Microeconomics 8th edition Perloff Solutions Manual

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Chapter 2
Supply and Demand

■ Chapter Outline

Challenge: ***Quantities and Prices of Genetically Modified Foods***

2.1 Demand
- The Demand Curve
  - Effect of Prices on the Quantity Demanded
  - Effect of Other Factors on Demand
  - **Application**: Calorie Counting
- The Demand Function
  - **Solved Problem 2.1**
- Summing Demand Curves
  - **Application**: Aggregating Corn Demand Curves

2.2 Supply
- The Supply Curve
  - Effect of Price on Supply
  - Effect of Other Variables on Supply
- The Supply Function
- Summing Supply Curves
- How Government Import Policies Affect Supply Curves
  - **Solved Problem 2.2**

2.3 Market Equilibrium
- Using a Graph to Determine the Equilibrium
- Using Math to Determine the Equilibrium
- Forces That Drive a Market to Equilibrium

2.4 Shocking the Equilibrium
- Effects of a Shock to the Supply Curve
  - **Solved Problem 2.3**
- Effects of a Shock to the Demand Curve

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2.5 Effects of Government Interventions
- Policies That Shift Supply Curves
  - Licensing Laws
  - **Application**: Occupational Licensing
  - Quotas
  - **Solved Problem 2.4**
- Policies That Cause the Quantity Demanded to Differ from the Quantity Supplied
  - Price Ceilings
  - **Application:** Venezuelan Price Ceilings and Shortages
  - Price Floors
    - **Solved Problem 2.5**
- Why the Quantity Supplied Need Not Equal the Quantity Demanded

2.6 When to Use the Supply-and-Demand Model

■ Teaching Tips

This chapter reviews basic supply-and-demand concepts from the principles level. Your interactions with the class from the first session or two should give you a good indication of how much class time to spend on it. If it has been some time since their principles course, students may need fairly consistent prompting to recall the basic supply-and-demand model. For example, many will remember that there is a Law of Demand but will not remember the law itself. Encourage students in the strongest terms to read the chapter carefully. It is well worth the time spent at this stage to make sure everyone has solid recognition of these basic tools and concepts.

A good way to motivate the chapter is by beginning with the genetically modified food example found in the Challenge. Try to keep the conversation focused on possible effects of entry or of the ban. Let students brainstorm about which parties might be in favor of a ban and who would be opposed and why.

When reviewing demand, be sure students are clear on the difference between movement along the curve and a shift of the entire curve. Two points should be helpful. First, note to them that both in Equation 2.1 and on the graph in Figure 2.1, price is the only independent variable present. Thus, only price can cause a movement along the curve. Second, underscore the role of other variables. After compiling a list of the factors that can shift the demand curve (once they get started, the class as a group should be able to provide you with this list), I ask what factors are held constant along a single demand curve. Surprisingly, this question is often greeted by a protracted silence. By realizing that it is the same factors that shift the curve when they change, students develop a more solid understanding. The text makes this point well in Equations 2.2 and 2.3.

The introduction of demand curves and equations is a good opportunity to review the basic geometric concepts of slope and intercept. This does not take much time, as most students can recognize slope and intercept of a written equation, but there is sometimes a surprising lack of connection between what appears in an equation and the resulting graph. Draw a demand curve and tell the class that the slope of this curve is –2. Then ask the students what will happen in the graph if the slope changes to −4. Although it is likely that several, perhaps most students will know immediately, some will not.

Rather than referring to the slope increasing or decreasing, I tend to refer to it as becoming steeper or flatter, and thus this way I can talk about the shift in supply and demand curve slopes the same way (an *increase* in slope would cause the demand curve to become flatter and the supply curve to become steeper,

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which can be confusing for students). I try to use the simple algebra and geometry in these early chapters to help me to gauge what portion of the class is likely to struggle when the material gets tougher. Assigning some of the quantitative problems at the end of the chapter and collecting them (even if you do not intend to collect homework throughout the term) is another good diagnostic. Alternatively use five minutes of lecture time to ask students to answer two or three basic quantitative questions and collect their responses. Assure the students that their answers will not be graded and will simply be used to gauge comprehension. This will allow you to adjust your next lecture if necessary, and by walking around while students are working, you can answer any basic questions they might have.

It is also valuable to discuss the inverse demand curve and the process of inversion. I usually motivate this review by noting that this process will be needed later when formulating a total revenue equation from a demand equation. I combine this with the discussion of the problem of the reversed axes. At this point, you can refer back to the graph and show how to find the intercept and slope from Equation 2.3

I try to keep the discussion of supply parallel to that of demand. For factors that can shift the entire supply curve, note that they can all be lumped together under the broader heading of costs, government rules and regulations, and other variables (as is done in the text). The text notes that there is no "Law of Supply," and most students have learned this in their principles course. Be aware, however, that some principles instructors refer to the upward slope of supply curves in the short run as the "Law of Supply." Adopting a uniform taxonomy and vocabulary reduces confusion. This includes uniformity with the text with respect to symbols and upper- versus lower-case labeling.

When combining supply and demand in the discussion of equilibrium, press the students for a usable definition of the term. You will likely receive the suggestion of "where supply equals demand." Though incorrect, this definition is useful in the introduction of price floors and ceilings where the quantity supplied does not equal demanded at the equilibrium quantity. An important point regarding equilibrium solutions of supply-and-demand problems is that they are typically stable and self-correcting. To illustrate this point, use examples of commonly purchased items such as discounted clothing where reduced prices reflect excess supply.

Now that students have an idea of what a market looks like in equilibrium, I might ask for examples of markets that are not in equilibrium. This leads in to the discussion of government interventions and how they distort the market. This is also a good place to use a news article to show students how to use graphs to explain effects mentioned in the article.

When discussing floors and ceilings, I stress the definitions using simple graphs as illustrations. Although it seems counterintuitive to some students that an effective floor must be *above* the equilibrium price and an effective ceiling must be *below,* suggest that they use this as a mnemonic device. In this section, I try to engage the class in a discussion of unintended or secondary effects of government intervention. This issue deserves significant class discussion time. Most students have not thought much about the consequences of ceilings and floors beyond the simple price effects. The text has a good description of the unintended effects of price controls in Zimbabwe. A discussion on the initial reaction to the price controls, and then the actual effect of the controls, would lead students to realize the importance of looking beyond the initial effect and using economic models to predict outcomes.

Another good example for discussing secondary effects is rent control. On the supply side, landlords' incentives to provide efficient levels of upkeep and safety measures in rent-controlled buildings are distorted. On the demand side, time spent searching and undesired doubling-up reduce consumer satisfaction. Secondary effects of floors are also worth noting. I recommend that you discuss the text's example of the possible negative effects of minimum wages. Again, students are likely to view minimum wages as strictly a benefit to workers because they have not considered that job loss will mean that some workers are harmed rather than helped by the establishment of minimums or increases in their level.

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These policy issues provide an opportunity to use current affairs in class. Using an article from a newspaper or online source, I often break down the predictions in the article and use the theory learned in class to determine their veracity.

In the section on when to use the supply-and-demand model, be sure to define and discuss transaction costs. Most students will not be familiar with this term from principles, and it has important implications on the functioning of thin markets and markets where there is substantial uncertainty.

At the end of the chapter, you can return to the discussion of genetically modified foods (or another appropriate example) and use the supply and demand model to analyze the effects of entry.

■ Discussion Questions

1. Can you think of any reasons why the Law of Demand might not hold?
2. Would you expect most supply curves to have an upward slope? Why or why not?
3. What are some examples of markets that are competitive?
4. In which markets that would otherwise be competitive would you expect transaction costs to be very high?
5. Can you think of situations where the government would want to take actions that cause shortages?
6. In what markets and situations would you expect that the quantity demanded would not equal the quantity supplied?
7. Can you think of an example where a good is sold below equilibrium price without government intervention causing excess demand? Which property of perfect competition is violated?

■ Additional Questions and Problems

1. Suppose you are planning to conduct a study of the running shoe market. List the factors that you believe would cause changes in the demand for running shoes. In each case, note whether the relationship would be positive (direct) or negative (inverse). Also list the factors that you believe would affect the supply, again noting the nature of the relationship.
2. In each case below, identify the effect on the demand curve for steak (a normal good).
   a. An increase in the price of lamb
   b. A decrease in the population
   c. An increase in consumer income
   d. A decrease in the price of steak sauce
   e. An increase in advertising by chicken producers
3. In each case below, identify the effect on the supply curve for coal.
   a. The development of a new, lower cost mining technique
   b. An increase in wages paid to coal miners
   c. The imposition of a $2 per ton tax on coal
   d. A government ban on all imports of coal
   e. A new government regulation requiring air purifiers in all work areas

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4. In a competitive labor market, demand for workers is $Q_D = 10{,}000 - 100W$, and supply is $Q_S = 2{,}000 + 1{,}900W$, where Q is the quantity of workers employed and W is the hourly wage. What is the initial equilibrium wage and employment level? Suppose that the government decides that \$5 per hour is the minimum allowable wage in any market. How would this new minimum wage alter this market? What would the new employment level be? What would happen to total payments to labor? Would there be any excess supply of labor? If so, how much?

5. For each of the following sentences describing changes in the tangerine market, note whether the statement is true, false, or uncertain, and explain your answer. You will find it helpful to draw a graph for each case.
   a. If consumer income increases and worker wages fall, quantity will rise, and prices will fall.
   b. If orange prices decrease and taxes on citrus fruits decrease, quantity will fall, and prices will rise.
   c. If the price of canning machinery (a complement) increases and the growing season is unusually cold, quantity and price will both fall.

6. If demand for show tickets is described by the equation $Q_D = 100 - p$, and supply is $Q_S = 20 + p$, find the equilibrium price and quantity. How would your answer change if the supply curve shifted to $Q_S' = 10 + p$ due to increases in actor salaries? What would the supply curve look like if the capacity of the theatre was 50 people?

7. Suppose the demand for onion ice cream was described by the equation $Q_D = 20 - p$ and the supply was described by $Q_S = -40 + p$. What are the equilibrium price and quantity? Show your answer using a graph.

8. If demand for toy drums is described by the equation $Q_D = 300 - 5p$ and supply is $Q_S = 60 + 3p$, find the equilibrium price and quantity. How would your answer change if a decrease in consumer income shifted the demand curve to $Q_D' = 220 - 5p$?

9. Suppose the United States does not produce any baseball hats domestically but imports them from foreign producers. Initially, demand is $Q_D = 1000 - 2p$, and supply (from foreign producers) is $Q_S = 100 + p$. Determine the equilibrium price and quantity. The government then decides that no more than 300 baseball hats should be imported per period and imposes a quota at that level. How does this quota affect the equilibrium price and quantity? Show the solution using a graph and calculate the numerical answer. How might this quota affect the market for cowboy hats (a substitute good)?

10. Demand for park visits is $Q_0^* = 10{,}000 - 100P$. If park visits are free, how many visitors will attend? How will your answer change if the park adds a \$20.00 admission fee? Show using a graph.

11. A firm introduces a new model of MP3 player that can play both audio and video files. The price is the same as that of a previous model that can only play audio files. What would happen to the market of the previous model? What if the new model is more expensive than the previous one?

12. In a competitive labor market, demand for workers is $Q_D = 9{,}900 - 100W$, and supply is $Q_S = 2{,}000 + 1{,}900W$, where Q is the quantity of workers employed and W is the hourly wage. Suppose the government decides to impose a wage ceiling of \$3 per hour. What would the equilibrium be in this labor market?

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13. New York requires all taxis to be licensed and limits the number of licenses available. Suppose the market is currently in equilibrium. If the city no longer requires licenses, what will happen to the equilibrium price and quantity supplied? Why?

■ Answers to Additional Questions and Problems

1. Possible responses include:

   Demand: The price of running shoes (–)
   Sock prices (–)
   Prices of other sneaker types (+)
   Number of people who are regular runners (+)
   Income (+)

   Supply: Worker wages (–)
   Increases in leather prices (–)
   Removal of import tariffs (+)
   A unit tax on running shoes (–)

2. a. The demand curve shifts to the right.
   b. The demand curve shifts to the left.
   c. The demand curve shifts to the right.
   d. The demand curve shifts to the right.
   e. The demand curve shifts to the left.

3. a. The supply curve shifts to the right.
   b. The supply curve shifts to the left.
   c. The supply curve shifts to the left.
   d. The supply curve shifts to the left.
   e. The supply curve shifts to the left.

4. Without minimum wages, the equilibrium is

$$10{,}000 - 100W = 2{,}000 + 1{,}900W$$
$$W^* = 4$$
$$Q^* = 9{,}600.$$

With the new minimum wage of $5, employment will equal the amount of labor demanded at the minimum wage.

$$Q_d = 10{,}000 - 100(5) = 9{,}500.$$

Total payments to labor would increase from $38,400 to $47,500. Excess supply of labor would equal 2,000 = 2,000 + 1,900(5) – 9,500. Thus, in addition to the 100 people who would lose jobs that they had before the minimum, an additional 1,900 would now want jobs that would be unobtainable at the higher wage rate.

5. In each case, you must draw a graph that shows the original supply and demand curves, plus the new curves after the changes. You must then consider whether it matters or not how far the curve shifts in response to the change in the parameter indicated.

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a. Uncertain. In this case, both the supply and the demand curves shift to the right. Quantity will definitely increase, but whether prices rise, fall, or remain constant depends on the relative sizes of the supply and demand shifts. See Figure 2.1; because the demand shift is relatively larger than the shift in supply, prices increase.

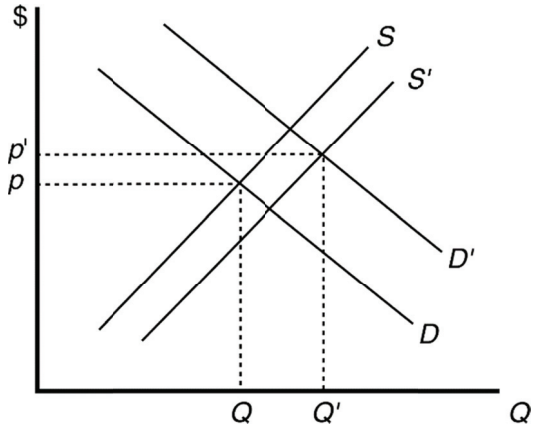

Figure 2.1

b. False. The supply curve shifts right due to the decrease in taxes, and the demand curve shifts left due to the decrease in orange prices. Prices will be lower, and the change in quantity depends on the magnitude of the shifts. See Figure 2.2. In the case of Figure 2.2, the large rightward shift in supply compared to the relatively small shift of the demand curve causes quantity to increase.

