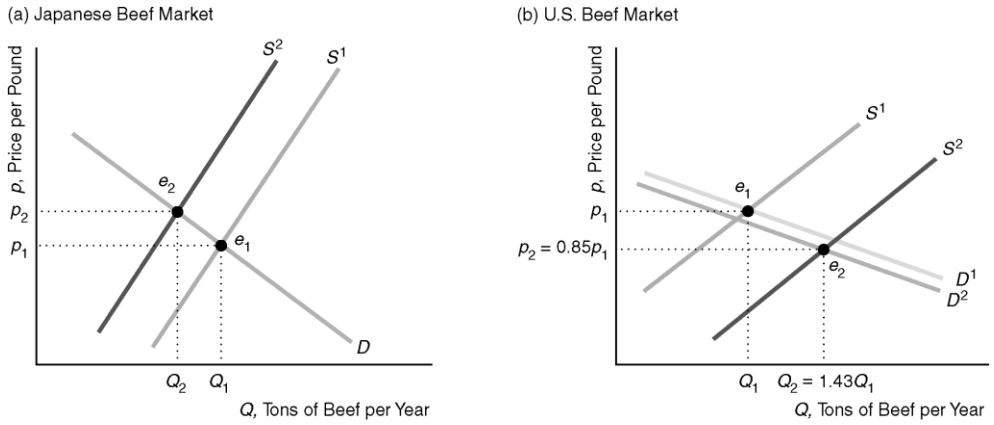
a. The market for apples is a competitive, agricultural market.

b. The market with convenience stores is a competitive, retail market.

c & d. The supply-and-demand model is not appropriate in markets in which there are only one or a few sellers (such as electricity), firms produce differentiated products (such as music CDs), consumers know less than sellers about quality or price (such as used cars), or there are high transaction costs (such as nuclear turbine engines). Electronic games are differentiated products supplied by three dominant firms.

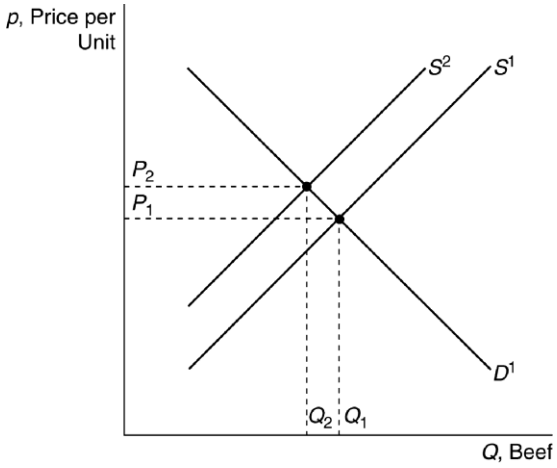
7.1 When Japan banned U.S. imports, the supply curve of beef in Japan shifted to the left from S^1 to S^2 in panel (a) of the figure. (The figure shows a parallel shift, for the sake of simplicity.) Presumably, the Japanese demand curve, D, was unaffected as Japanese consumers had no increased risk of consuming tainted meat. Thus, the shift of the supply curve caused the equilibrium to move along the demand curve from e_1 to e_2. The equilibrium price rose from p_1 to p_2 and the equilibrium quantity fell from Q_1 to Q_2. U.S. beef consumers' fear of mad cow disease caused their demand curve in panel (b) of the figure to shift slightly to the left from D^1 to D^2. In the short run, total U.S. production was essentially unchanged. Because of the ban on exports, beef that would have been sold in Japan and elsewhere was sold in the United States, causing the U.S. supply curve to shift to the right from S^1 to S^2. As a result, the U.S. equilibrium changed from e_1 (where S^1 intersects D^1) to e_2 (where S^2 intersects D^2). The U.S. price fell 15% from p_1 to $p_2 = 0.85p_1$, while the quantity rose 43% from Q_1 to $Q_2 = 1.43Q_1$.

***Note*:** Depending on exactly how the U.S. supply and demand curves had shifted, it would have been possible for the U.S. price and quantity to have both fallen. For example, if D^2 had shifted far enough left, it could have intersected S^2 to the left of Q_1, so that the equilibrium quantity would have fallen.



7.2 If the demand curve had shifted to the left more than the supply curve shifted to the right, then the equilibrium quantity would have fallen. Under no circumstances could the equilibrium price increase, given the direction of the shifts, because the leftward shift in demand and the rightward shift in supply work together to lower the equilibrium price.

7.3 See figure below. The increase in Australian beef exports to Japan decreases Australia's domestic supply of beef, which increases the domestic equilibrium price and decreases the domestic equilibrium quantity.



7.4 Both the demand and supply of guns have increased; that is, demand shifted up to the right and supply shifted down to the right. However, the results suggest that the increase in demand was greater than the increase in supply and this led to an increase in both equilibrium price and quantity.

7.5

a. World demand decreased (China's decrease in imports) and world supply increased (the increase in supply from the United States' bumper crop was greater than the decrease in supply from Asian soy rust). The rightward shift of world supply and the leftward shift of world demand both work to lower the world price of soybeans.

b. In this case, since supply increased and demand decreased (the shifts were in opposite directions), the price is unambiguously lower. In general, however, we have to know the magnitude of the shifts in addition to their direction to predict accurately the effect on price and quantity.