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Chapter 2
Supply and Demand

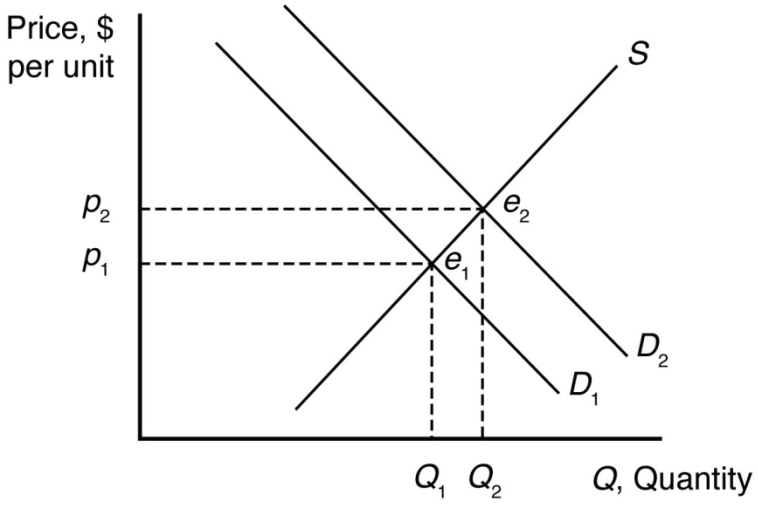
SOLUTIONS TO END-OF-CHAPTER QUESTIONS

DEMAND

1.1 When the price of coffee changes, the change in the quantity demanded reflects a movement along the demand curve. When other variables that affect demand change, the entire demand curve shifts. For example, when income changes, this causes coffee demand to shift.

1.2 $\frac{\partial Q}{\partial Y} = 0.1$.

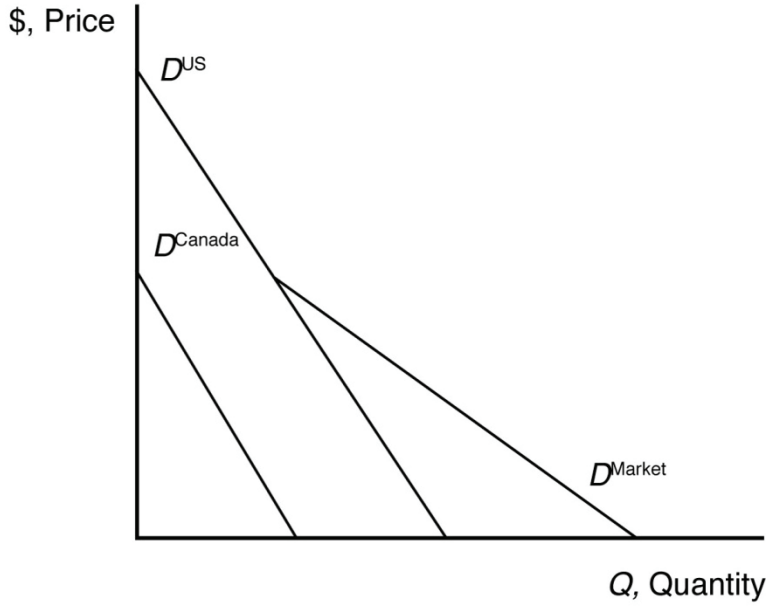
An increase in Y shifts the demand curve to the right, from D_1 to D_2.



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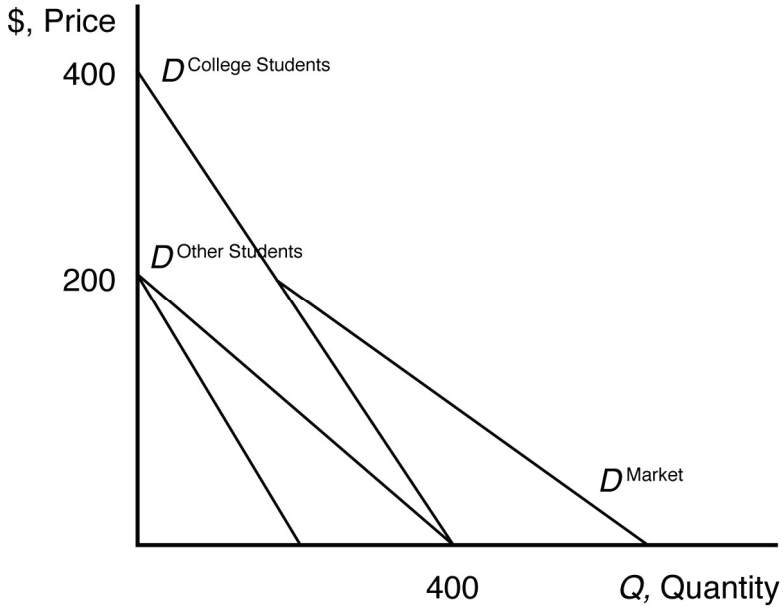
1.3 The market demand curve is the sum of the quantity demanded by individual consumers at a given price. Graphically, the market demand curve is the horizontal sum of individual demand curves.



1.4 a. The inverse demand curve for other town residents is $p = 200 - 0.5Q_r$.

b. At a price of $300, college students demand 100 units of firewood, and other residents demand no firewood. Other residents will demand zero units of firewood if the price is greater than or equal to $200.

c. The market demand curve is the horizontal sum of individual demand curves, as illustrated below.



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SUPPLY

2.1 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 by 22 units at every price (i.e., a parallel shift to the left).

2.2 When the price of avocados changes, the change in the quantity supplied reflects a movement along the supply curve. When costs or other variables that affect supply change, the entire supply curve shifts. For example, the price of fertilizer represents a key factor of avocado production, which affects the cost of avocado production, shifting the avocado supply curve. This is because avocado prices are measured on a graph axis. Other factors that affect supply are not measured by a graph axis.

2.3 Given the supply function,

$$Q = 58 + 15p - 20p_f,$$

The effect of a change in p on Q is

$$\frac{\Delta Q}{\Delta p} = 15p.$$

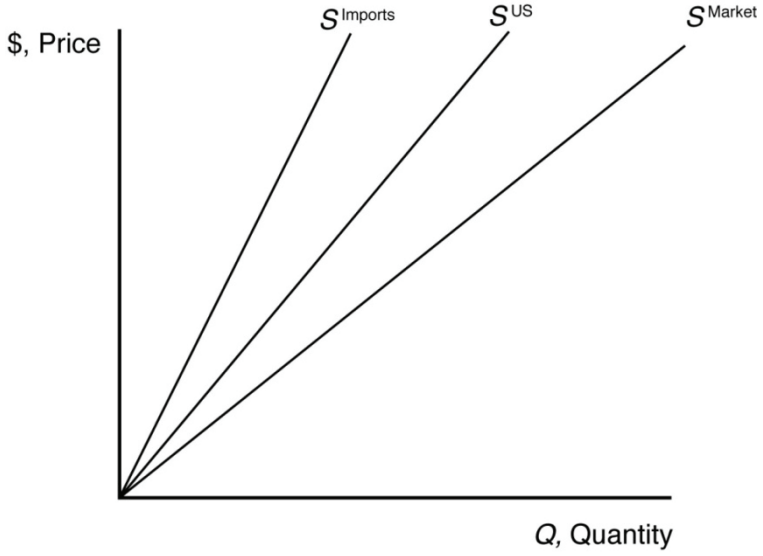
To change quantity by 60, price would need to change by

$$60 = 15p$$
$$p = \$4.00.$$

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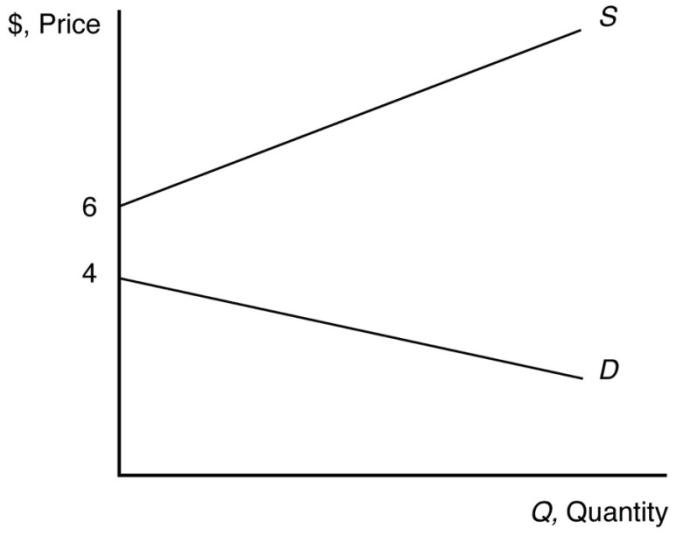
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2.4 The market supply curve is the sum of the quantity supplied by individual producers at a given price. Graphically, the market supply curve is the horizontal sum of individual supply curves.



MARKET EQUILIBRIUM

3.1 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.



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3.2 The equilibrium price is $p = 20$ and the equilibrium quantity is $Q = 80$.

3.3 Given that $p_c = \$5$ and $Y = \$55{,}000$ (note Y is measured in thousands, so the value to use here is 55), the demand for coffee can be rewritten as

$$Q = 14 - p$$

and the supply of coffee can be rewritten as

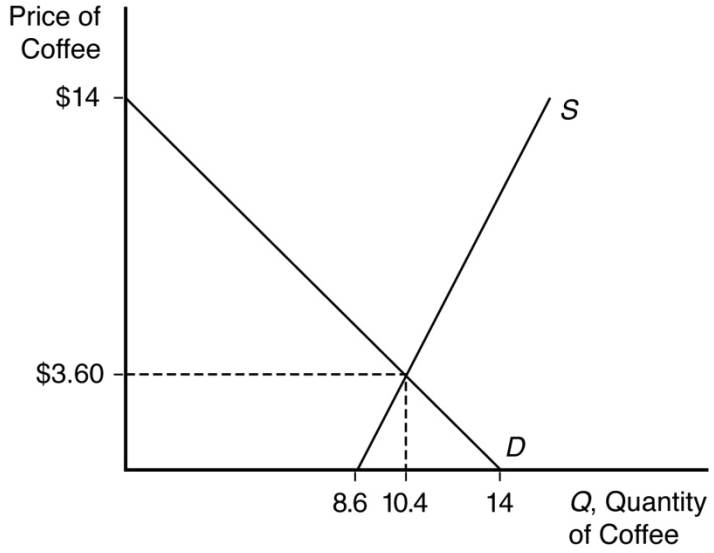
$$Q = 8.6 + 0.5p.$$

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. Thus, the equilibrium price is

$$\begin{aligned} D &= S \\ 14 - p &= 8.6 + 0.5p \\ 5.4 &= 1.5p \\ p &= \$3.60. \end{aligned}$$

Find the equilibrium quantity by substituting this price into either the supply or demand function. For example, using the supply function, the equilibrium quantity is

$$\begin{aligned} Q &= 8.6 + 0.5p \\ Q &= 8.6 + 0.5(3.60) \\ Q &= 8.6 + 1.8 \\ Q &= 10.4 \text{ units.} \end{aligned}$$