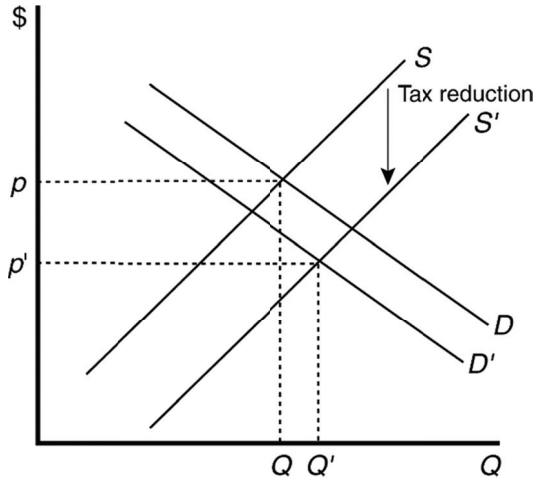

Figure 2.2

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c. Uncertain. In this case, the demand and supply curves both shift to the left. Quantity decreases, but price may rise, fall, or remain unchanged depending on the relative magnitude of the shifts. See Figure 2.3. In this case, price remains unchanged.

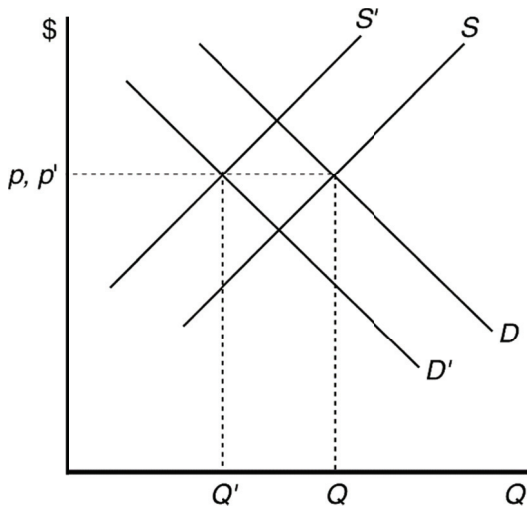


Figure 2.3

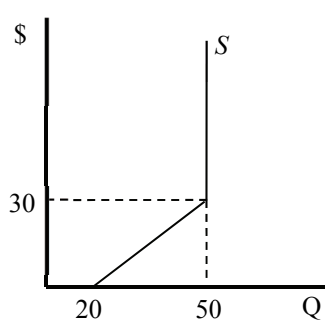
6. Set $Q_D = Q_S$ and solve.

For

$$Q_S = 20 + p$$
$$100 - p = 20 + p$$
$$p^* = 40$$
$$Q^* = 60$$

For

$$Q' = 10 + p$$
$$100 - p = 10 + p$$
$$p^* = 45$$
$$Q^* = 55$$



When the capacity of the theater has been reached at 50 tickets, the supply curve becomes vertical; increases in price will have no effect on the number of tickets the theater will supply.

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7. Set $Q_S = Q_D$ and solve.

$$P^* = 30$$
$$Q^* = -10$$

Equilibrium quantity is zero because the demand curve lies below the supply curve at all prices where output is positive. See Figure 2.4.

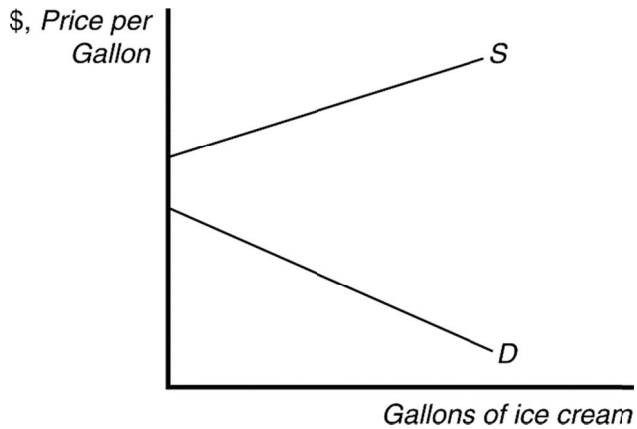

Figure 2.4

8. Set $Q_D = Q_S$ and solve.

For
$$Q_D = 300 - 5p$$
$$300 - 5p = 60 + 3p$$
$$p^* = 30$$
$$Q^* = 150 \text{ units}$$

For
$$Q_D' = 220 - 5p$$
$$220 - 5p = 60 + 3p$$
$$p^* = 20$$
$$Q^* = 120$$

9. The equilibrium solution with no government intervention is

$$1000 - 2p = 100 + p$$
$$p^* = 300$$
$$Q^* = 400.$$

When the quota is imposed at 300 units, supply cannot exceed that level, regardless of price. Thus, the supply curve becomes vertical at 300 units. The new equilibrium quantity is 300, and price is determined by where the supply curve with the quota (S_{quota}) intersects the demand curve (see Figure 2.5). To solve for the price, plug the quota value (300) into the demand equation.

$$1000 - 2p = 300$$
$$p^* = 350$$

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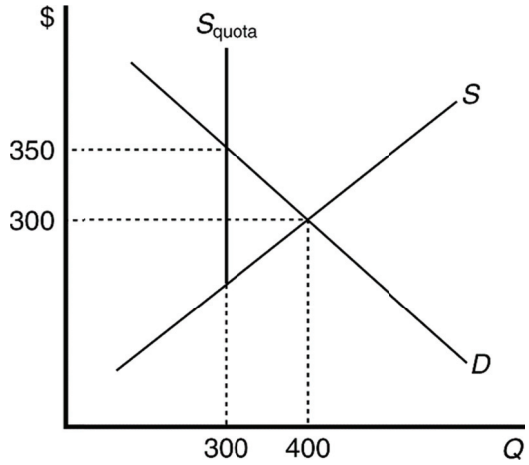

Figure 2.5

A quota on baseball hats would increase the price of baseball hats, which are a substitute for cowboy hats. As a result, demand for cowboy hats would increase (shift upwards), and the equilibrium price for cowboy hats would increase.

10. When park visits are free, the equilibrium quantity is 10,000 = 10,000 – 100(o). With a $20.00 entrance fee quantity falls to 8,000. See Figure 2.6.

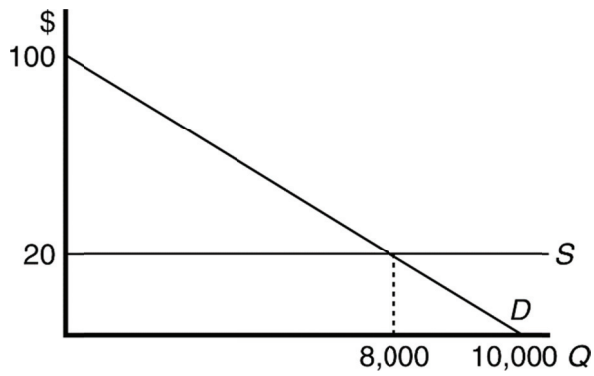

Figure 2.6

11. The demand curve of the previous model shifts to the right. If the new model is more expensive, the demand curve for the previous model still shifts to the right, but with a smaller magnitude.

12. Without the wage ceiling, the equilibrium is given by

$$10,000 - 100W = 2,000 + 1,900W,$$

where

$$W = 4 \text{ and } Q = 9,600.$$

With the wage ceiling of $3 per hour, the market wage rate will be $W = 3$, and the amount of labor employed will be 7,700.

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13. If the government limits the number of licenses available, new taxis can no longer enter the market if the price increases. As a result, once the number of taxis equals the number of licenses available, the supply curve becomes steeper, as any additional taxi rides must be supplied by taxis currently in the market. When the government eliminates the restriction, the supply curve no longer has a kink and becomes flatter, and the equilibrium price decreases, while the equilibrium quantity increases. See Figure 2.7.

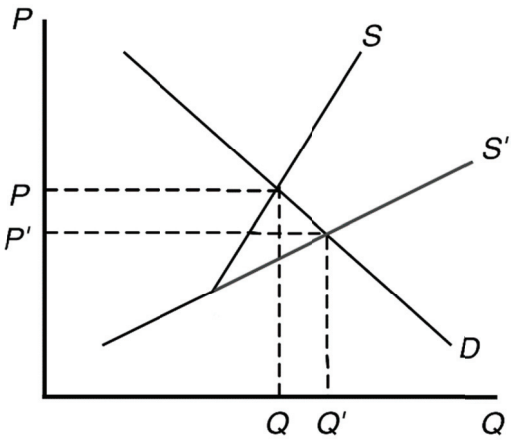

Figure 2.7

■ Answers to Textbook Questions

Chapter 2

Supply and Demand

1.1 $Q = 171 - 20p + 20p_b + 3p_c + 2Y = 171 - 20p + 20(3) + 3(3\frac{1}{3}) + 2(12.5) = 266 - 20p.$

1.2 The demand curve for pork is $Q = 171 - 20p + 20p_b + 3p_c + 2Y$. As a result, $\Delta Q/\Delta Y = 2$. A \$100 increase in income causes the quantity demanded to increase by 0.2 million kg per year.

1.3 The demand for Starbucks' coffee will shift to the left (decrease), assuming that consumers were unaware of the calorie content prior to the signage and view high calorie drinks negatively.

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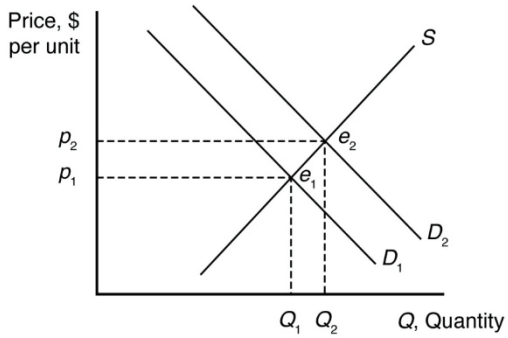
1.4 Substituting in the price of tomatoes and the original level of income gives $Q = 160 - 40p$ or $p = 4 - 0.025Q$. With the new level of income, $Q = 170 - 40p$ or $p = 4.25 - 0.025Q$. The demand curve shifts to the right.



1.5 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.

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

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

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

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

and for $p < 27.56$

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

$$Q = \begin{cases} 1{,}487 - 22.1\,p, & p \geq 27.56 \\ 7{,}734.5 - 248.8\,p, & p < 27.56 \end{cases}$$

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

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

1.9 The total demand function is $Q = 1.4p^{-2} + 1.4p^{-3.7}$. At a price of \$1.00, Apple Store customers demand $Q_A = 1.4 * 1^{-2} = 1.4\,\text{apps}$, and Google Play customers demand $Q_A = 1.4 * 1^{-3.7} = 1.4\,\text{apps}$, for a total of 2.8 million apps.

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 change in avocadoes supplied with respect to a change in the price of fertilizer is $\frac{\Delta Q}{\Delta p_f} = -20$.

Thus a \$1.10 increase in income results a 22 unit decrease in avocadoes supplied. Graphically, this would be a leftward shift of the supply curve.

2.3 The world supply is:

$$Q = Q_a + Q_r = (a + bp) + (a + cp) = 2a + (b+c)p.$$

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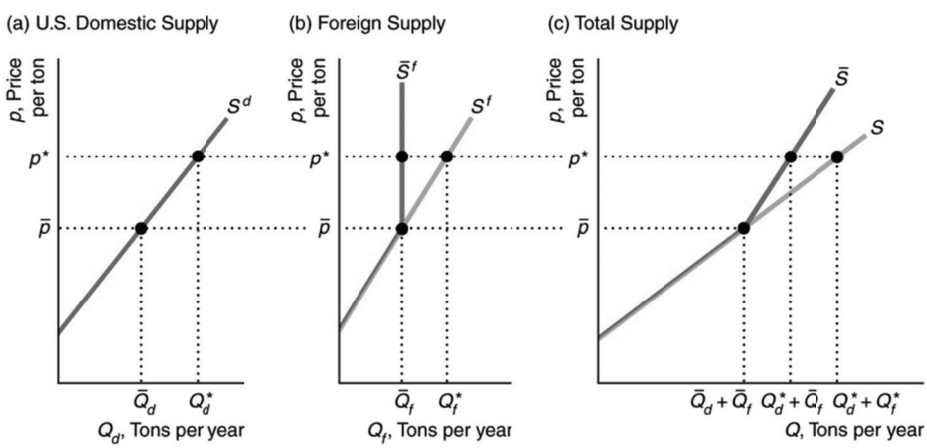
2.4 In the following figure, the no-quota total supply curve, S in panel c, is the horizontal sum of the U.S. domestic supply curve, S^d, and the no-quota foreign supply curve, S^f. At prices less than $\bar{p}$, foreign suppliers want to supply quantities less than the quota, $\bar{Q}$. As a result, the foreign supply curve under the quota, $\bar{S}^f$, is the same as the no-quota foreign supply curve, S^f, for prices less than $\bar{p}$. At prices above $\bar{p}$, foreign suppliers want to supply more but are limited to $\bar{Q}$. Thus the foreign supply curve with a quota, $\bar{S}^f$, is vertical at $\bar{Q}$ for prices above $\bar{p}$. The total supply curve with the quota, $\bar{S}$, is the horizontal sum of S^d and $\bar{S}^f$. At any price above $\bar{p}$, the total supply equals the quota plus the domestic supply. For example, at p^*, the domestic supply is Q_d^*, and the foreign supply is $\bar{Q}_f$, so the total supply is $Q_d^* + \bar{Q}_f$. Above $\bar{p}$, $\bar{S}$ is the domestic supply curve shifted $\bar{Q}$ units to the right. As a result, the portion of $\bar{S}$ above $\bar{p}$ has the same slope as S^d. At prices less than or equal to $\bar{p}$, the same quantity is supplied with and without the quota, so $\bar{S}$ is the same as S. At prices above $\bar{p}$, less is supplied with the quota than without one, so $\bar{S}$ is steeper than S, indicating that a given increase in price raises the quantity supplied by less with a quota than without one.



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.

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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.")

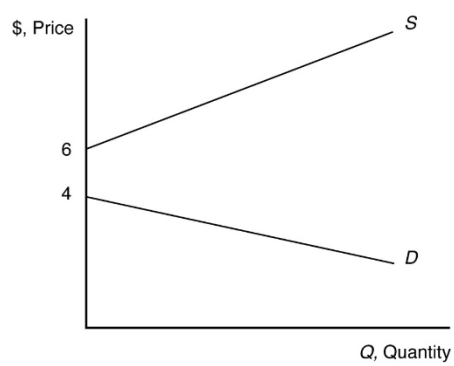
3.2

a. We know that the town consumes 9000 gallons per day at no cost; thus, there is a point on the demand curve at $p = 0$, $q = 9{,}000$. Thus (becauase 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 Set quantity demanded equal to quantity supplied:

$$171 - 20p + 20p_b + 3p_c + 2Y = 178 + 40p - 60p_h$$

Solving for p yields:

$$p = -\frac{7}{60} + \frac{1}{3}p_b + \frac{1}{20}p_c + \frac{1}{30}Y + p_h$$

Solving for q yields:

$$q = \frac{520}{3} + \frac{40}{3}p_b + 2p_c + \frac{4}{3}Y - 20p_h$$

Inserting prices of other goods yields $P = \$3.30$ and $Q = 220$.

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

$$\begin{aligned} 0.75\ln(p) &= 2.4 + 0.15\ln(p_t) \\ \ln(p) &= 3.2 + 0.2\ln(p_t) \\ p &= e^{3.2} * p_t^{0.2} = 24.53p_t^{0.2}. \end{aligned}$$

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

$$\begin{aligned} 1.22P^{0.55} &= 27.24P^{-0.2} \\ P^{0.75} &= 22.33 \Rightarrow P = \$62.80. \end{aligned}$$

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

4.1 The supply shock is unusually good luck or an unexpected increase in the number of lobsters in the ocean. The supply curve shifts to the rights, and thus the price falls.

4.2 Because it is now more attractive to rent an apartment (because you can more easily sublet for short periods of time), demand for apartments increases, which, all other things equal, increase the equilibrium rental price and quantity of apartments rented. (Note that an alternative answer might be that it reduces the supply of apartments on the market because if owners of apartments can make more money through Airbnb than through renting conventionally, they may withhold apartments from the market. In this case, supply decreases as well, reinforcing the rental price increase but making the effect on the quantity indeterminate.

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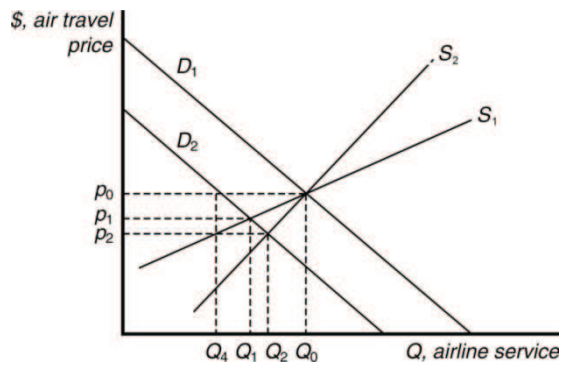
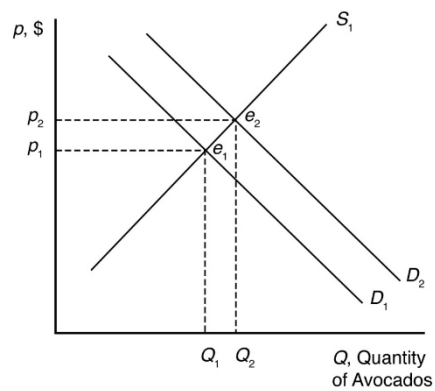
4.3 The demand curve shifts to the left from D_1 to D_2 by 30 percent, which is the distance between Q_0 and Q_4. For supply curve S_1, the price drops from p_0 to p_1, a change of less than 30 percent. For a steeper supply curve S_2, the price decreases to p_2, a larger decrease, yet still smaller than 30 percent. Accordingly, the equilibrium quantity changes less than 30 percent as well. (See figure below.)

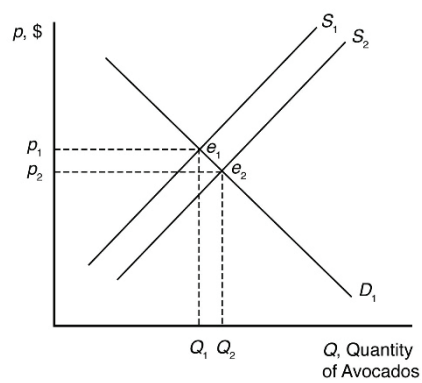


4.4 A decrease in the supply of eggs increases the equilibrium price of eggs and reduces the equilibrium quantity.

4.5 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.



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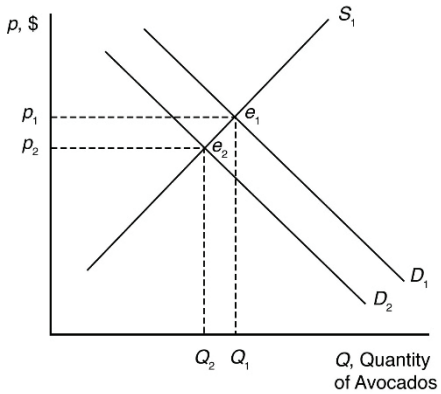
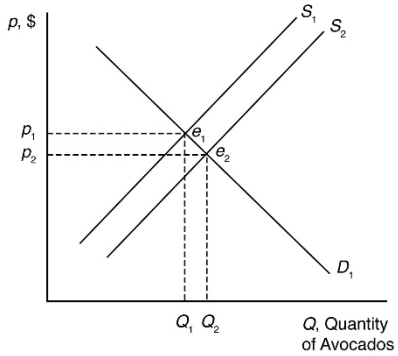
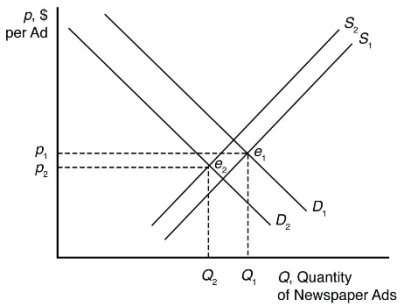
A recession shifts the demand curve for avocados to the left because fewer avocados are now demanded at each price. The new market equilibrium is where the original supply curve intersects the new avocado demand curve, at a lower price and lower quantity.



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.



4.6 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.



4.7 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.

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4.8 Setting quantity supplied equal to quantity demanded gives $p = 40 + 4r$. As the price of capital increases, the equilibrium price rises. Likewise, inverting the demand and supply curves and solving now for quantity, $Q = 140 - 8r$. The equilibrium quantity falls as the price of capital increases. (The increase in the price of capital reduces supply.)

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

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

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

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

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

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

and

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

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

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

(Answers will vary slightly with rounding)

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

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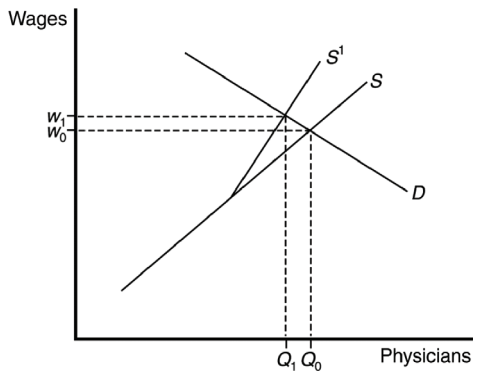
curve becomes vertical. Below that price, the supply curve is unaffected. If the demand curve intersects the supply curve at a price below the kink, the equilibrium is unaffected, and the quota does not bind. If the quota is binding (the demand curve intersects supply above the kink), the equilibrium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

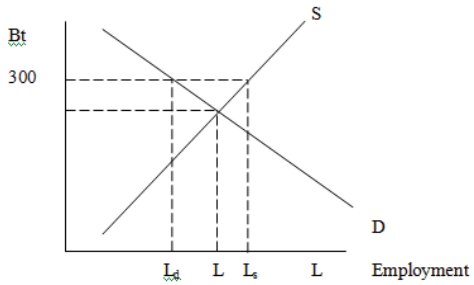
5.5 The quota on foreign-trained physicians would alter the supply curve. In the following figure, the unregulated supply curve, *S*, becomes more inelastic once the quota on foreign doctors is reached. The new supply curve, S^1, results in higher prices for medical services due to higher salaries for 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: $L_s - L_d$.

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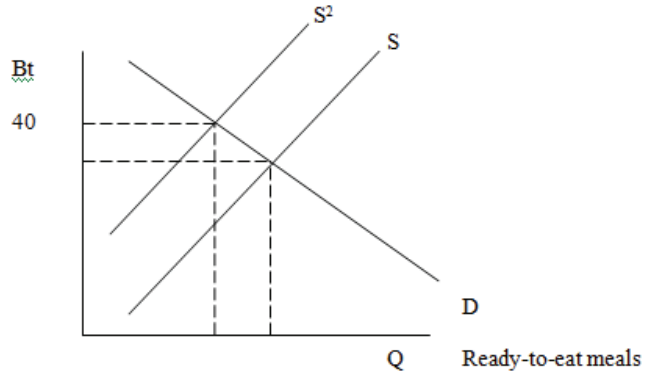
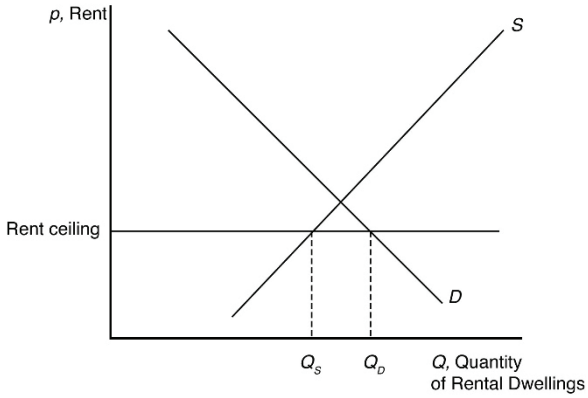
b. The minimum wage shifts the supply curve up, as production costs increase, until the point where the demand curve intersects the new supply curve is at a price of Bt40 for ready-to-eat meals.



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 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.

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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.

5.11 In the Venezuelan corn flour market, there is a price ceiling, and thus there is a shortage (graph is the same as the rent ceiling graph in Question 5.8). If corn flour is smuggled to Columbia, the supply of corn flour increases there, resulting in a lower price and higher quantity sold.

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 proven 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.

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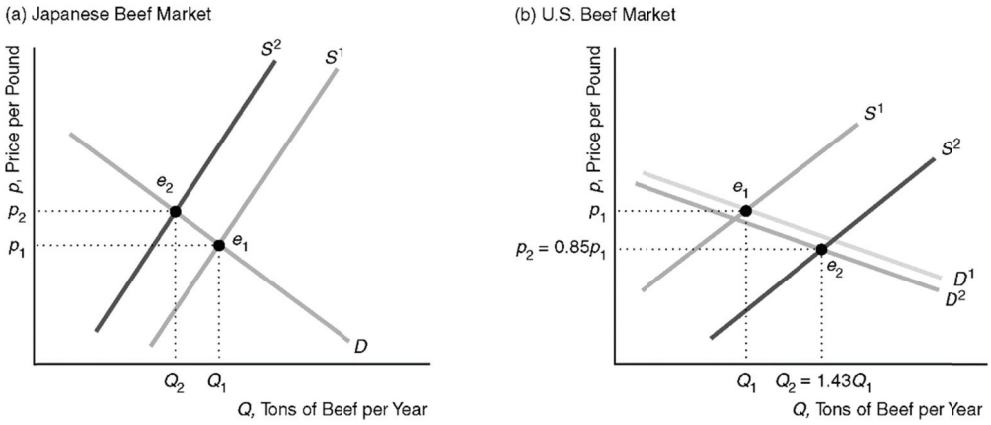

7.2 If the demand curve had shifted to the left more than the supply curve shifted to the right, then the equilibrium quantity would have fallen. Under no circumstances could the equilibrium price increase, given the direction of the shifts, because the leftward shift in demand and the rightward shift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

7.3 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.

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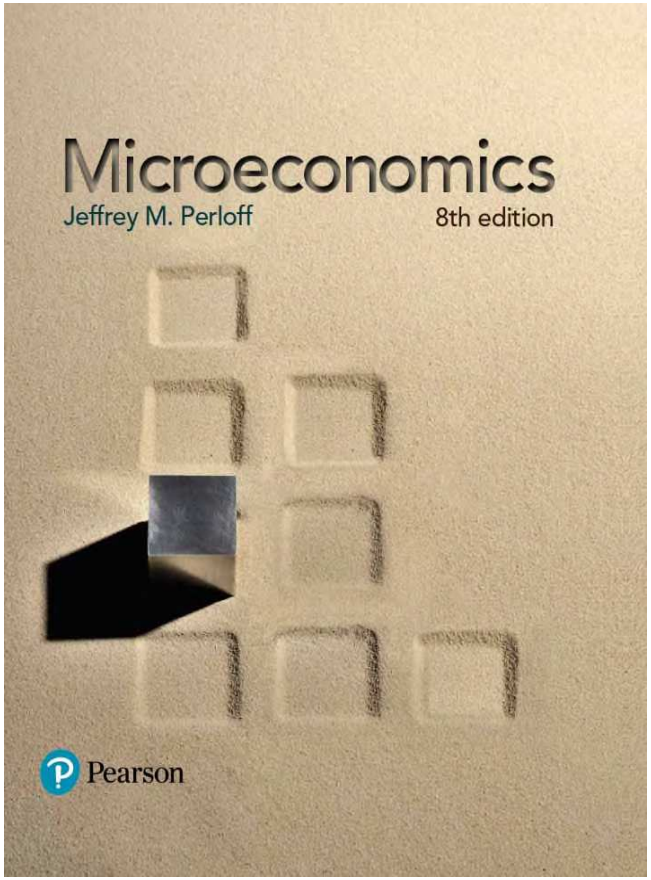

Chapter 2

Supply and Demand

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Learning Objectives

2.1 Demand

2.2 Supply

2.3 Market Equilibrium.

2.4 Shocking the Equilibrium

2.5 Effects of Government Interventions

2.6 When to Use the Supply-and-Demand Model.

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Demand: Determinants of Demand

Potential consumers decide how much of a good or services to buy on the basis of its **price** and many other factors, including:

- Tastes
- Information
- Prices of other goods
- Income
- Government actions

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The Demand Curve

- **Quantity demanded** – the amount of a good that consumers are willing to buy at a given price, holding constant other factors that influence purchases.
- **Demand curve** – shows the quantity demanded at each possible price, holding constant other factors that influence purchases.