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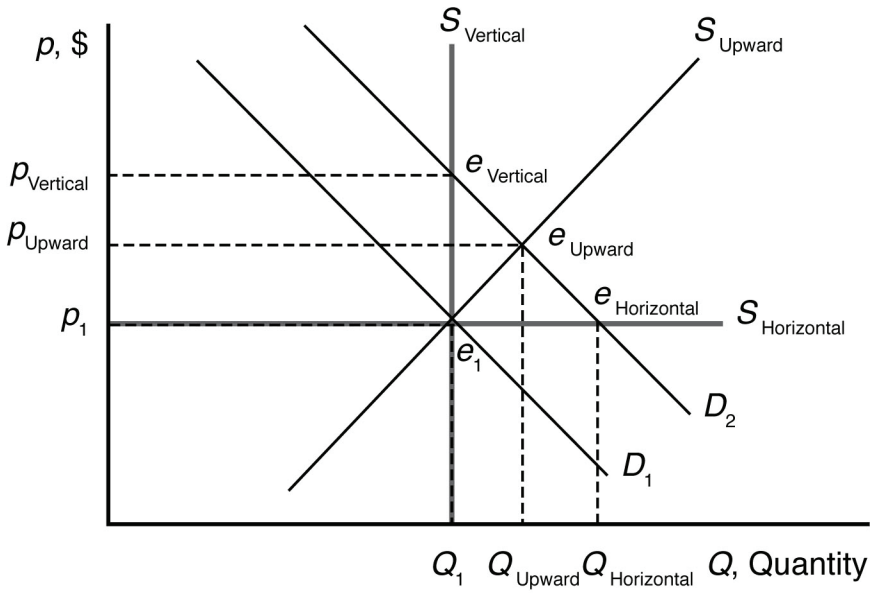
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SHOCKS TO THE EQUILIBRIUM

4.1 a. The new equilibrium with the horizontal supply curve is where the new demand curve intersects the horizontal supply curve. The new equilibrium price is unchanged. See figure.

b. The new equilibrium with the vertical supply curve is where the new demand curve intersects the vertical supply curve. The new equilibrium price is higher. See figure.

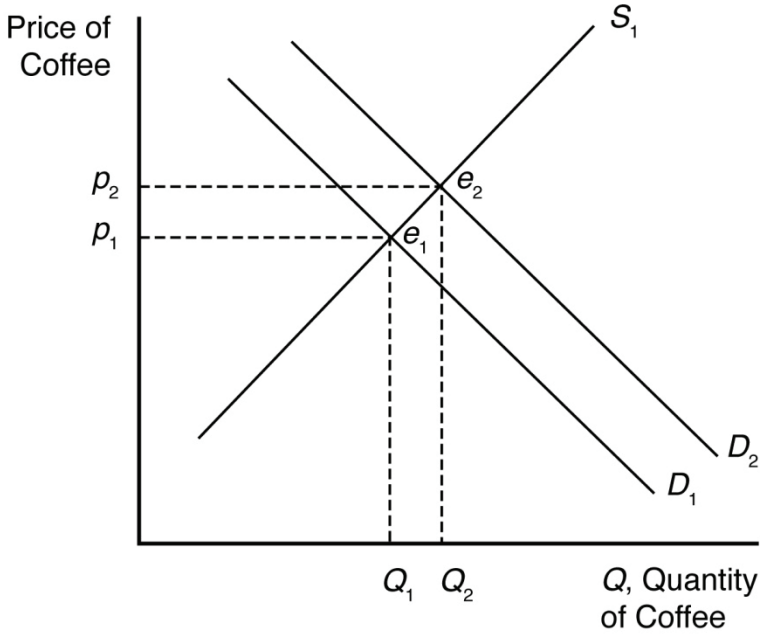
c. The new equilibrium with the upward-sloping supply curve is where the new demand curve intersects the upward-sloping supply curve. The new equilibrium price is higher. See figure.



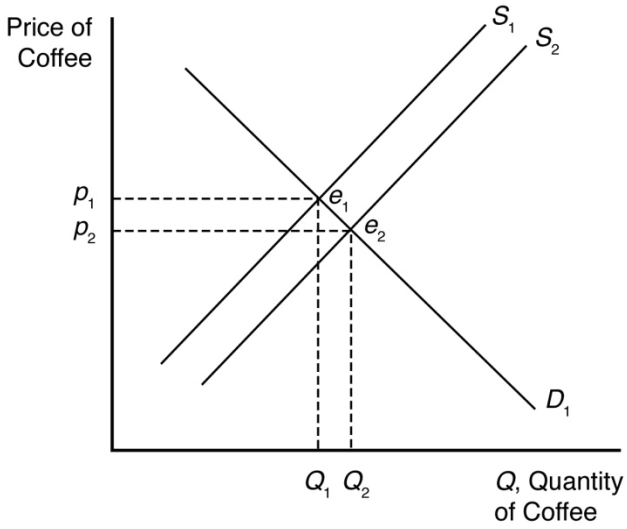
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4.2 a. Health benefits from drinking coffee shift the demand curve for coffee to the right because more coffee is now demanded at each price. The new market equilibrium is where the original supply curve intersects the new coffee demand curve, at a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



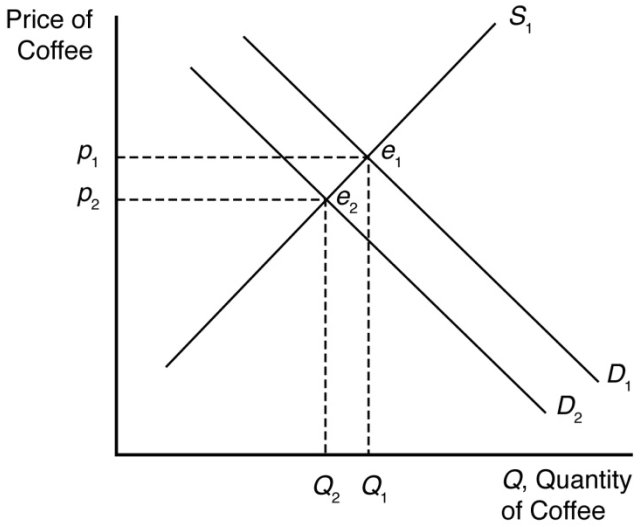
b. An increase in the usefulness of cocoa will increase demand for cocoa. This will drive up the equilibrium price of cocoa. Since cocoa and coffee are likely substitutes, this will increase the demand for coffee. The new market equilibrium is where the original supply curve intersects the new coffee demand curve, at a higher price and higher quantity.



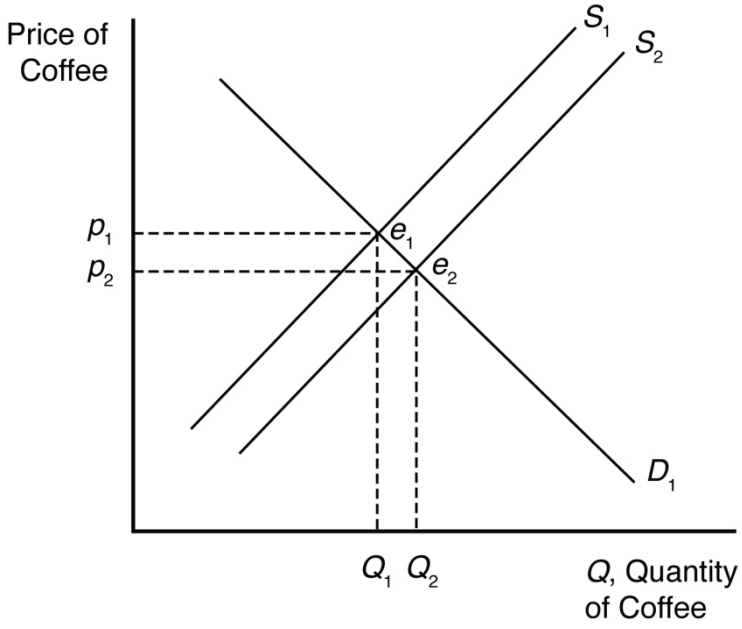
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c. A recession shifts the demand curve for coffee to the left because less coffee is now demanded at each price. The new market equilibrium is where the original supply curve intersects the new coffee demand curve, at a lower price and lower quantity.



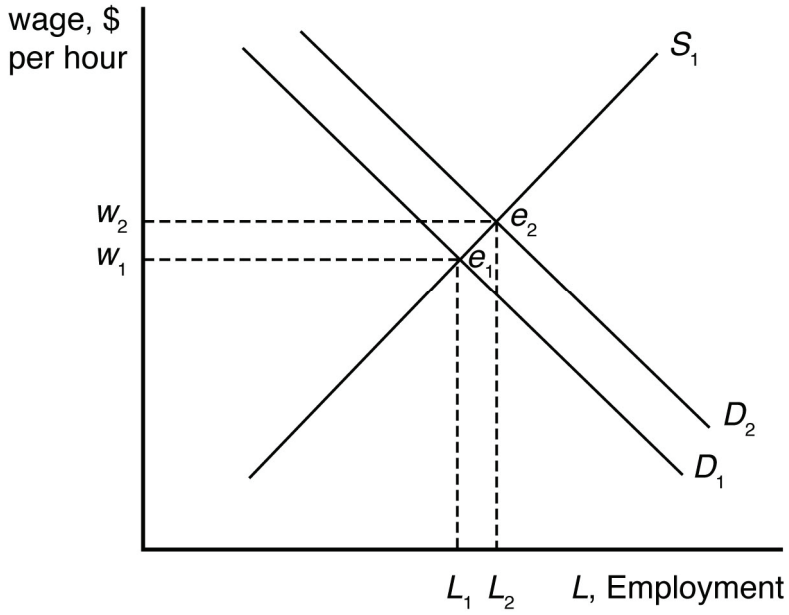
d. New technologies increasing yields shift the supply curve for coffee to the right because more coffee is now supplied at each price. The new market equilibrium is where the original demand curve intersects the new coffee supply curve, at a lower price and higher quantity.



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4.3 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.



4.4 Given that p_t = \$0.80, the demand for avocados can be rewritten as

$$Q = 160 - 40p$$

and the supply of avocados can be rewritten as

$$Q = 50 + 15p.$$

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. Thus, the equilibrium price is

$$D = S$$
$$160 - 40p = 50 + 15p$$
$$110 = 55p$$
$$p = \$2.00.$$

Find the equilibrium quantity by substituting this price into either the supply or demand function. For example, using the supply function, the equilibrium quantity is

$$Q = 50 + 15p$$
$$Q = 50 + 15(2.00)$$
$$Q = 50 + 30$$
$$Q = 80 \text{ units.}$$

When the price of tomatoes increases to \$1.35, the demand curve for avocados shifts out to

$$Q = 171 - 40p$$

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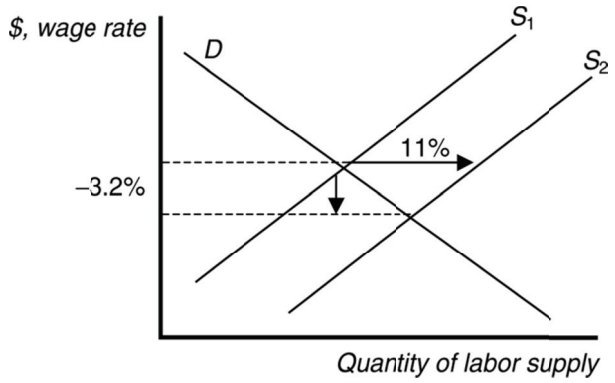
The supply of avocados is unchanged. The new equilibrium is found where

$$D = S$$
$$171 - 40p = 50 + 15p$$
$$121 = 55p$$
$$p = \$2.20.$$

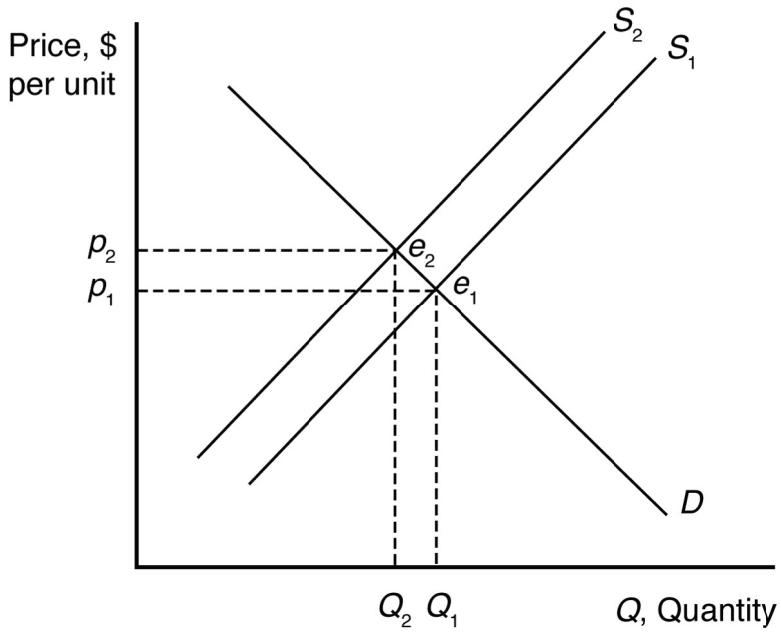
The equilibrium quantity is found as before

$$Q = 50 + 15p$$
$$Q = 50 + 15(2.20)$$
$$Q = 50 + 33$$
$$Q = 83 \text{ units.}$$

4.5 The numbers suggest that labor demand is inelastic. The supply curve shifts to the right by 11 percent, yet the decrease in equilibrium wage is only 3.2 percent.



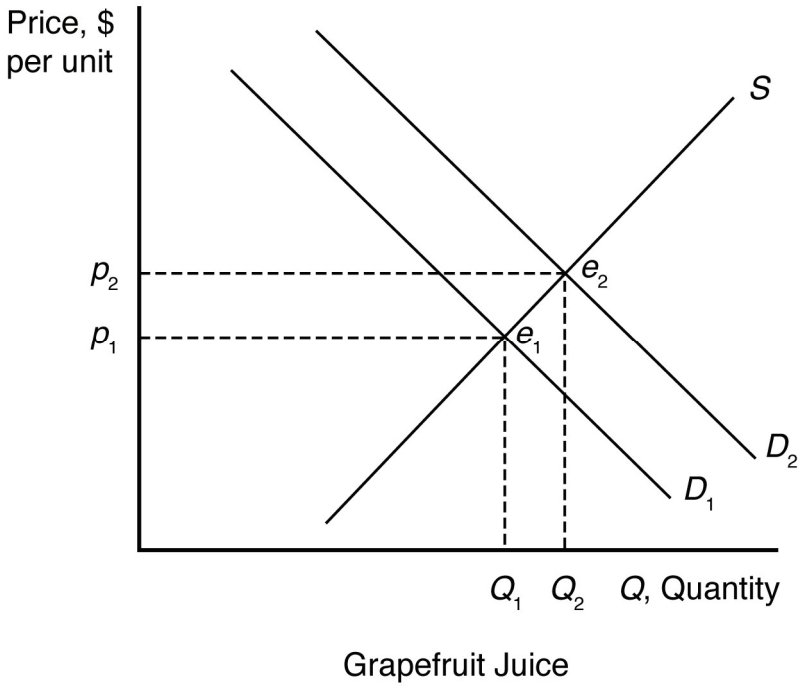
4.6 The damage reduces the supply of oranges, increasing the equilibrium price and decreasing the equilibrium quantity of orange juice.



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The demand for grapefruit juice increases as the price of orange juice increases because grapefruit juice is a substitute. As the demand for grapefruit juice increases, the equilibrium price and quantity of grapefruit juice increase.



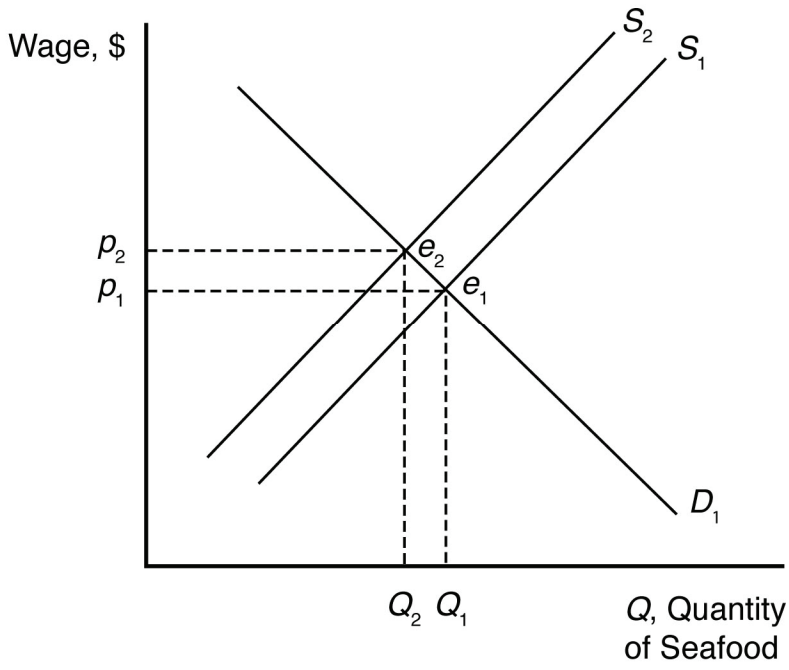
Grapefruit Juice

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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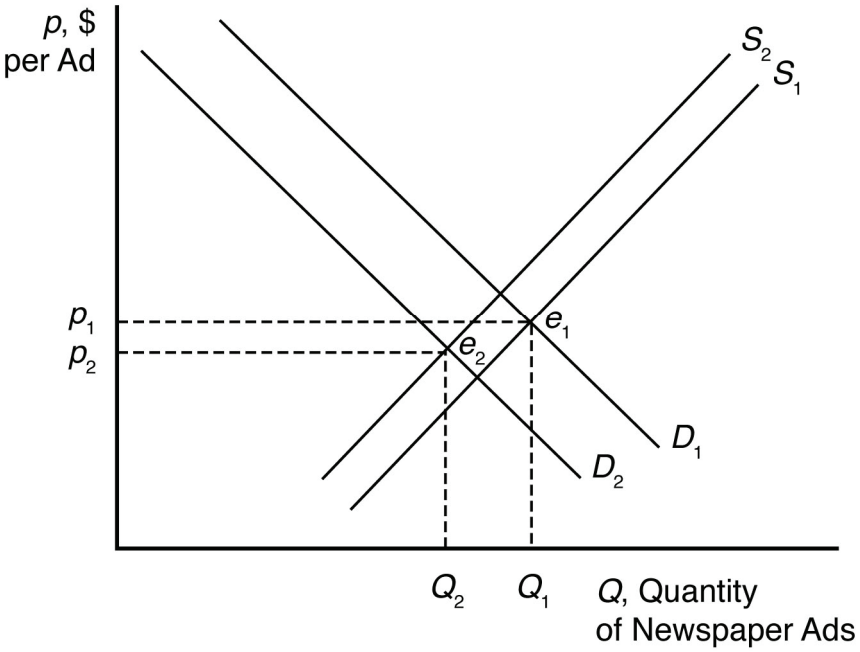
4.8 Suppose supply is initially S_1, but it decreases by a small amount to S_2 after the BP oil spill. When all market participants are able to buy or sell as much as they want, we say that the market is in equilibrium: a situation in which no participant wants to change its behavior. Graphically, a 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.



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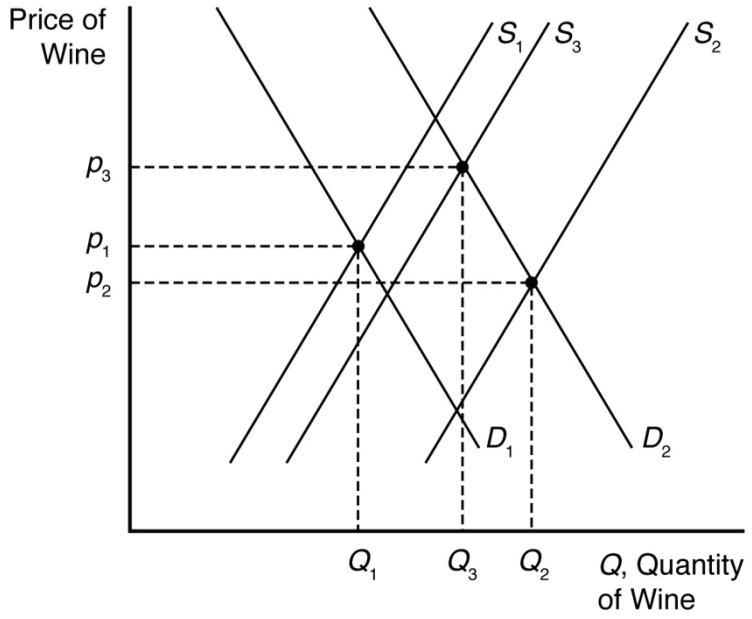
4.9 The Internet shifts the demand curve for newspaper advertising to the left because fewer companies demand newspaper advertising with online advertising available. The Internet may force some newspapers out of business, so the supply curve for newspaper advertising will shift to the left some. The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



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4.10 If global warming causes both an increase in the supply of wine during a period of time when the demand for wine is also rising, then the overall effect on the equilibrium quantity of wine will be for the quantity to increase. This is true because both the increase in supply (from S_1 to S_2 or S_3) and the increase in demand (from D_1 to D_2) will result in higher equilibrium quantities on their own, and so the combination of the two effects will definitely be an increase in quantity. The effect of these events on the equilibrium price of wine, however, is indeterminate. The increase in demand will lead to a higher equilibrium price, but the increase in supply will lead to a lower equilibrium price. Taken together, the net effect on price will be determined by how large the shifts of supply and demand are relative to one another. If the supply shift is larger (from S_1 to S_2), then price will fall. If, on the other hand, the demand shift is larger, then price will rise.