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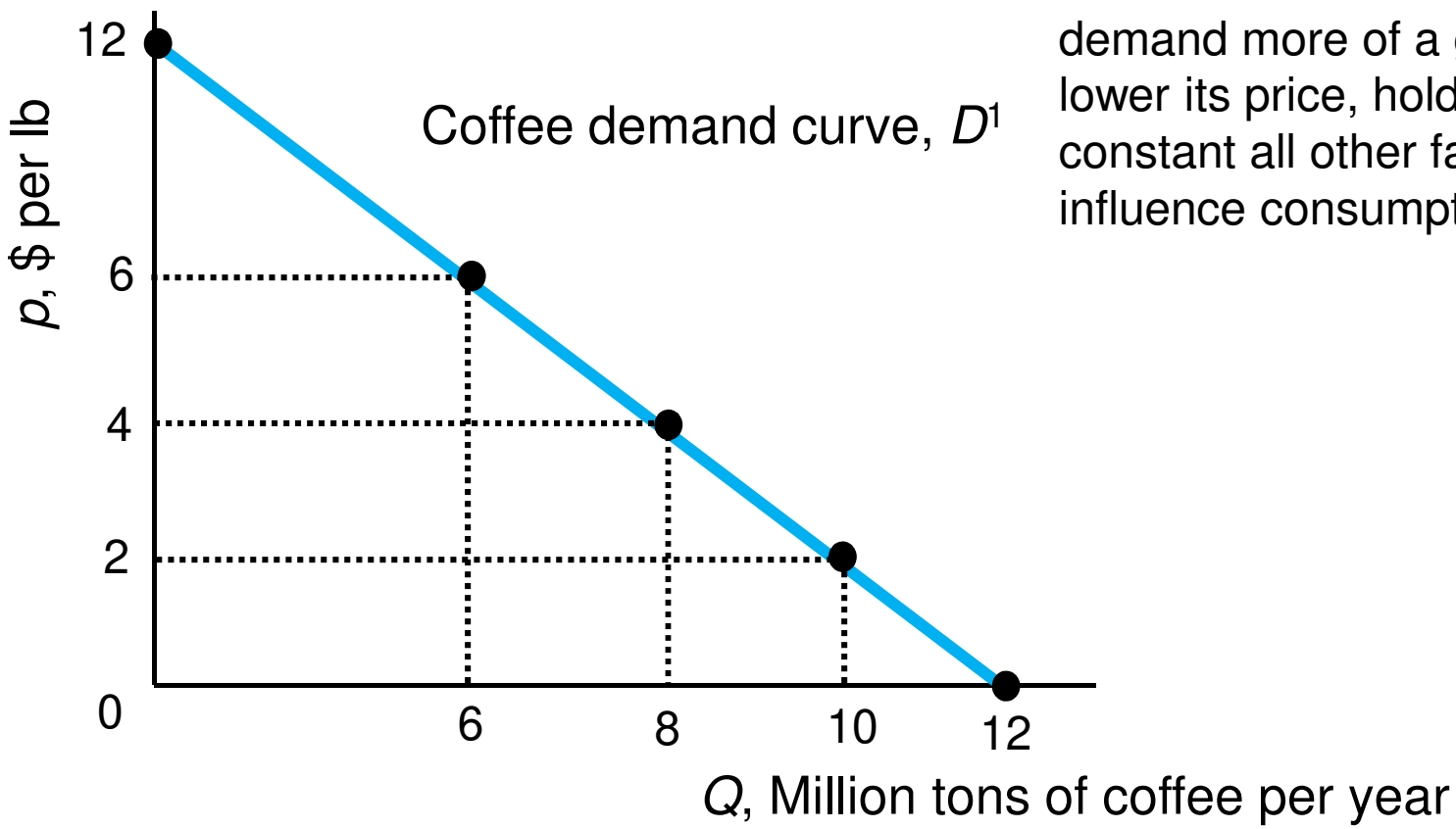
Figure 2.1 A Demand Curve



Law of Demand: consumers demand more of a good the lower its price, holding constant all other factors that influence consumption.

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Effects of Other Factors on Demand

- **Substitute** – a good or service that may be consumed instead of another good or service.
- **Complement** – a good or service that is jointly consumed with another good or service.
- A movement along a demand curve VS a shift of a demand curve

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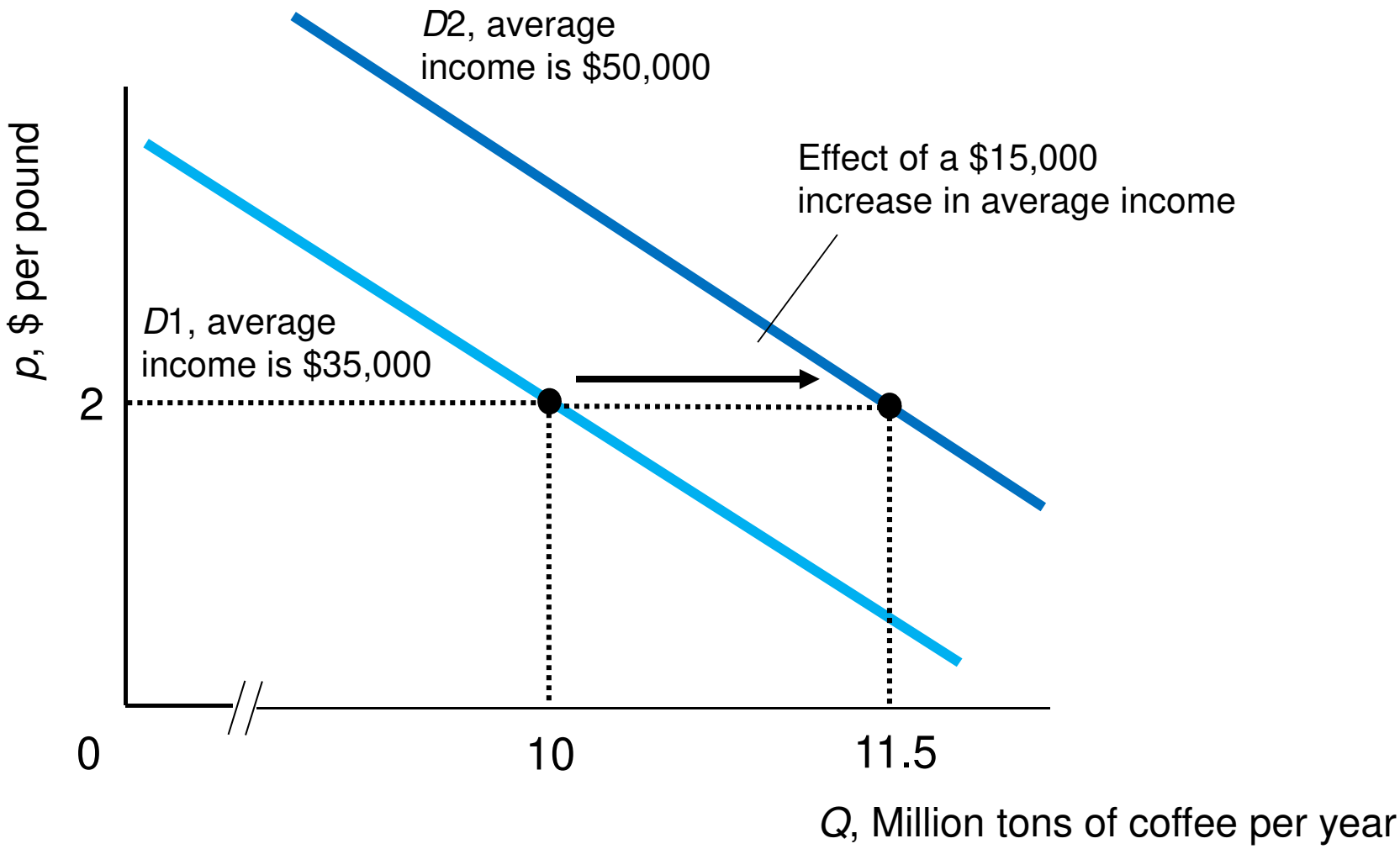
Figure 2.2 A Shift of the Demand Curve



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The Demand Function (1 of 3)

- The coffee demand function is:

$$Q = D\left(p, p_{s,} Y\right)$$

  - where Q is the quantity of coffee demanded (millions of tons per year)
  - p is the price of coffee (dollars per lb)
  - p_s is the price of sugar (dollars per lb)
  - Y is the average annual household income in high-income countries (thousands of dollars)

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The Demand Function (2 of 3)

- The estimated world demand function for green coffee beans:

$$Q = 8.56 - p - 0.3p_s + 0.1Y$$

- Use the values of p_s = \$0.20 per lb and Y = \$35 thousands per year, we have

$$Q = 12 - p$$

  – The linear demand function for coffee

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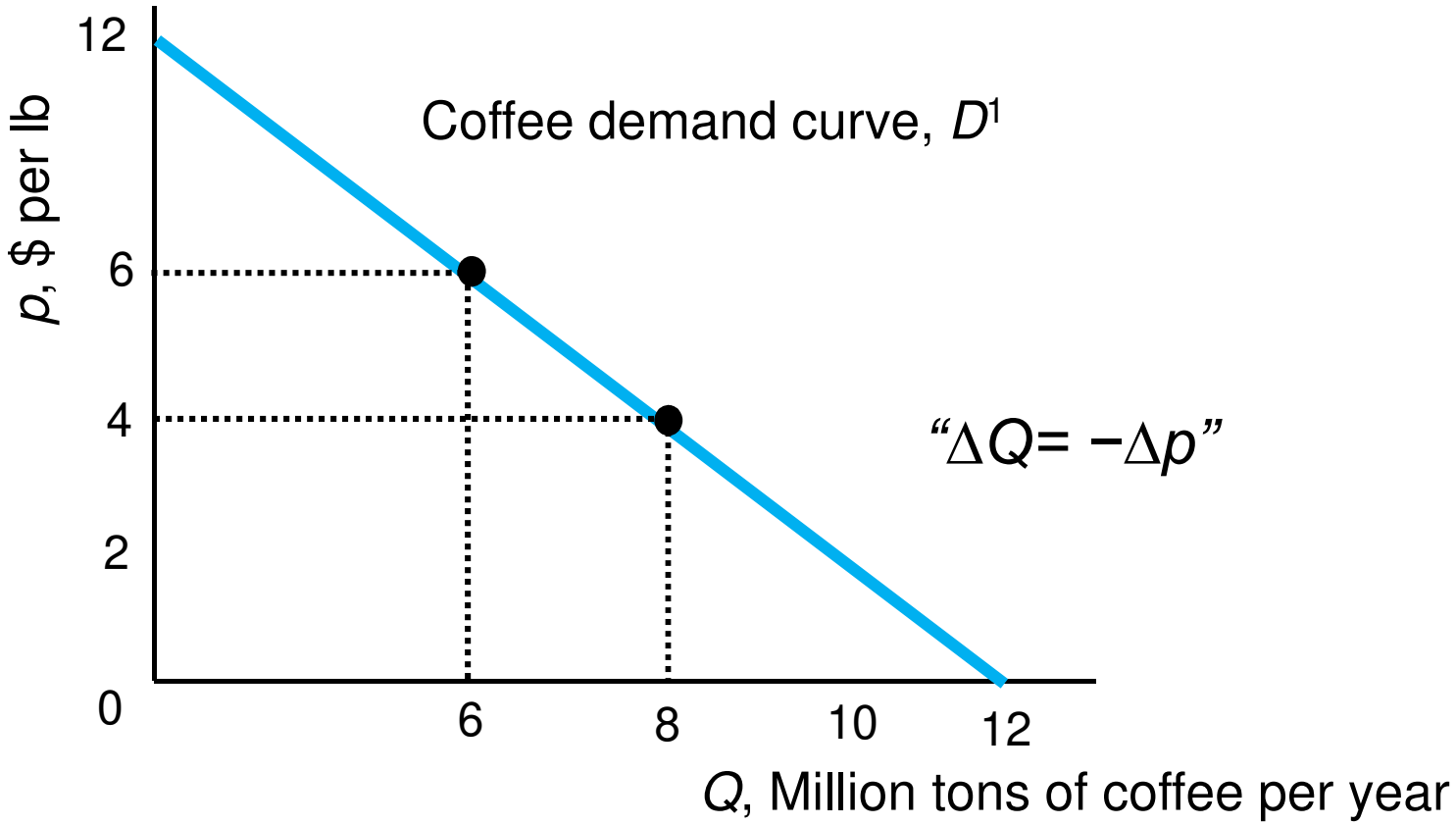
The Demand Function (3 of 3)



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Solved Problem 2.1

- How much would the price have to fall for consumers to be willing to buy 1 million more tons of coffee per year?

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Solved Problem 2.1: Answer (1 of 2)

1. Express the price that consumers are willing to pay as a function of quantity.

$$Q = 12 - p$$

$$p = 12 - Q$$

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Solved Problem 2.1: Answer (2 of 2)

2. Use the inverse demand curve to determine how much the price must change for consumers to buy 1 million more **tons of coffees** per year.

$$\begin{aligned}\Delta p &= p_2 - p_1 \\ &= (12 - Q_2) - (12 - Q_1) \\ &= -(Q_2 - Q_1) \\ &= -\Delta Q.\end{aligned}$$

   – The change in quantity is $\Delta Q = Q_2 - Q_1 = (Q_1 + 1) - Q_1 = 1$, so the change in price is $\Delta p = -1$.