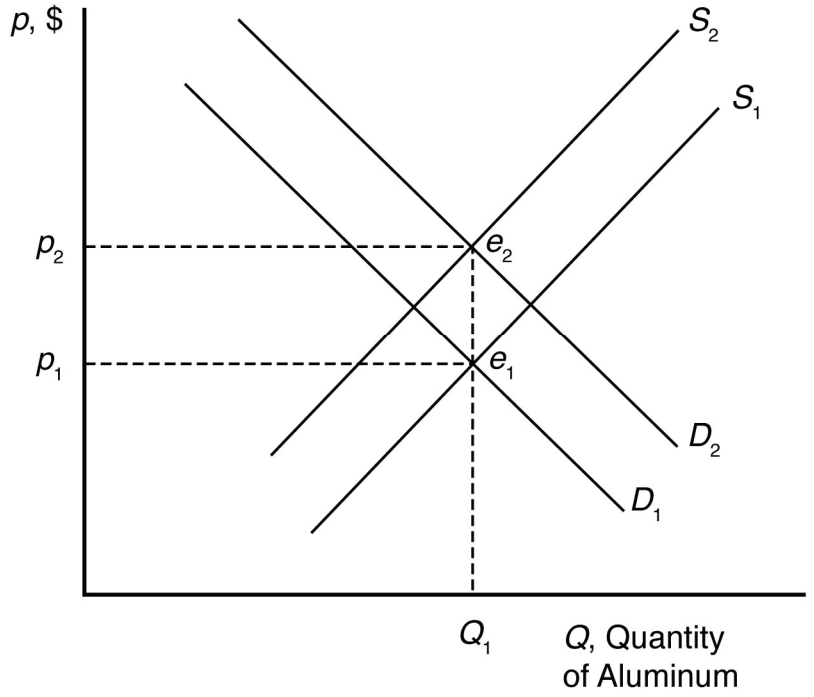


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4.11 An increase in petroleum prices shifts the aluminum supply curve to the left because the cost of producing aluminum is more expensive at each price. An increase in the cost of petroleum also shifts the demand curve for aluminum to the right because the petroleum price increase makes a substitute, plastic, more expensive (by making the cost of plastic production higher). The new equilibrium is where the new aluminum supply curve intersects the new aluminum demand curve.

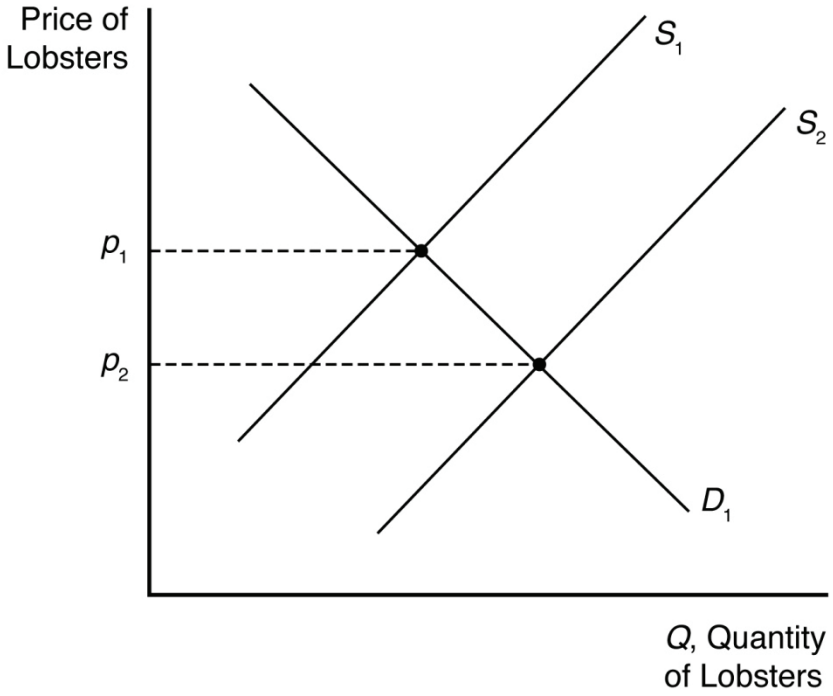
When the supply curve shifts to the left, the new equilibrium price is higher, and the new equilibrium quantity is lower. When the demand curve shifts to the right, the new equilibrium price is higher, and the new equilibrium quantity is higher. When both curves shift, the new equilibrium price is higher, but the new equilibrium quantity could be higher, lower, or unchanged.



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4.12 The cartoon seems to show a bumper harvest of lobsters. A large increase in the catch will shift the supply curve to the right (from S_1 to S_2), which will cause price to fall from p_1 to p_2.



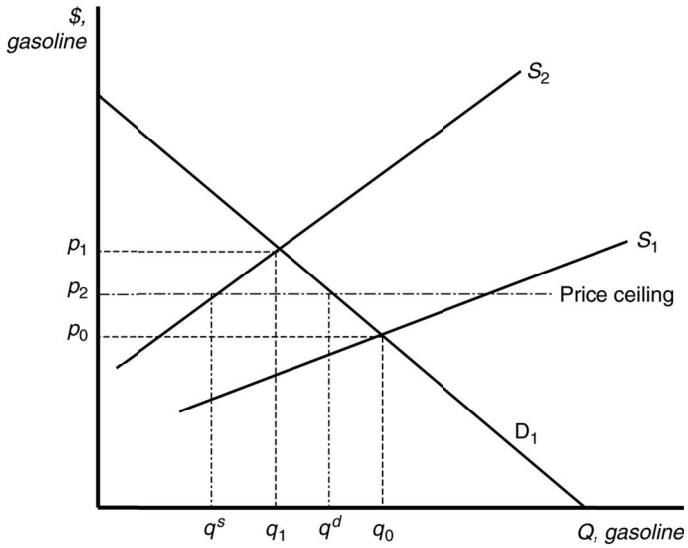
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EFFECTS OF GOVERNMENT INTERVENTIONS

5.1 Requiring occupational licenses shifts the labor supply curve to the left because fewer people are able to supply their labor at each wage. The new market equilibrium is where the original demand curve intersects the new labor supply curve, at a higher wage and lower employment level.

5.2 In the absence of price controls, the leftward shift of the supply curve as a result of Hurricane Katrina would push market prices up from p_0 to p_1 and reduce quantity from q_0 to q_1. At a government imposed maximum price of p_2, consumers would want to purchase q^d units, but producers would only be willing to sell q^s units. The resulting shortage would impose search costs on consumers, making them worse off. The reduced quantity and price also reduce firms' profits.

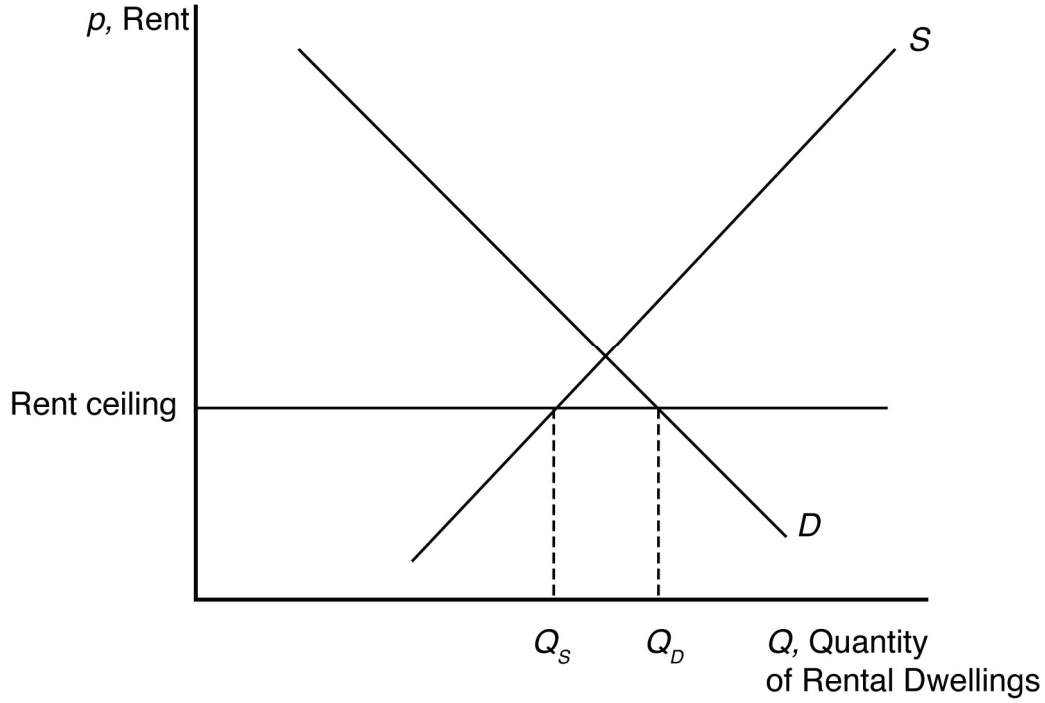


5.3 With a binding price ceiling, such as a ceiling on the rate that can be charged on loans, some consumers who demand loans at the rate ceiling will be unable to obtain them. This is because the demand for bank loans is greater than the supply of bank loans to low-income households with the usury law.

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5.4 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.



5.5 We can determine how the total wage payment, $W = wL(w)$, varies with respect to w by differentiating. We then use algebra to express this result in terms of an elasticity:

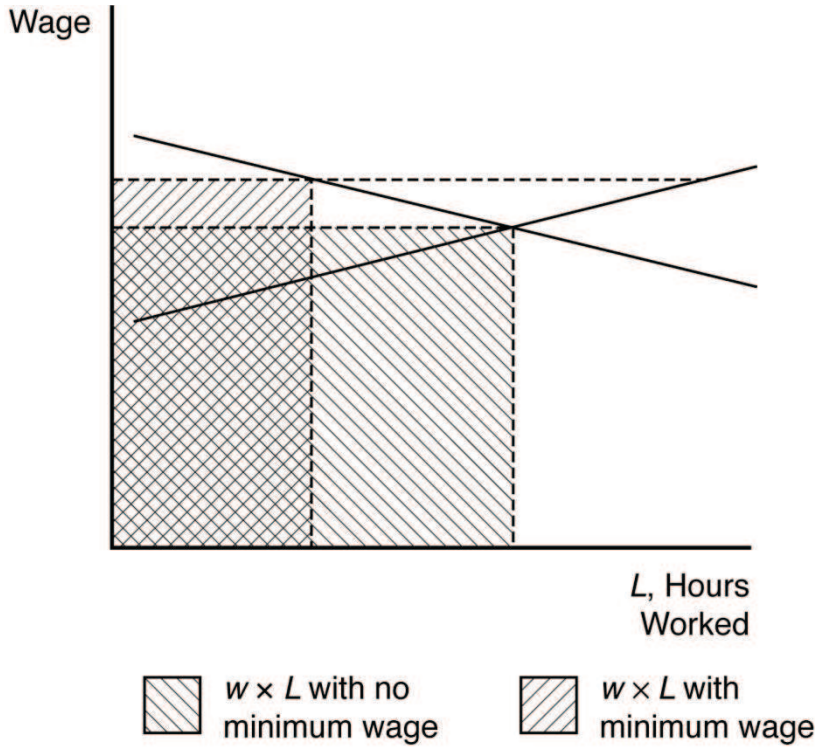
$$\frac{dW}{dw} = L + w\frac{dL}{dw} = L\left(1 + \frac{dL}{dw}\frac{w}{L}\right) = L(1+\varepsilon),$$

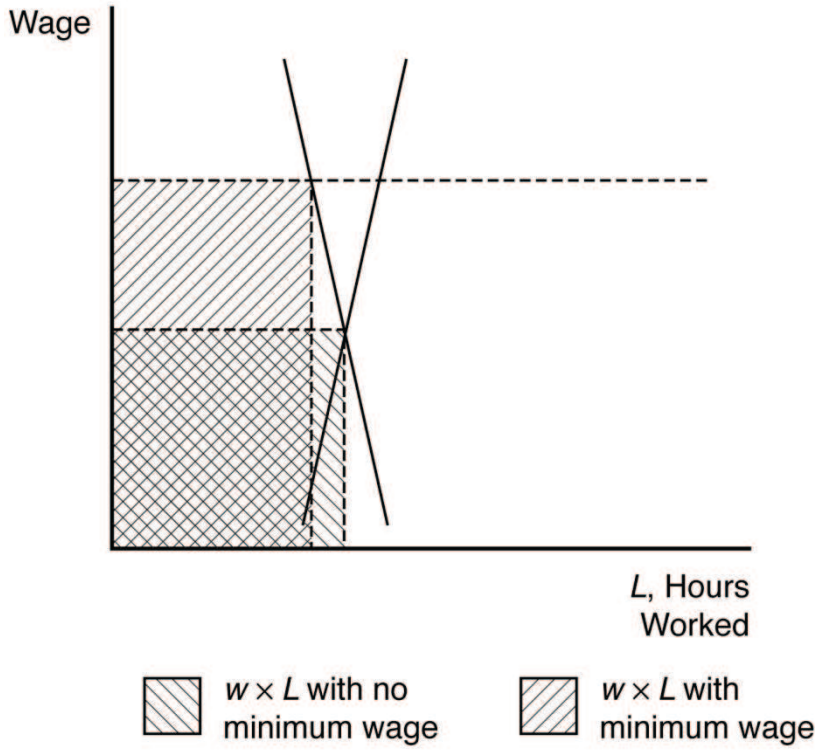
where ε is the elasticity of demand of labor. The sign of dW/dw is the same as that of $1 + \varepsilon$. Thus total labor payment decreases as the minimum wage forces up the wage if labor demand is elastic, $\varepsilon < -1$, and increases if labor demand is inelastic, $\varepsilon > -1$.

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For a graphical explanation, see the figures below. In the top panel with very flat supply and demand curves, the imposition of a minimum wage causes overall wage payments to fall dramatically. On the other hand, when supply and demand curves are steep (as in the bottom panel) overall wage payments increase substantially.





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5.6 Before the tax is imposed, the demand for avocados can be rewritten as

$$Q = 160 - 40p$$

and the supply of avocados is given as

$$Q = 50 + 15p.$$

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. Thus, the equilibrium price is

$$\begin{gathered} D = S \\ 160 - 40\text{p} = 50 + 15p \\ 110 = 55p \\ p = \$2.00. \end{gathered}$$

Find the equilibrium quantity by substituting this price into either the supply or demand function. For example, using the supply function, the equilibrium quantity is

$$\begin{gathered} Q = 50 + 15p \\ Q = 50 + 15(2.0) \\ Q = 50 + 30 \\ Q = 80 \text{ units}. \end{gathered}$$

If a \$0.55 tax is imposed, the demand curve can be rewritten to account for the tax. First, the demand curve can be rewritten as inverse demand by solving for p

$$\begin{gathered} Q = 160 - 40p \\ p = 4 - 0.025Q. \end{gathered}$$

The tax is subtracted from inverse demand to give

$$p = 3.45 - 0.025Q$$

and then this inverse demand curve can be turned back into a demand curve

$$Q = 138 - 40p.$$

Setting supply equal to demand, the new equilibrium (pretax) price is

$$\begin{gathered} D = S \\ 138 - 40p = 50 + 15p \\ 88 = 55p \\ p = \$1.60. \end{gathered}$$

The after-tax price is \$2.15.

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Using the supply function, the equilibrium quantity is

$$Q = 50 + 15p$$
$$Q = 50 + 15(1.60)$$
$$Q = 50 + 24$$
$$Q = 74 \text{ units.}$$

5.7 A tax on consumers will shift the demand curve down by an amount equal to the size of the tax. The new equilibrium price and quantity with the tax will be where the new demand curve intersects the original supply curve. The decrease in quantity will be larger the more horizontal the supply curve is. Just the opposite, the equilibrium quantity will not decrease at all if the supply curve is completely vertical.

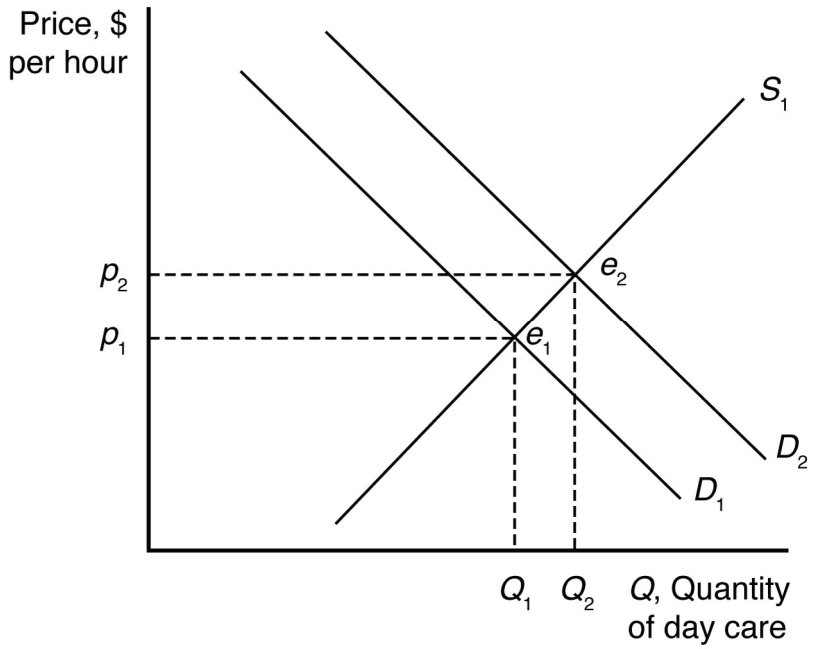
5.8 a. If demand is vertical and supply is upward sloping, then all the tax burden is paid by consumers because they are not price sensitive.

b. If demand is horizontal and supply is upward sloping, then all the tax burden is paid by producers because consumers are infinitely price sensitive.

c. If demand is downward sloping and supply is horizontal, then all the tax burden is paid by consumers because producers are infinitely price sensitive.

5.9 a. A daycare subsidy shifts the demand curve for daycare up by an amount equal to the size of the subsidy. The new equilibrium is where the new demand curve for daycare intersects the supply curve for daycare. This is at a higher equilibrium price and a higher equilibrium quantity.

b. See figure.



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WHEN TO USE THE SUPPLY-AND-DEMAND MODEL

6.1 The supply-and-demand model is accurate in perfectly competitive markets, which are markets in which all firms and consumers are price takers: no market participant can affect the market price. If there is only one seller of a good or service—a monopoly—that seller is a price taker and can affect the market price. Firms are also price setters in an oligopoly—a market with only a small number of firms. Experience has shown that the supply-and-demand model is reliable in a wide range of markets, such as those for agriculture, financial products, labor, construction, many services, real estate, wholesale trade, and retail trade.

MANAGERIAL PROBLEM

7.1 A tax paid by consumers shifts the demand curve down by an amount equal to the size of the tax. Just the opposite, suspending a tax on consumers should raise the demand curve by an amount equal to the size of the suspended tax. Although fuel supply is more likely to be vertical in the short run than in the long run, equilibrium fuel prices will increase when the demand curve shifts up whether the supply curve is vertical or upward sloping.

SOLUTIONS TO SPREADSHEET EXERCISES

See the associated Excel files.

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Chapter 2
Supply and Demand

CHAPTER OUTLINE

Managerial Problem: Carbon Taxes

2.1 Demand
- The Demand Curve
- The Demand Function
  - Using Calculus: Deriving the Slope of a Demand Curve
- Summing Demand Curves
  - Mini-Case: Summing Corn Demand Curves

2.2 Supply
- The Supply Curve
- The Supply Function
- Summing Supply Curves

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

2.4 Shocks to the Equilibrium
- Effects of a Shift in the Demand Curve
  - Q&A 2.1
- Effects of a Shift in the Supply Curve
  - Managerial Implication: Taking Advantage of Future Shocks
- Effects of Shifts in both Supply and Demand Curves
  - Mini-Case: Genetically Modified Foods
  - Q&A 2.2

2.5 Effects of Government Interventions
- Policies That Shift Curves
  - Mini-Case: Occupational Licensing
- Price Controls
  - Mini-Case: Venezuelan Price Ceilings and Shortages
- Sales Taxes
  - Q&A 2.3
  - Managerial Implication: Cost Pass-Through

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2.6 When to Use the Supply-and-Demand Model

Managerial Solution: Carbon Taxes

MAIN TOPICS

1. Demand: The quantity of a good or service that consumers demand depends on price and other factors such as consumer incomes and the prices of related goods.

2. Supply: The quantity of a good or service that firms supply depends on price and other factors such as the cost of inputs and the level of technological sophistication used in production.

3. Market Equilibrium: The interaction between consumers' demand and producers' supply determines the market price and quantity of a good or service that is bought and sold.

4. Shocks to the Equilibrium: Changes in a factor that affect demand (such as consumer income) or supply (such as the price of inputs) alter the market price and quantity sold of a good or service.

5. Effects of Government Interventions: Government policy may also affect the equilibrium by shifting the demand curve or the supply curve, restricting price or quantity, or using taxes to create a gap between the price consumers pay and the price firms receive.

6. When to Use the Supply-and-Demand Model: The supply-and-demand model applies very well to highly competitive markets, which are typically markets with many buyers and sellers.

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OVERVIEW

This is obviously an important chapter, and while much of this material will be review for many students, a good, solid understanding of the basics here will pay big dividends later.

Demand: This is a good place to begin because most students have experience thinking about market situations from the perspective of a consumer. Whether students have been exposed to this material previously or not, one of the trickiest parts in this section is the distinction between a change in price and a change in any of the other determinants of demand. The former, of course, leads to a change in quantity demanded and a movement along the demand curve, while the latter leads to a change in demand and a shift of the entire demand curve. It is helpful to point out that this distinction is somewhat artificial and is driven by the fact that the demand relationship is being represented graphically in two dimensions. Depending on the mathematical preparation of the class, it can be very helpful to discuss the demand relationship algebraically without worrying about drawing the diagram. This allows for multiple right hand side variables in the demand function and no concern about which one leads to which type of change. For some students, this can be an eye-opening observation.