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Summing Demand Curves

- The total quantity demanded at a given price is the sum of the quantity each consumer demands at that price.

$$
\begin{aligned}
Q &= Q_1 + Q_2 \\
&= D^1(p) + D^2(p)
\end{aligned}
$$

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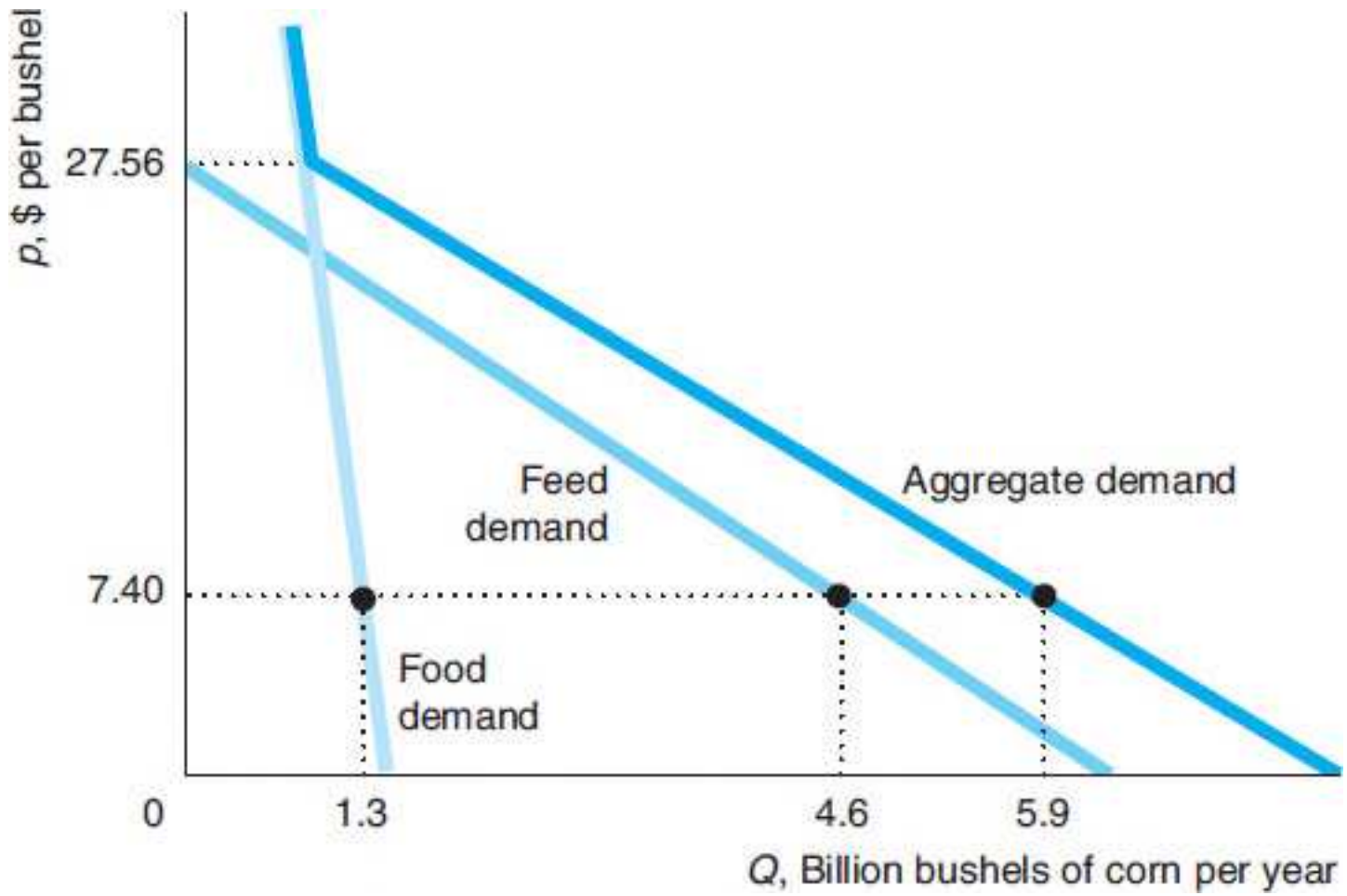
Application: Aggregating Corn Demand Curves



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Supply

Firms determine how much of a good to supply on the basis of the **price** of that good and other factors, including:

- The costs of production
- Government rules and regulations

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The Supply Curve

- **Quantity supplied** – the amount of a good that firms want to sell at a given price, holding constant other factors that influence firms' supply decisions, such as costs and government actions.
- **Supply curve** – shows the quantity supplied at each possible price, holding constant the other factors that influence firms' supply decisions.

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Figure 2.3 A Supply Curve

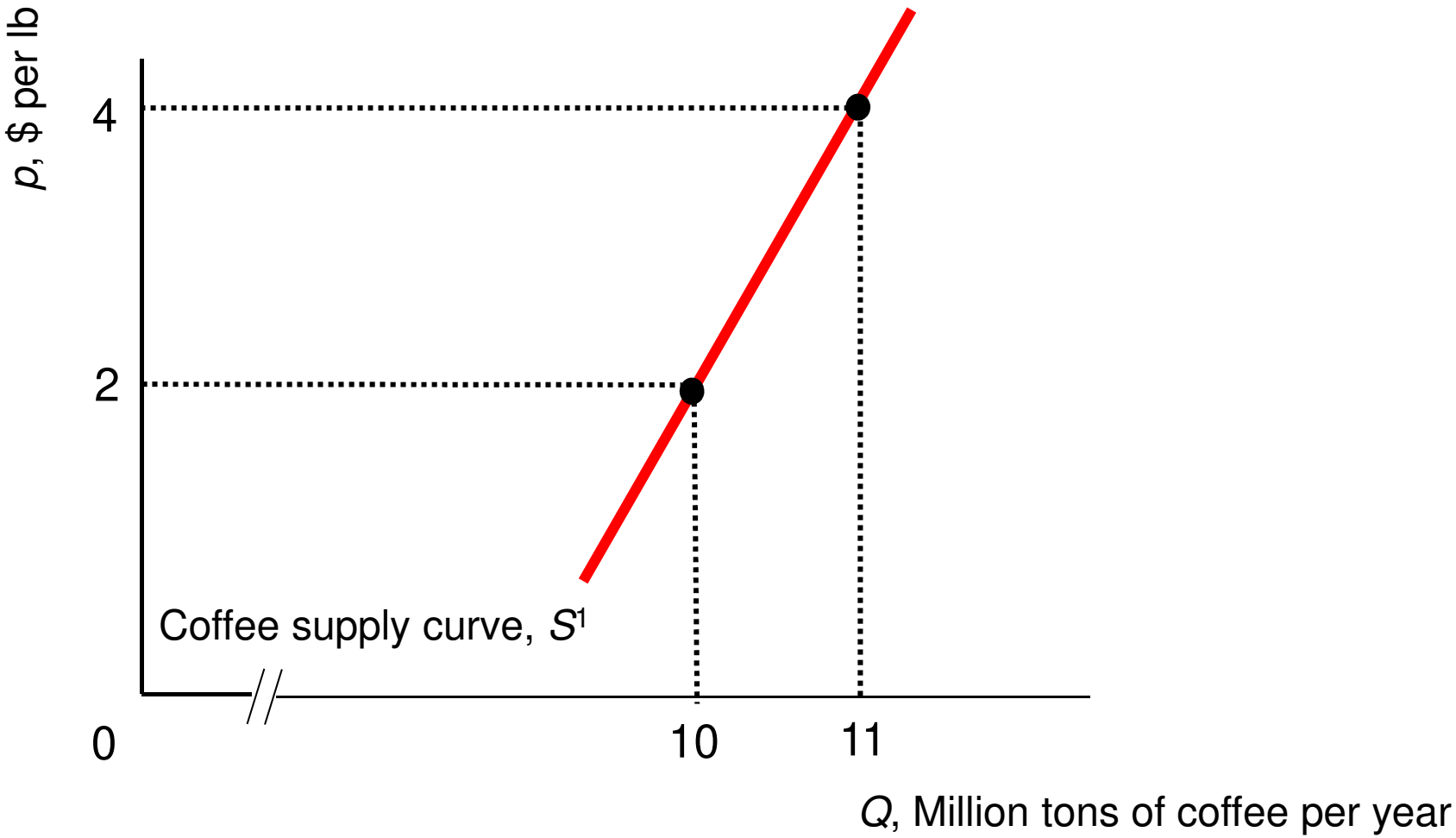

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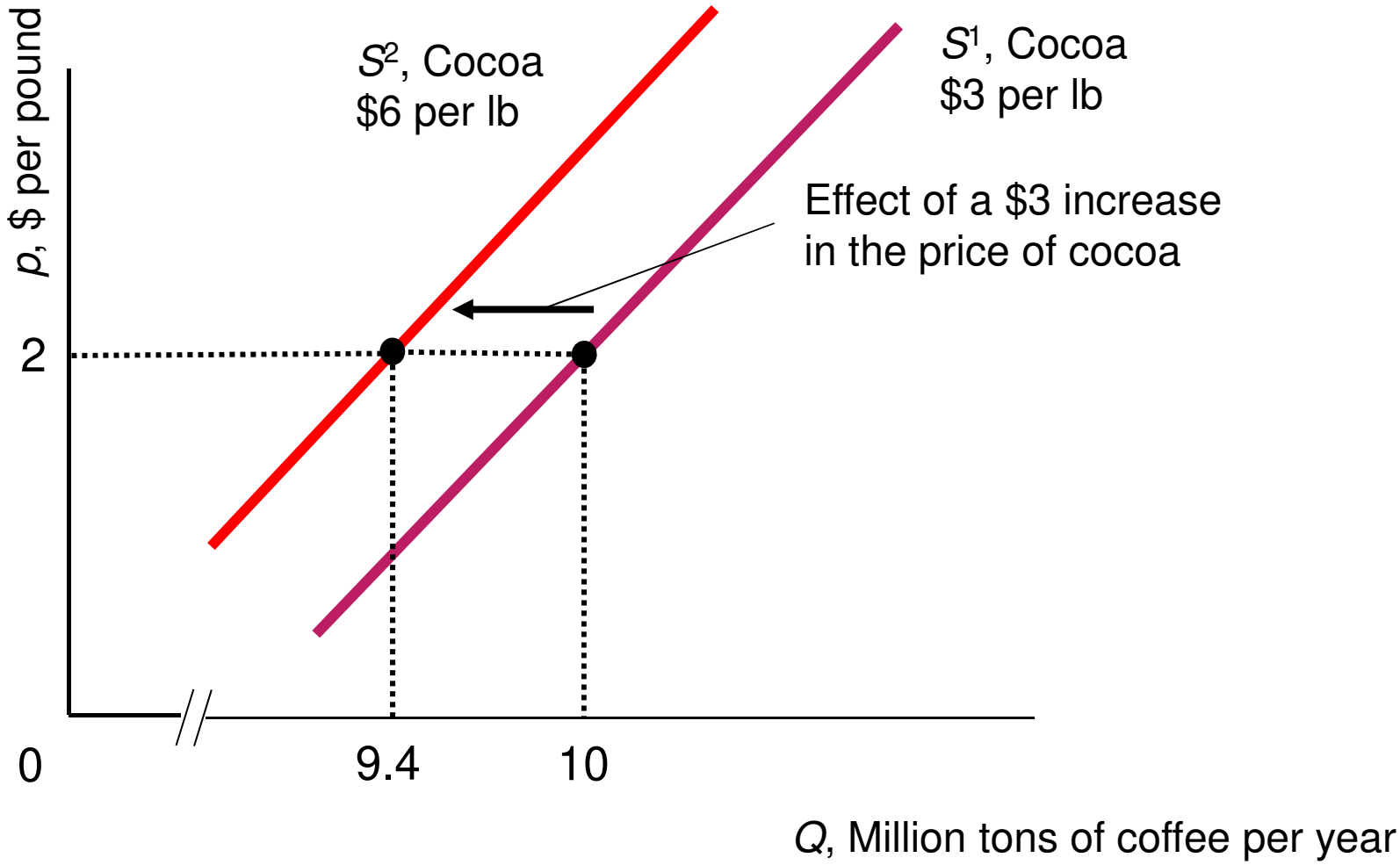
Figure 2.4 A Shift of a Supply Curve



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The Supply Function (1 of 2)

- The coffee supply function is:

$$Q = S(p, p_c)$$

  - where Q is the quantity of coffee supplied (millions of tons per year)
  - p is the price of coffee (dollars per lb)
  - p_c is the price of cocoa (dollars per lb)

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The Supply Function (2 of 2)

- The estimated coffee supply function is:

$$Q = 9.6 + 0.5p - 0.2p_c$$

- Using the values p_c = **$3** per lb:

$$Q = 9 + 0.5p$$

- What happens to the quantity supplied if the price of coffee increases by

$$\Delta p = p_2 - p_1 \text{ ?}$$

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Summing Supply Curves

- The total supply curve shows the total quantity produced by all suppliers at each possible price.
- Horizontal sum of each producer's supply curve.
  - Sum of all quantities supplied at a given price.