Supply: The discussion here parallels the discussion in the section on demand. The biggest difference is that students are not as familiar with taking the perspective of a producer, so additional discussion might be necessary to get them thinking in this way. The same technical concern arises with a shift in the supply curve versus a movement along the curve, but it can be handled the same way that it was in discussing demand.

Market Equilibrium: If there is one result that students are likely to recall from past coursework, it is the fact that the intersection of the supply and demand curves marks the equilibrium point in the market. Despite this familiarity, however, it is important to take the time to work through any parts of the discussion that are new (e.g., solving for equilibrium price and quantity algebraically).

It is often easiest to remind students of why the intersection of supply and demand is the equilibrium by considering prices that are both higher and lower. Label the (potential) equilibrium price in the diagram and then ask students to think about high prices (those above this proposed value) and low prices (those below this value). It should be relatively easy for students to recall and see that at high prices, there is a surplus where quantity supplied exceeds quantity demanded. It also should be relatively easy for them to suggest that prices should fall in this circumstance. Likewise, at low prices there will be a shortage as quantity demanded exceeds quantity supplied. This disequilibrium should lead to rising prices. This

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leaves only the point where quantity supplied equals quantity demanded as the spot where there is no market pressure for prices to rise or fall, that is, the market is in equilibrium.

Shocks to the Equilibrium: This is the basic story of comparative statics. Students likely will be familiar with this type of analysis from a graphical, qualitative perspective, but it is a good idea to spend some time showing them how the same analysis can become more quantitative in the presences of specific functional forms for supply and demand. This is an opportunity to practice some basic algebra skills and also serves as motivation for the estimation of demand and supply functions that will be coming up in Chapter 3.

Effects of Government Interventions: Two topics are here: (1) price ceilings and floors and (2) sales taxes. The discussion on price ceilings and floors should be pretty straightforward after discussing equilibrium and why prices above and below market equilibrium are not balanced. An effective price ceiling or floor essentially creates a persistent disequilibrium with a resulting excess shortage or surplus. Take care to emphasize that not all price ceilings and floors result in disequilibrium and that it is important to compare the price restriction to the actual market equilibrium to determine whether there will be any effect.

The discussion on sales taxes is less intuitive and often takes work for students to understand. The key result is that the effect of tax is determined solely by the nature of supply and demand and not by the administrative decision about who should remit the tax to the taxing authority. Perhaps the most effective way to make this point (and it provides good practice as well) is to work through a numerical example. It also can be helpful for students to work out and discuss the results of taxes imposed in markets with extreme supply and demand relationships (vertical or horizontal supply and/or demand curves).

When to Use the Supply-and-Demand Model: This short section makes the important point that not all market situations are suitable for analysis with the supply-and-demand model. Take a few minutes to point out that this model is a description of a competitive market to help students avoid the common mistake of misapplying these results later on.

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TEACHING TIPS

Is This Economics or Chemistry?: One of my favorite examples to use when teaching about equilibrium and comparative statics in the supply-and-demand model involves a trip down memory lane. I tell students the story of my first chemistry lab as a young lad in high school. What was so interesting about this lab experience, and the way it relates to teaching about equilibrium, is that the exercise involved a period of great disequilibrium. In the chemistry experiment, this disequilibrium took the form of a bubbling, stinky liquid. The experiment started with all the chemicals in equilibrium—a beaker with a clear liquid, a test tube with a gray powder, etc. The task for the lab was to mix them together and, based on the changes that occurred, determine the identity of each of the original components. So initial equilibrium was followed by bubbling and stinky, which, in turn, was followed by a new equilibrium. We then compared the starting point to the ending point—essentially doing comparative statics in chemistry lab.

A Classroom Experiment: This topic more than any other in the course lends itself to a demonstration in the form of a classroom experiment. Students can the experience seeing an equilibrium price and quantity develop many different ways, but one of my favorites is from Charlie Holt [Holt, Charles A., "Classroom Games: Trading in a Pit Market," *Journal of Economic Perspectives,* 10:1 (Winter 1996), 193–203]. The beauty of an exercise like this is that it gives students the opportunity to really feel market forces at work. You can spice up the experiment by bringing along some prizes (candy bars work well) to get everyone motivated to play seriously.

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ADDITIONAL DISCUSSION QUESTIONS

1. Explain why the difference between a shift in the demand curve and movement along the demand curve is so important. Explain why it becomes less important once we leave two-dimensional diagrams behind.

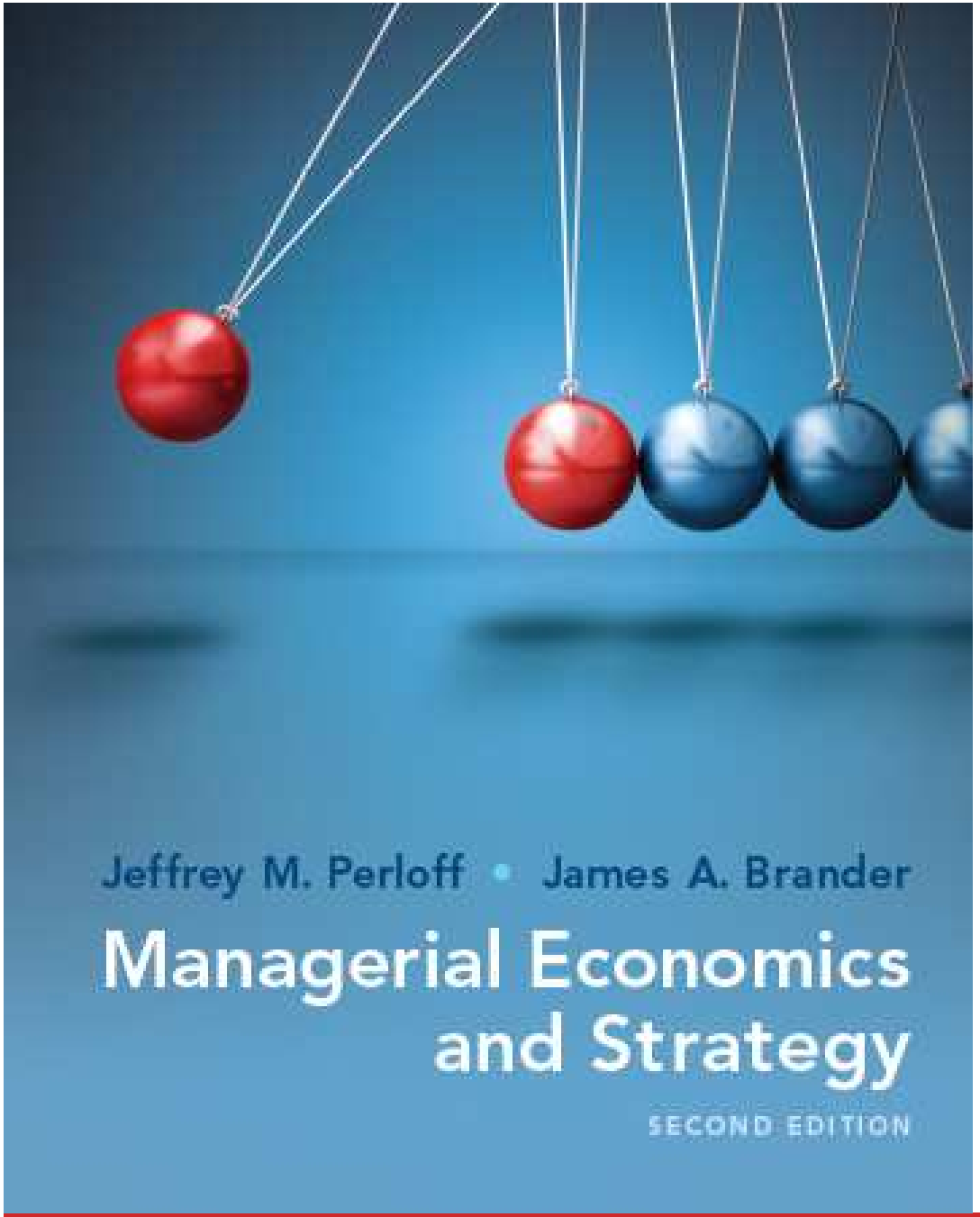
2. Can you think of examples of taxes that are paid largely by consumers? What about those that are likely to be paid by producers? Explain why who pays is different from who is responsible for sending the tax money off to the taxing authority.

3. Give an example of a market that is likely to be similar to the supply-and-demand model presented here. Can you give an example of one that is very different?

4. What are sales and income tax rates in your state? What would happen if these taxes were reduced and a carbon tax took their place? Do you think this is a good idea?

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Chapter 2

Supply and Demand

ALWAYS LEARNING

PEARSON



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2.1 Demand

2.2 Supply

2.3 Market Equilibrium

2.4 Shocks to the Equilibrium

2.5 Effects of Government Interventions

2.6 When to Use the Supply-and-Demand Model

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Introduction

Managerial Problem

- What will be the effect of imposing a carbon tax on the price of gasoline?

Solution Approach

- Managers use the supply-and-demand model to answer this type of questions.

Model

- The supply-and-demand model provides a good description of many markets and applies particularly well to markets in which there are many buyers and many sellers.
- In markets where this model is applicable, it allows us to make clear, testable predictions about the effects of new taxes or other shocks on prices and other market outcomes.

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2.1 Demand

- Consumers decide whether to buy a particular good or service.
  - ✓ If they decide to buy, how much is based on its *own price* and on *other factors*.
- Own Price
  - ✓ Economists focus most on how a good's *own price* affects the quantity demanded.
  - ✓ To determine how a change in price affects the quantity demanded, economists ask what happens to quantity when price changes and other factors are held constant.
- Other Factors
  - ✓ The list of other factors usually includes income, price of related goods, tastes, information, government regulation.
  - ✓ Go to next slide for more detail about these other factors of demand.

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2.1 Demand

- Other factors of demand include the following:
- Income
  - ✓ When a consumer's income rises that consumer will often buy more of many goods.
- Price of related goods
  - ✓ Substitute: Different brands of essentially the same good are close substitutes.
  - ✓ Complement: is a good that is used with the good under consideration.
- Information
  - ✓ Information about characteristics and the effects of a good has an impact on consumer decisions
- Tastes
  - ✓ Consumers do not purchase goods they dislike. Firms devote significant resources to trying to change consumer tastes through advertising.
- Government Regulations
  - ✓ Governments may ban, restrict, tax or subsidize goods or services

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2.1 Demand

The Demand Curve

- A demand curve shows the quantity demanded at each possible price, holding constant the other factors that influence purchases.
- The quantity demanded is the amount of a good that consumers are willing to buy at a given price, holding constant the other factors that influence purchases.
- Graphical Presentation
  - ✓ In Figure 2.1, the demand curve hits the vertical axis at $12, indicating that no quantity is demanded when the price is $12 per lb or higher.
  - ✓ The demand curve hits the horizontal quantity axis at 12 million lbs, the quantity of avocados that consumers would want if the price were zero.
  - ✓ The quantity demanded at a price of $2 per lb is 10 million lbs per year.