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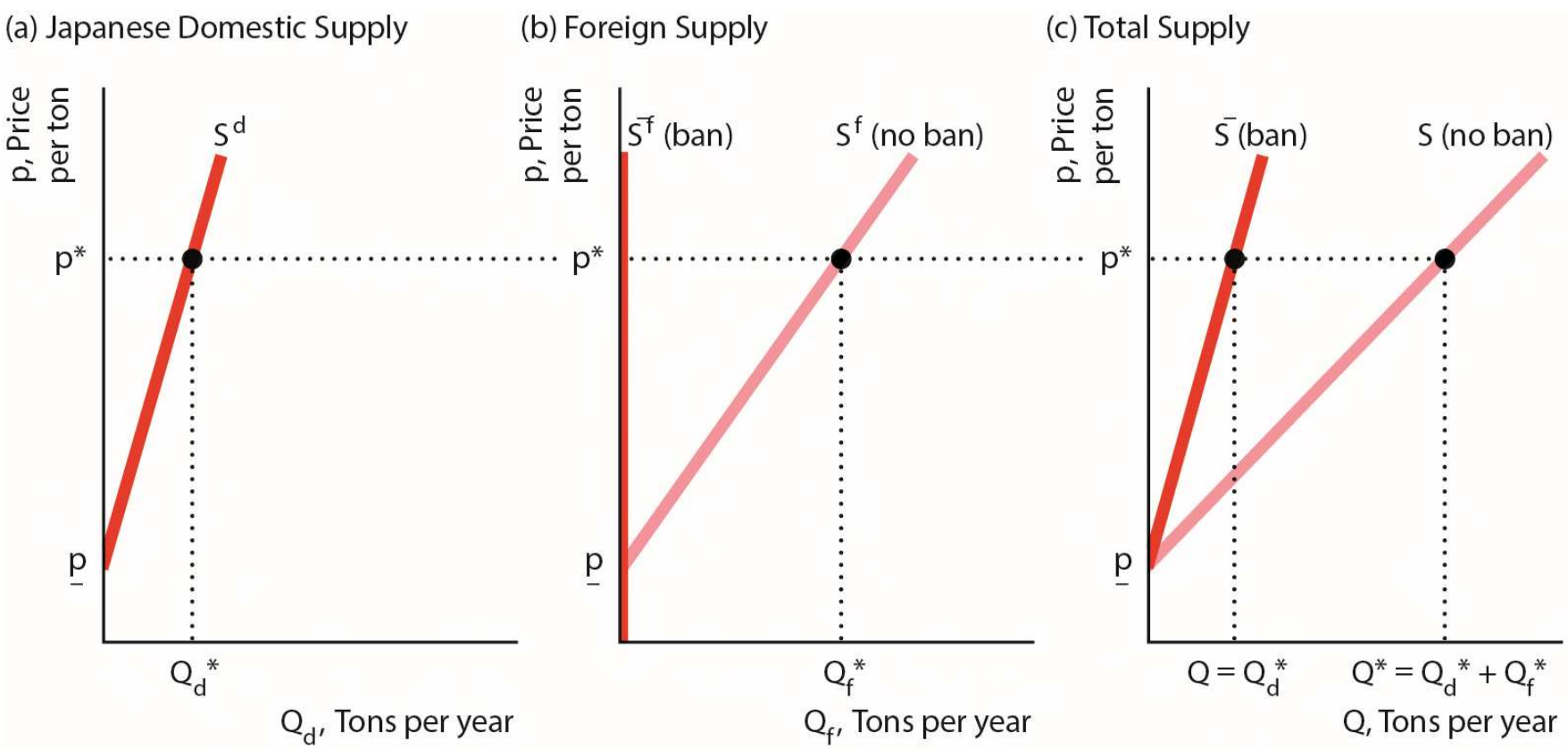
Figure 2.5 Total Supply: The Sum of Domestic and Foreign Supply



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Solved Problem 2.2

- How does a quota set by the United States on foreign sugar imports affect the total American supply curve for sugar given the domestic supply curve, S^d in panel a of the graph, and foreign supply curve, S^f in panel b?

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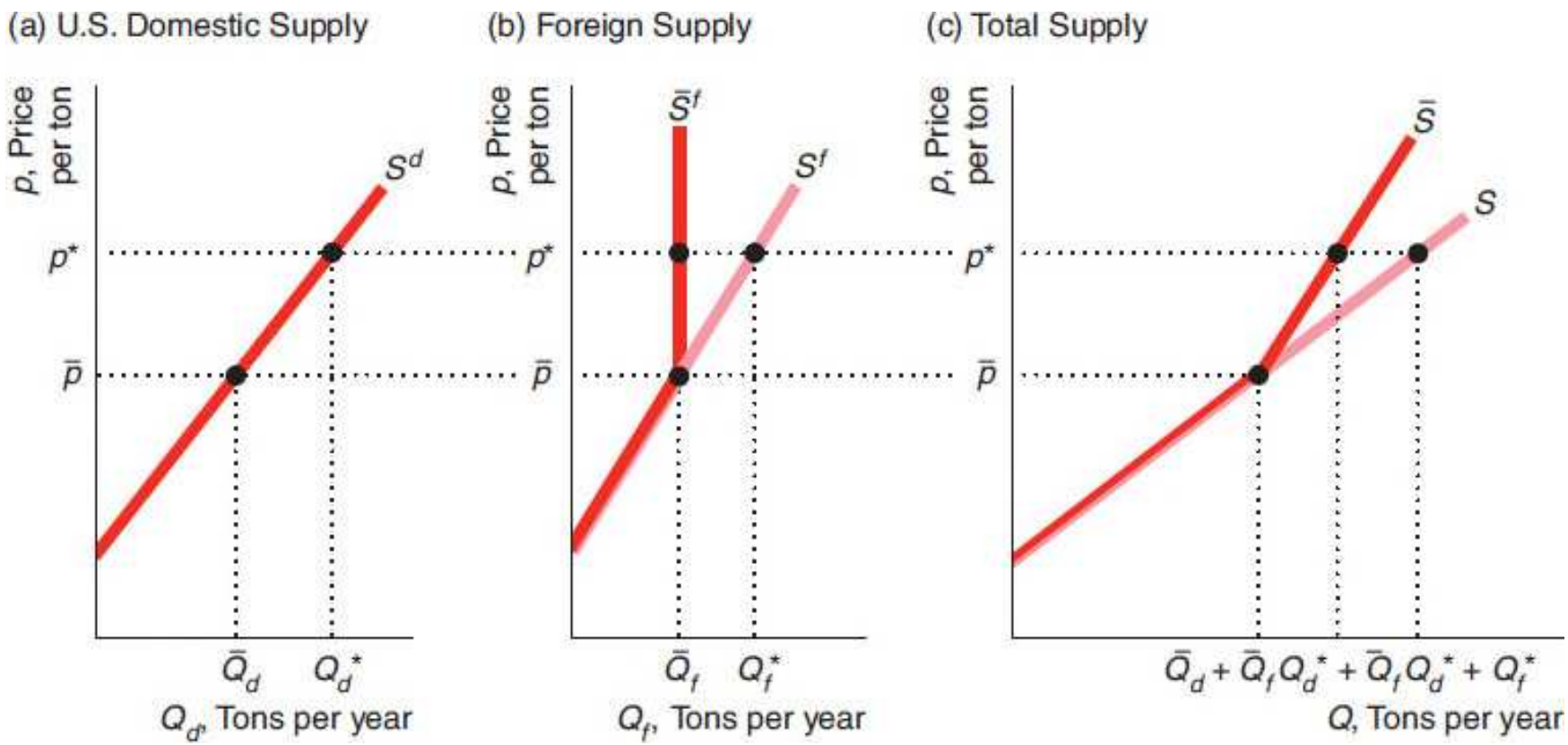
Solved Problem 2.2: Answer



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Market Equilibrium

- **Equilibrium** - a situation in which no one wants to change his or her behavior.
  - **equilibrium price** is the price at which consumers can buy as much as they want and sellers can sell as much as they want.
  - **equilibrium quantity** is the quantity bought and sold at the equilibrium price.

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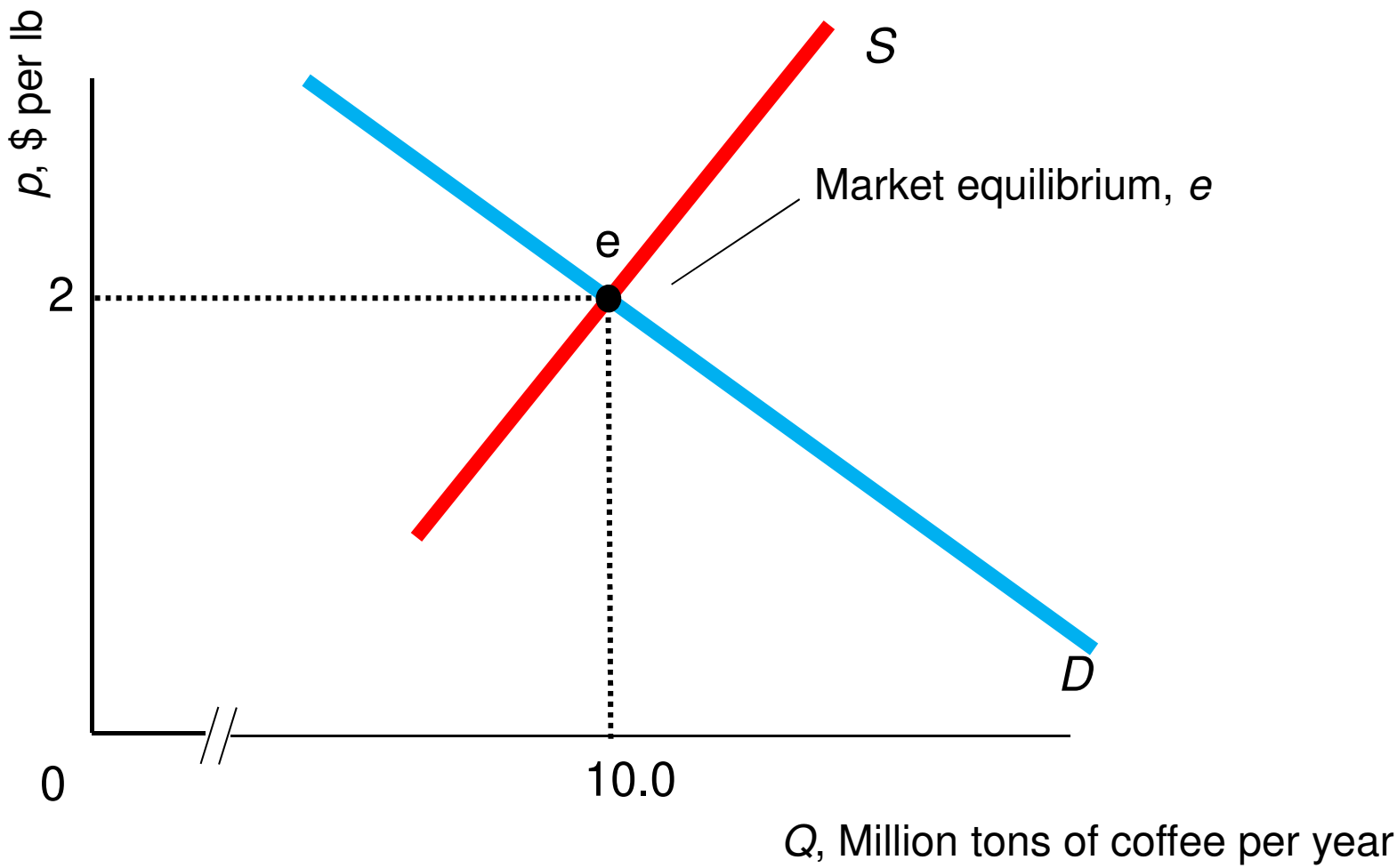
Use a Graph to Determine the Equilibrium



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Use Math to Determine the Equilibrium

- Demand: $Q_d = 12 - p$
- Supply: $Q_s = 9 + 0.5p$
- Equilibrium:

$$Q_d = Q_s$$

$$12 - p = 9 + 0.5p$$

$$1.5p = 3$$

$$p = \$2$$

$$Q = 12 - 2 = 10 \text{ or}$$

$$Q = 9 + 0.5 \times 2 = 10$$

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Forces that Drive the Market to Equilibrium

- **Disequilibrium** - the quantity demanded is not equal to the quantity supplied.
- **Excess demand** - the amount by which the quantity demanded exceeds the quantity supplied at a specified price.
- **Excess supply -** the amount by which the quantity supplied is greater than the quantity demanded at a specified price.

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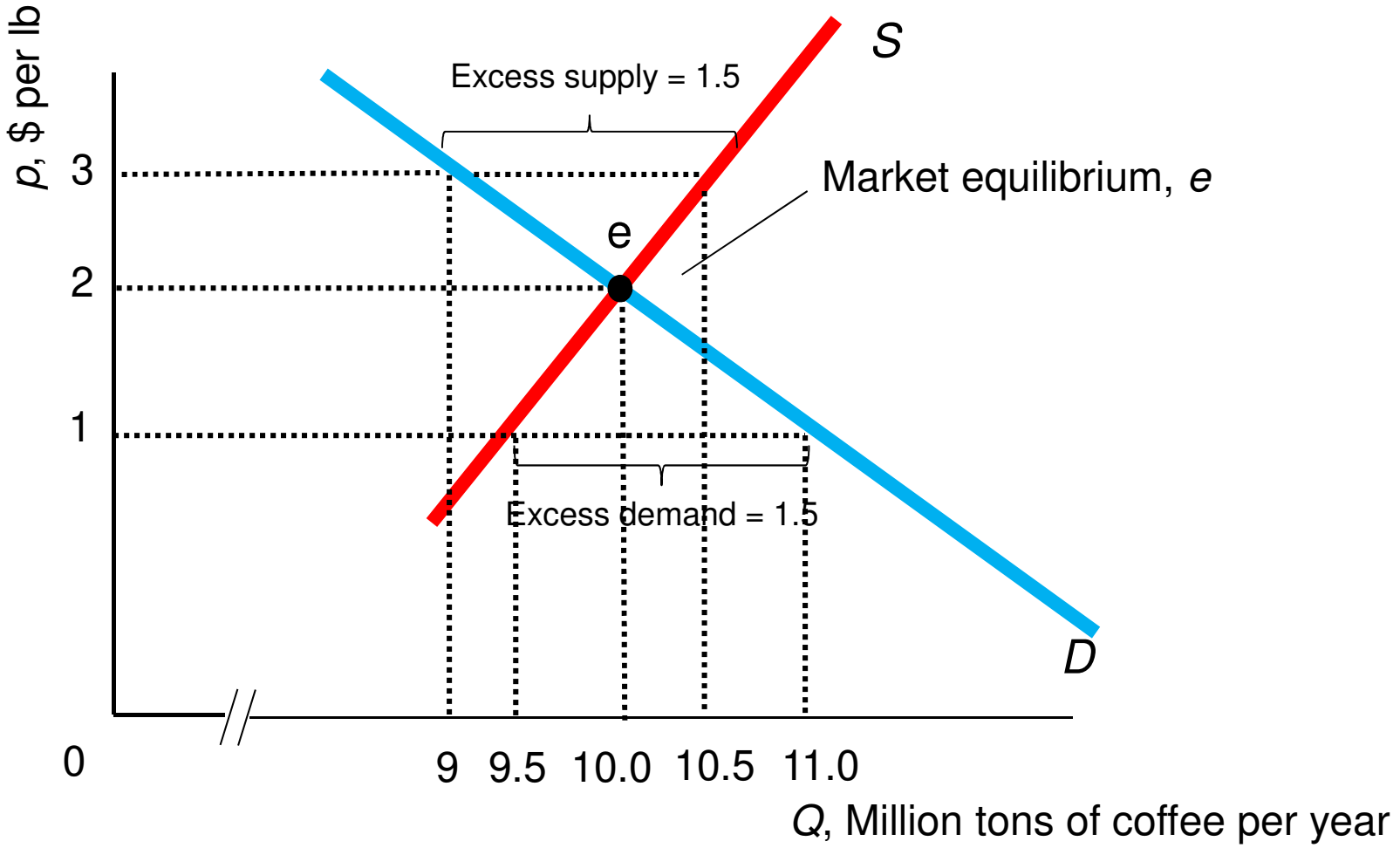
Figure 2.6 Market Equilibrium



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Shocking the Equilibrium

- The equilibrium changes only if a shock occurs that shifts the demand curve or the supply curve.
- These curves shift if one of the variables we are holding constant changes.
- If tastes, income, government policies, or costs of production change, the demand curve or the supply curve or both shift, and the equilibrium changes.