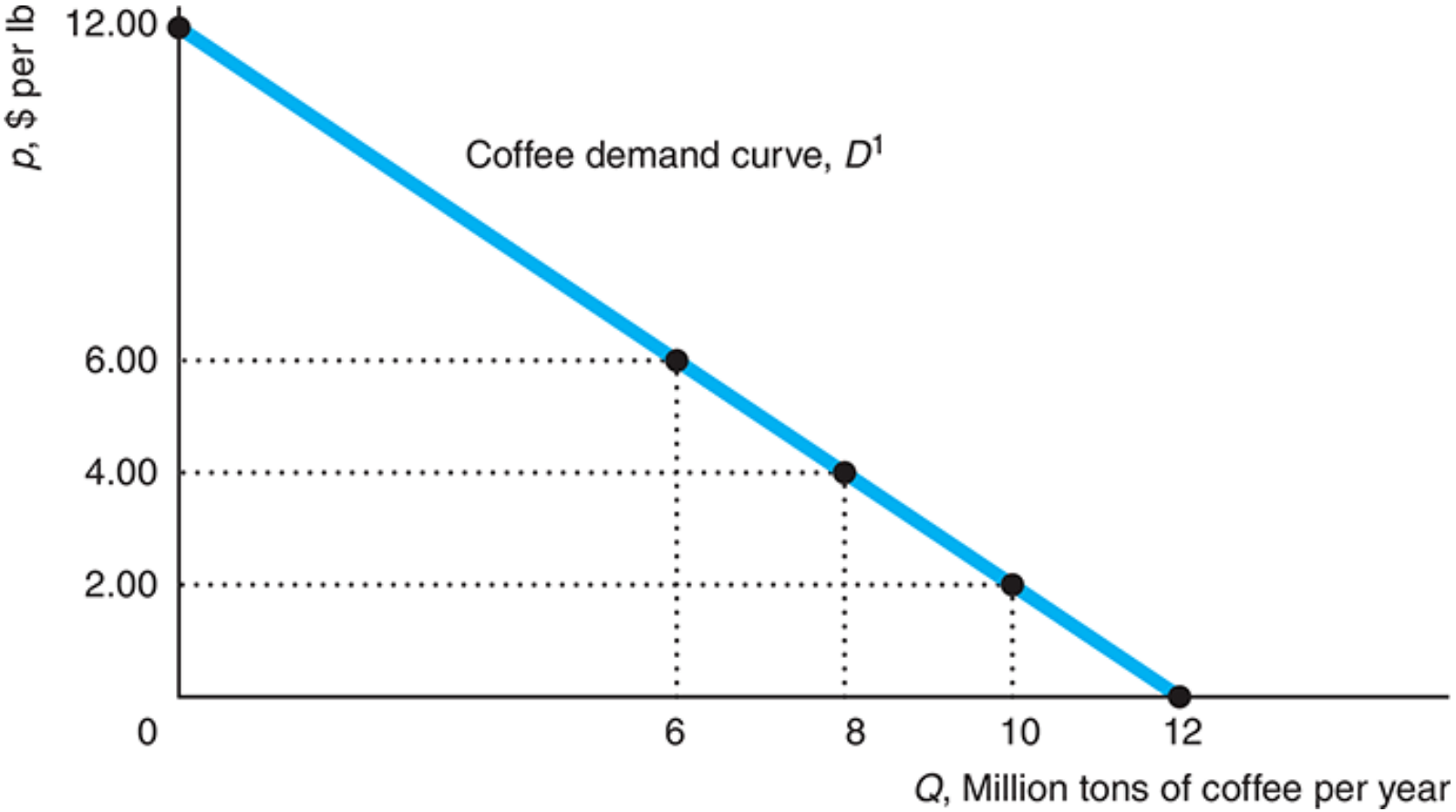
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2.1 Demand

Figure 2.1 A Demand Curve



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2.1 Demand

Effects of a Price Change on the Quantity Demanded

- The Law of Demand states that consumers demand more of a good if its price is lower or less when its price is higher.
  - ✓ The law of demand assumes income, the prices of other goods, tastes, and other factors that influence the amount they want to consume are constant.
  - ✓ The law of demand is an empirical claim—a claim about what actually happens.
  - ✓ According to the law of demand, demand curves slope downward, as in Figure 2.1.
- The demand curve is a concise summary of the answer to the question: What happens to the quantity demanded as the price changes, when all other factors are held constant?
  - ✓ Changes in the quantity demanded in response to changes in price are movements along the demand curve.

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2.1 Demand

Effects of Other Factors on Demand

- A change in any relevant factor other than the price of the good causes a shift of the demand curve rather than a movement along the demand curve.
- Example and Figure 2.2:
  - ✓ if average family income goes up from $35,000 to $50,000, the global demand for coffee shifts to the right from D^1 to D^2.
  - ✓ The price remains at $2 per pound, but the quantity demanded increases from 10 to 11.5 million pounds per year.
  - ✓ Verify the same shift of demand would occur if the price of a substitute of coffee, say tea, goes up.

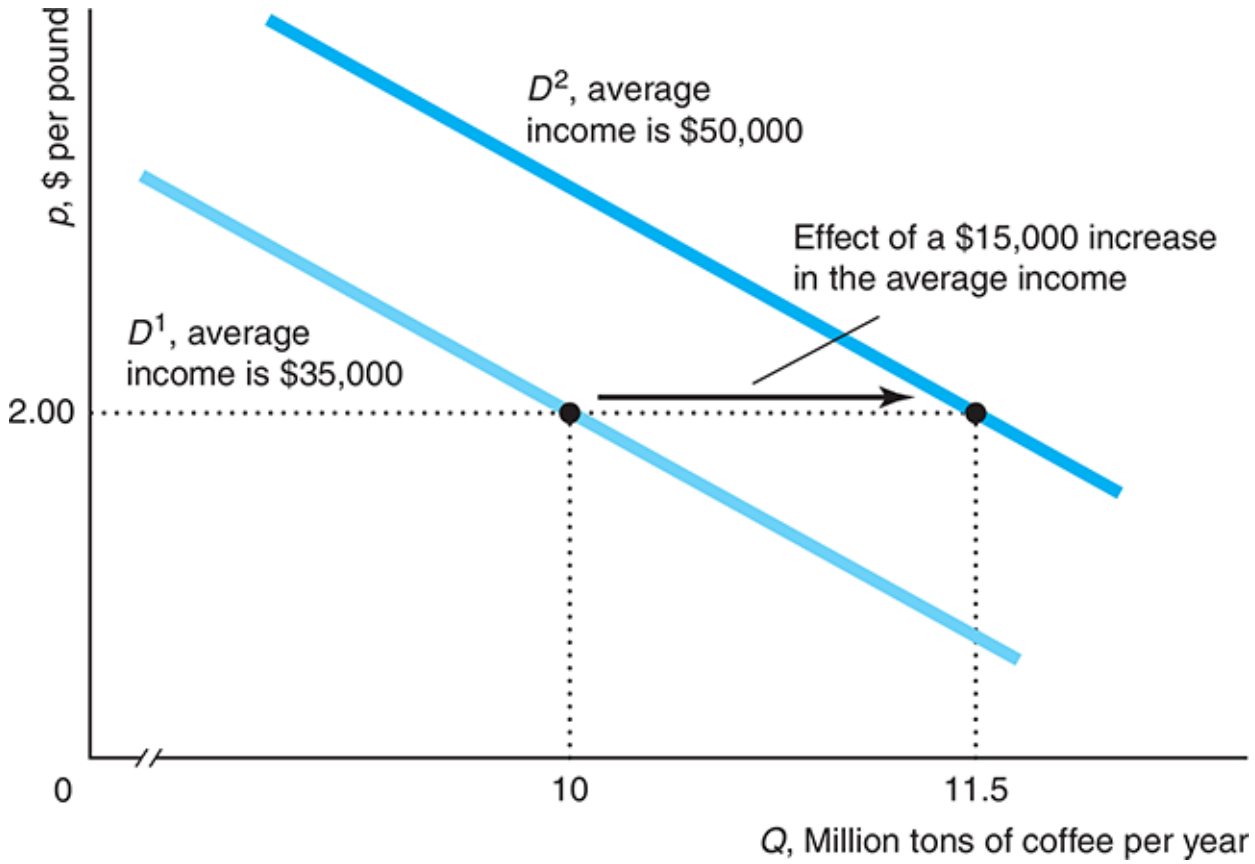
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2.1 Demand

Figure 2.2 A Shift of the Demand Curve



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2.1 Demand

The Demand Function: $Q = D(p,Y)$

- Q of coffee demanded is a function of its price p and income Y. Other factors are constant.
- Estimated Demand Function: $Q = 8.5 - p + 0.1Y$
  - ✓ This specific linear form reflects empirical evidence; p is negative and Y is positive. The constant term, 8.5, represents all other factors.
- Demand Curve: $Q = 12 - p$
  - ✓ Straight-line demand curve D^1 in Figure 2.1 with $Y = 35$. Notice that $\Delta Q = -\Delta p$. *So, if* $\Delta p = -\$2$, then $\Delta Q = -(-2) = 2$ million tons per year.
- The Law of Demand and Calculus
  - ✓ The Law of Demand states that the derivative of the demand function with respect to price is negative, $dQ/dp < 0$.
  - ✓ The demand function for coffee: $Q = 12 - p$. *So, the* derivative of the demand with respect to price: $dQ/dp = -1$.

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2.1 Demand

Summing Demand Curves

Demand for Consumer 1
$Q_1 = D^1(p)$

+

Demand for Consumer 2
$Q_2 = D^2(p)$

=

Total Quantity Demanded
$Q = Q_1 + Q_2 = D^1(p) + D^2(p)$

- The overall demand for coffee is composed of the demand of many individual consumers.
- The total quantity demanded at a given price is the sum of the quantity each consumer demands at that price.
- We can generalize this approach to look at the total demand for more than two consumers, or we can apply it to groups of consumers rather than just to individuals.

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2.2 Supply

- Firms determine how much of a good to supply on the basis of the price of that good and on other factors, including the costs of producing the good.
- Own Price
  - ✓ Usually, we expect firms to supply more quantity at a higher price.
- Other Factors
  - ✓ These other factors usually include costs of production, technological change, government regulations, and other factors.
  - ✓ Go to next slide for more detail about these other supply factors.

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2.2 Supply

- Costs of Production
  - ✓ The costs of labor, machinery, fuel and other costs affect how much of a product firms want to sell.
  - ✓ As a firm's cost falls, it is usually willing to supply more, holding price and other factors constant. Conversely, a cost increase will often reduce a firm's willingness to produce.
- Technological Change
  - ✓ If a technological advance allows a firm to produce its good at lower cost, the firm supplies more of that good at any given price, holding other factors constant.
- Government Regulations
  - ✓ Government rules and regulations can affect supply directly without working through costs.
  - ✓ For example, in some parts of the world, retailers may not sell most goods and services on particular days of religious significance.