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Figure 2.7 (a) Equilibrium Effects of a Shift of a Demand or Supply Curve

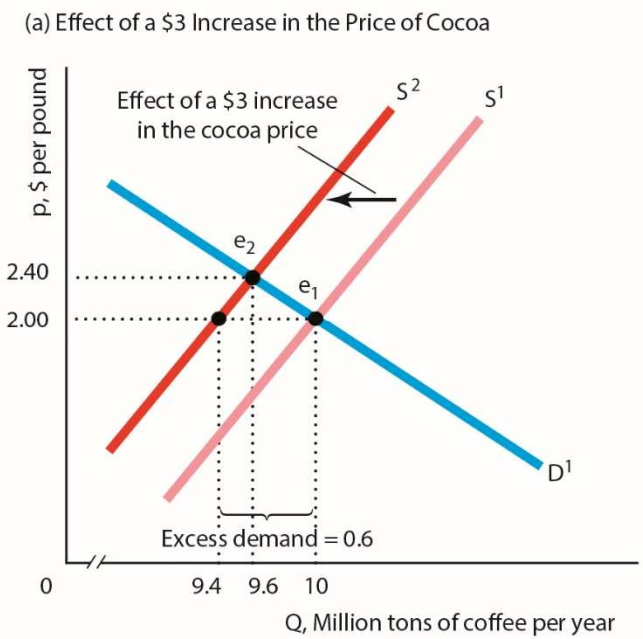

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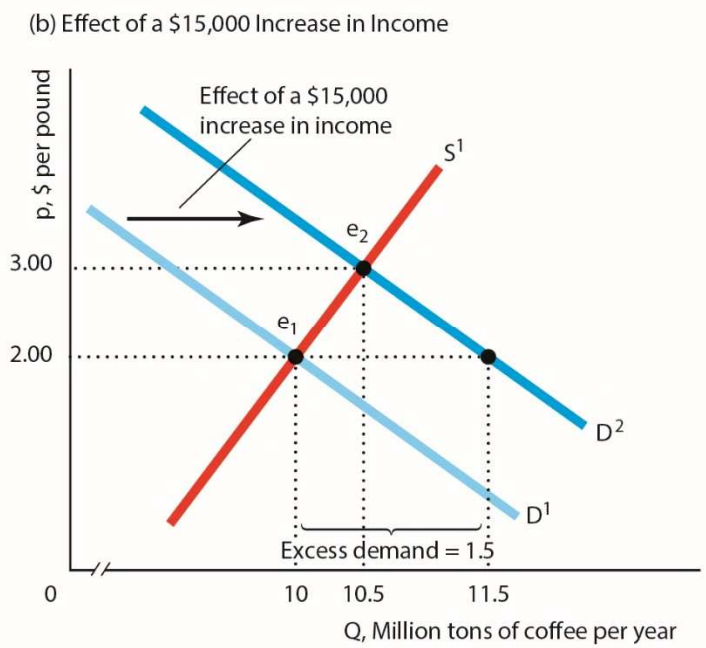
Figure 2.7 (b) Equilibrium Effects of a Shift of a Demand or Supply Curve



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Solved Problem 2.3

- Using algebra, determine how the equilibrium price and quantity of coffee change from the initial levels, $p = \$2$ and $Q = 10$, if the price of cocoa increases from its original price of $p_c = \$3$ by \$3 to \$6 per lb.

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Solved Problem 2.3: Answer (1 of 4)

1. Show how the demand and supply functions change due to the increase in the price of cocoa.

The demand function remains unchanged: S

$$Q_d = 12 - p$$

The new supply function:

$$Q_s = 9.6 + 0.5p - (0.2 \times 6)$$
$$= 8.4 + 0.5p$$

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Solved Problem 2.3: Answer (2 of 4)

2. Equate the supply and demand functions to determine the new equilibrium.

$$12 - p = 8.4 + 0.5p$$

Solve this equation for the equilibrium price is p = **$2.40,** then calculate the equilibrium quantity for substituting this price into the demand or supply functions:

$$Q = 12 - 2.4 = 8.4 + (0.5 \times 2.40)$$

$$= 9.6 \text{ million tons per year}$$

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Solved Problem 2.3: Answer (3 of 4)

3. Show how the equilibrium price and quantity of coffee changes by subtracting the original price and quantity from the new ones.

The change in the equilibrium price is

$$\Delta p = \$2.40 - \$2 = \$0.40$$

The change in the equilibrium quantity is

$$\Delta Q = 9.6 - 10 = -0.40 \text{ million tons per year}$$

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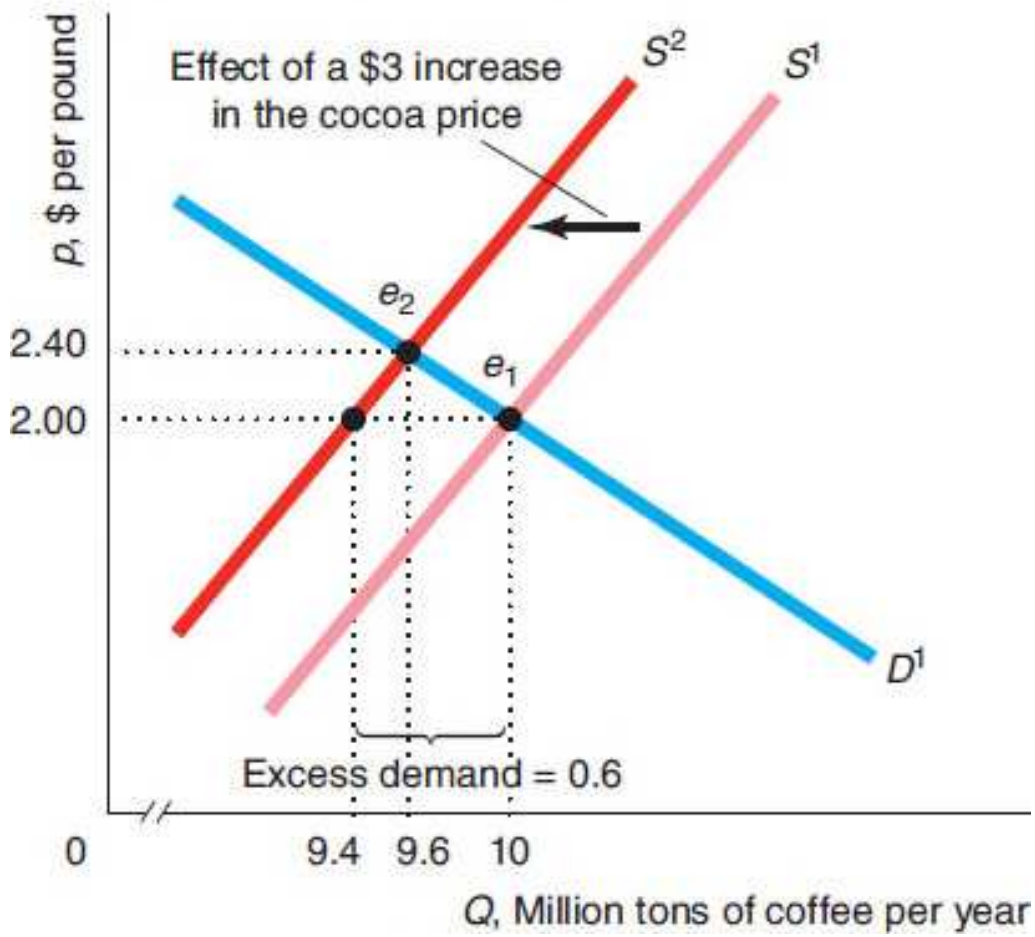
Solved Problem 2.3: Answer (4 of 4)

(a) Effect of a $3 Increase in the Price of Cocoa



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Effects of Government Interventions

- Government actions can cause
  - a shift in the supply curve, the demand curve, or both curves.
  - the quantity demanded to differ from the quantity supplied.
- Policies that shift supply curves
  - Licensing laws
  - quotas
- Policies that cause demand to differ from supply
  - Price ceilings
  - price floors

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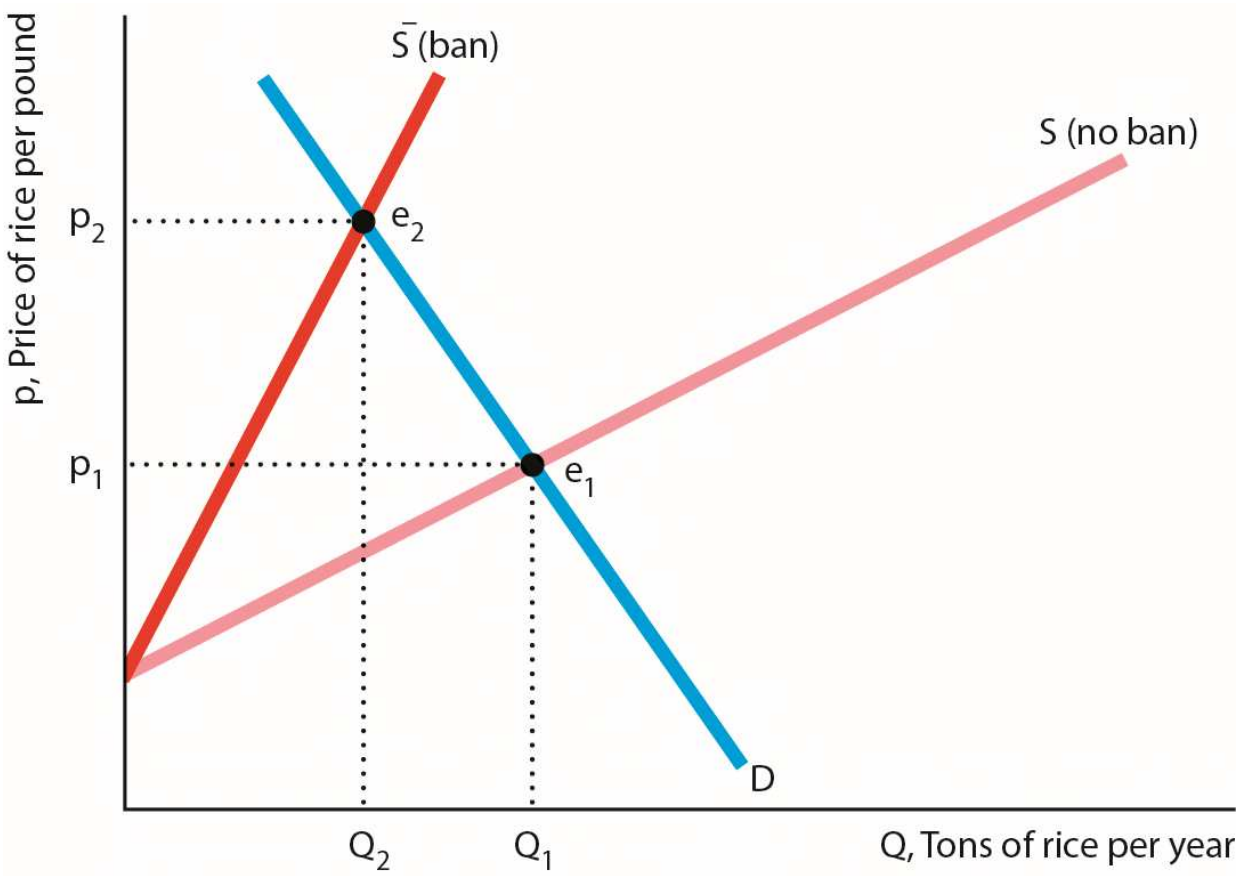
Figure 2.8 A Ban on Rice Imports Raises the Price in Japan



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Solved Problem 2.4

- What is the effect of a United States quota on sugar on the equilibrium in the U.S. sugar market? Hint: The answer depends on whether the quota binds (is low enough to affect the equilibrium).

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Solved Problem 2.4: Answer

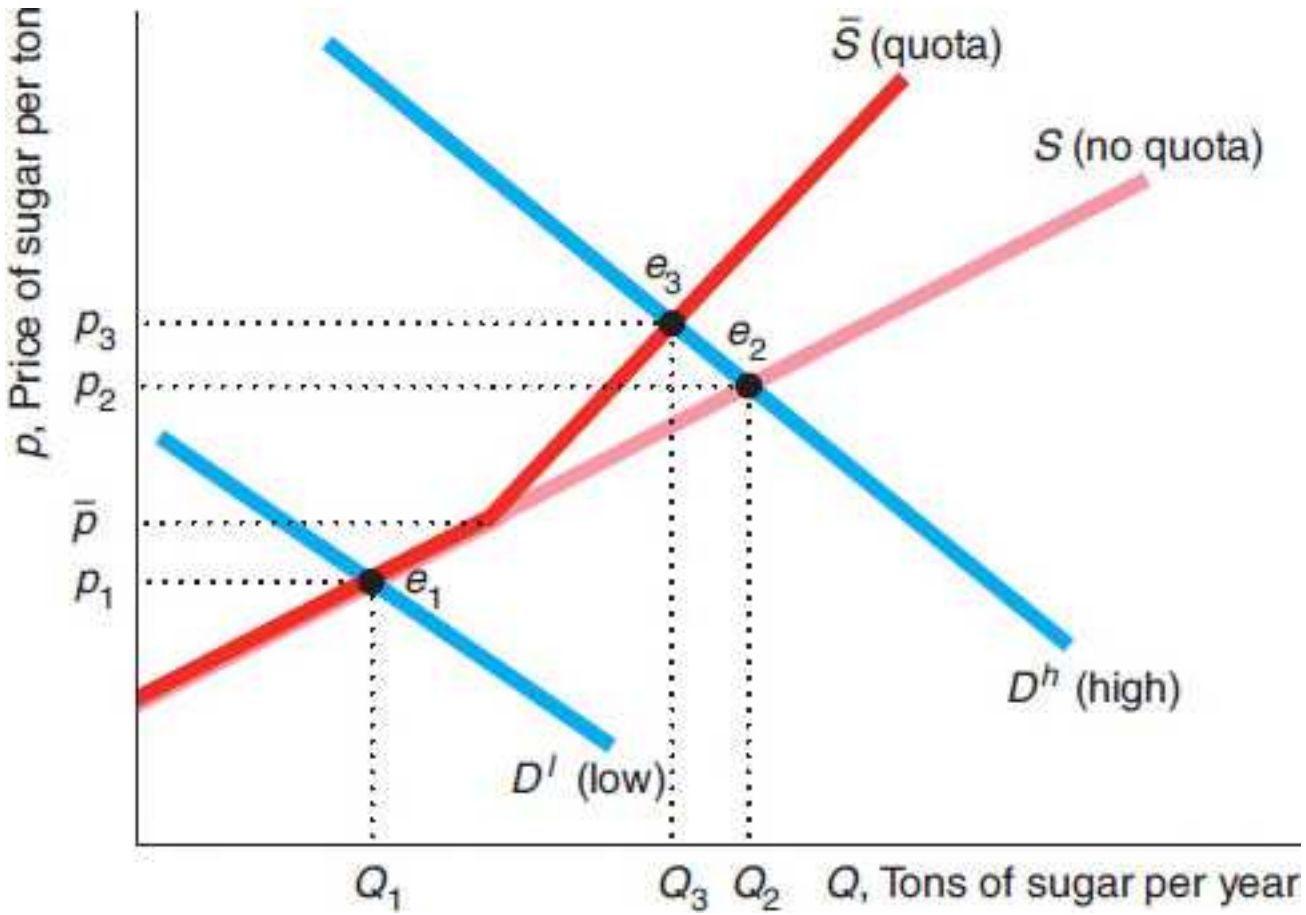

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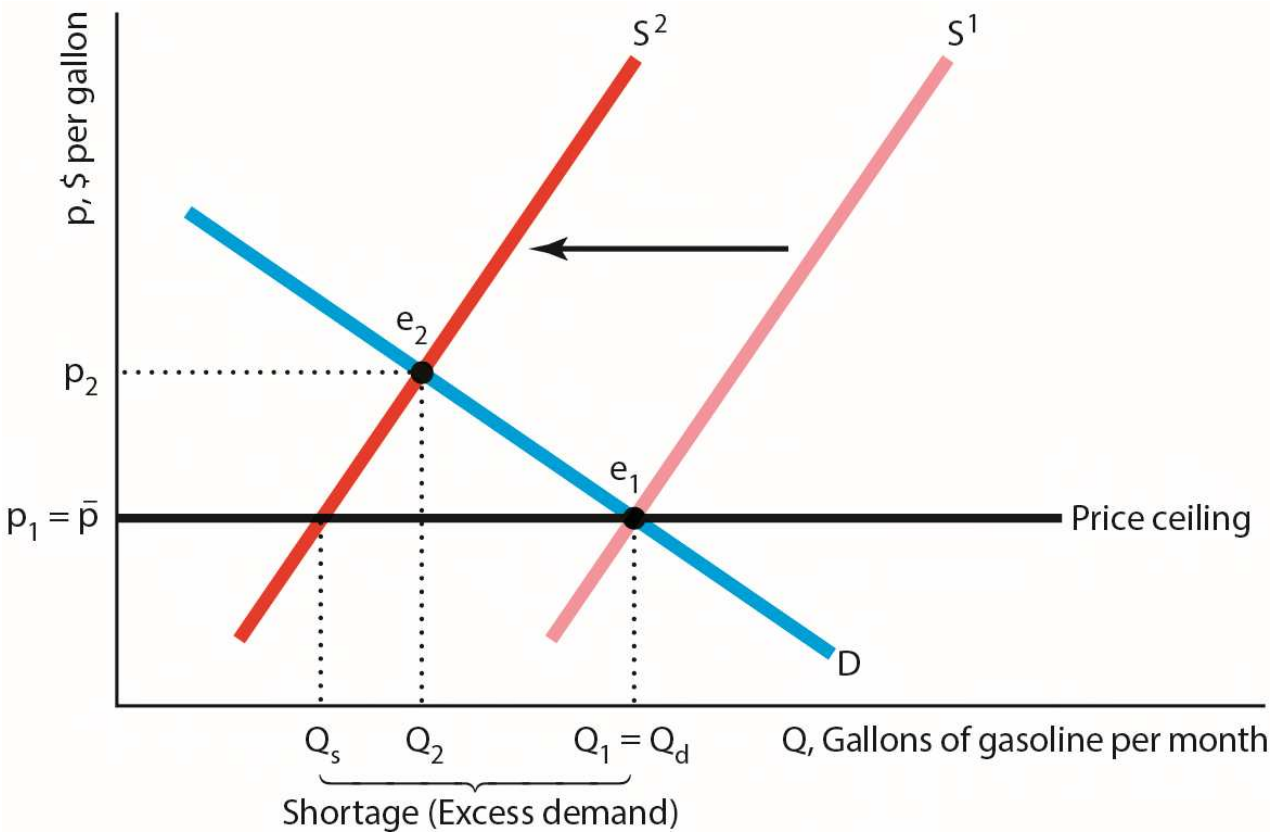
Figure 2.9 Price Ceiling on Gasoline

When OPEC reduced supplies of oil



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Solved Problem 2.5

- Suppose everyone is paid the same wage in a labor market. what happens to the equilibrium in this market if the government imposing a binding minimum wage, $\underline{w}$?

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Solved Problem 2.5: Answer (1 of 2)

- Answer:
  - Show the initial equilibrium before the minimum wage is imposed.
  - Draw a horizontal line at the minimum wage, and show how the market equilibrium changes.

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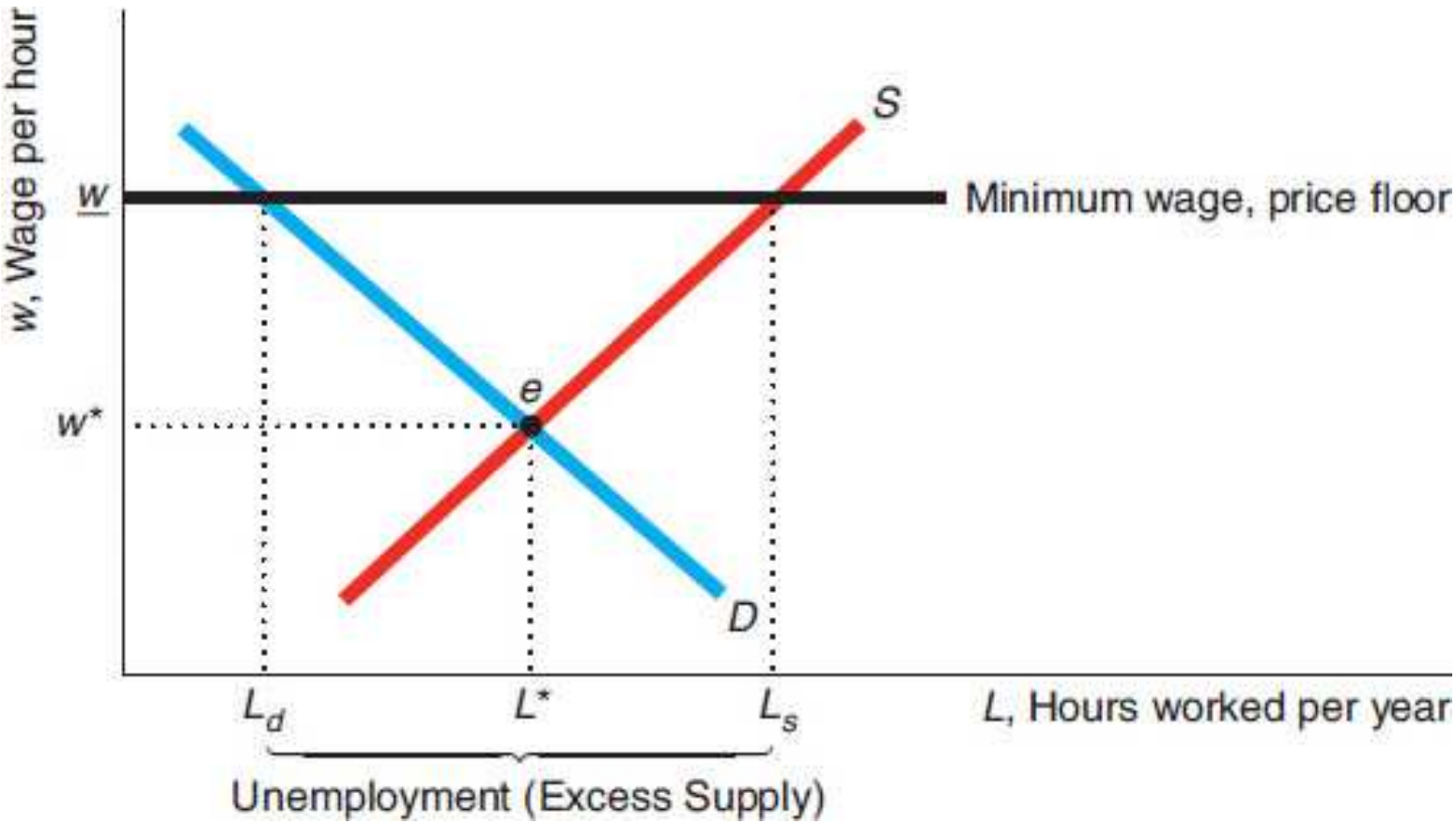
Solved Problem 2.5: Answer (2 of 2)



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Why the Quantity Supplied Need Not Equal the Quantity Demanded

- Common Confusion: Demand must equal supply
- The quantity that firms want to sell and the quantity that consumers want to buy at a given price need not equal the **actual** quantity that is bought and sold.
  - Example: price ceiling.

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When to Use the Supply-and-Demand Model

- Everyone is a price taker.
- Firms sell identical products.
- Everyone has full information about the price and quality of goods.
- Costs of trading are low.

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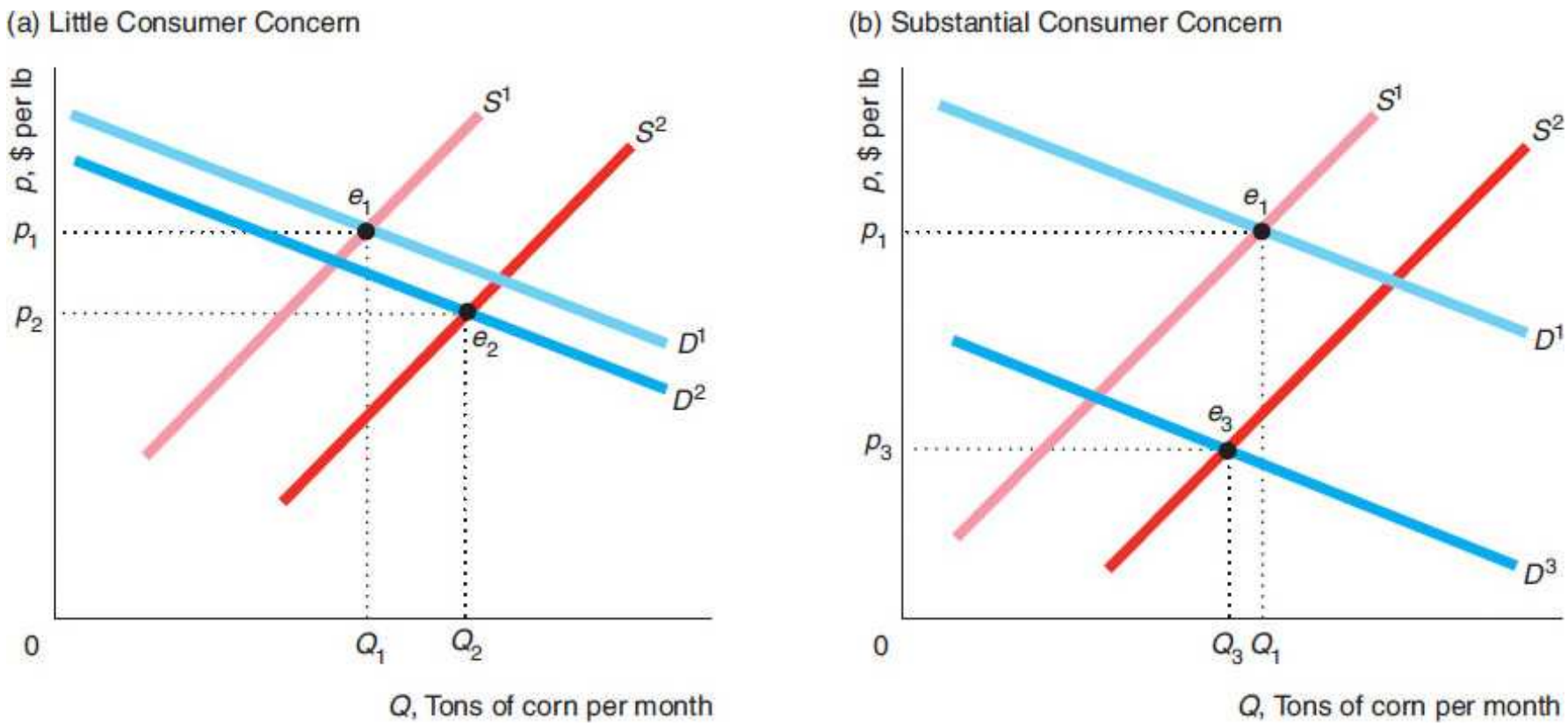
Quantities and Prices of Genetically Modified Foods



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