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2.2 Supply

The Supply Curve

- A supply curve shows the quantity supplied at each possible price, holding constant the other factors that influence firms' supply decisions.
- The quantity supplied is 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.
- Graphical Presentation
  - ✓ In Figure 2.3, the price on the vertical axis is measured in dollars per physical unit (dollars per lb), and the quantity on the horizontal axis is measured in physical units per time period (millions of tons per year).
  - ✓ The quantity supplied at a price of $2 per lb is 10 million tons per year and 11 million tons per year when the price is $4.

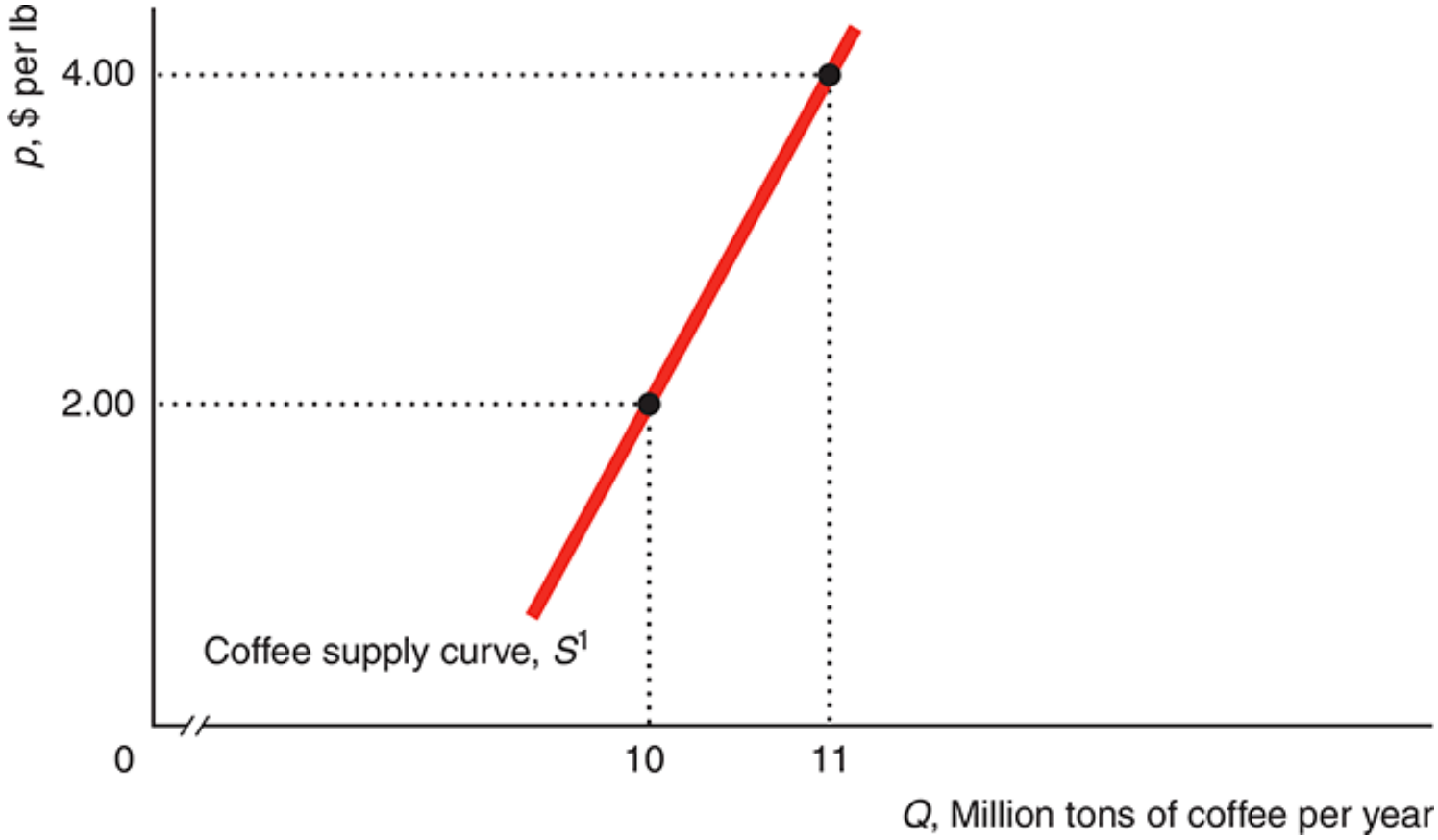
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2.2 Supply

Figure 2.3 A Supply Curve



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2.2 Supply

Effects of Price on Supply

- The supply curve is usually upward sloping. There is no "Law of Supply" stating that the supply curve slopes upward.
- We observe supply curves that are vertical, horizontal, or downward sloping in particular situations. However, supply curves are commonly upward sloping.
- Along an upward-sloping supply curve a higher price leads to more output being offered for sale, holding other factors constant.
- Changes in Quantity Supplied
  - ✓ An increase in the price of avocados causes a movement along the supply curve, resulting in more coffee being supplied.
  - ✓ As the price increases, firms supply more.
  - ✓ In Figure 2.3, if the price rises from $2 per lb to $4 per lb, the quantity supplied rises from 10 to 11 million tons per year.

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2.2 Supply

Effects of Other Variables on Supply

- A change in a relevant variable other than the good's own price causes the entire supply curve to shift rather than a movement along the supply curve.
- Example and Figure 2.4:
  - ✓ When the price of cocoa rises from $3 per lb to $6 per lb, many coffee farmers switch to producing cocoa. As a consequence, the supply curve for coffee shifts weftward, from S^1 to S^2 (Figure 2.4).
  - ✓ That is, firms want to supply less coffee at any given price than before the cocoa price increase. At a price of $2 per lb for coffee, the quantity supplied falls from 10 million lbs on S^1, to 9.4 million tons on S^2 (after the cocoa price increase).

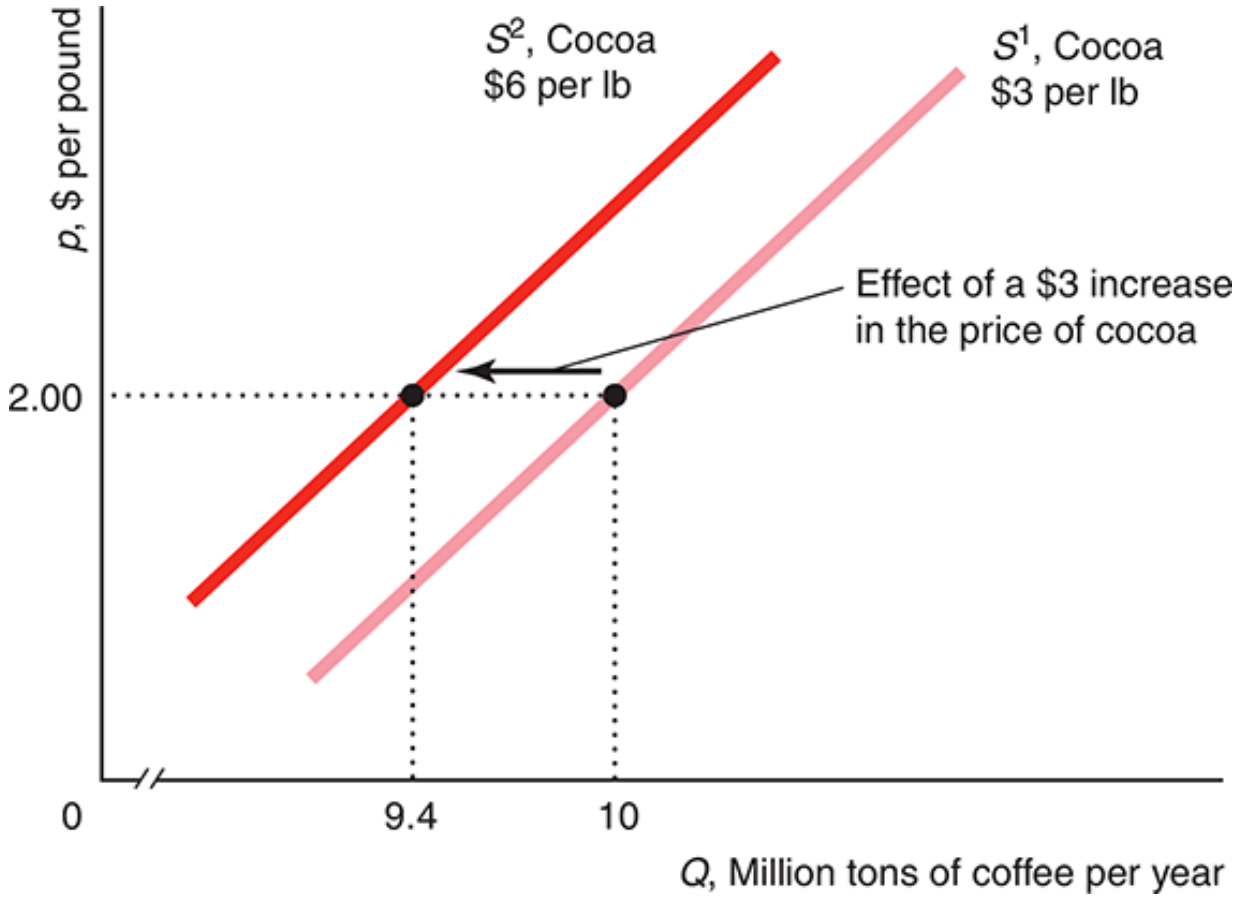
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2.2 Supply

Figure 2.4 A Shift of a Supply Curve



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2.2 Supply

The Supply Function: $Q = S(p, p_c)$

- Q of coffee demanded is a function of its price p and the price of cocoa p_c. Other factors are constant.
- Estimated Supply Function: $Q = 9.6 + 0.5p - 0.2p_c$
  - ✓ This specific linear form reflects empirical evidence; p is positive and p_c is negative. The constant term, 9.6, represents all other factors
- Supply Curve: $Q = 9 + 0.5p$
  - ✓ Straight-line supply curve S^1 in Figure 2.3 with p_c = \$3. Notice that $\Delta S = 0.5\Delta p$. *So, if* Δp = \$1, then ΔS = 0.5 million tons per year.
  - ✓ Thus, a \$1 increase in price causes the quantity supplied to increase by 0.5 million tons per year.
  - ✓ This change in q induced by a change in p is a movement along the supply curve.

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2.2 Supply

Summing Supply Curves

Supply for Producer 1

$Q_1 = S^1(p)$

+

Supply for Producer 2

$Q_2 = S^2(p)$

=

Total Quantity Supplied

$Q = Q_1 + Q_2 = S^1(p) + S^2(p)$

- The total supply curve shows the total quantity produced by all suppliers at each possible price.
- In the coffee case, for example, the overall market quantity supplied at any given price is the sum of the quantity supplied by Brazilian, Vietnamese, Colombian, and other producers in various countries.

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2.3 Market Equilibrium

The *D* curve shows the *q* consumers want to buy at various *p*

- The *S* and *D* curves jointly determine the *p* and *q* at which a good or service is bought and sold.
- The **market is in equilibrium** when all market participants are able to buy or sell as much as they want (no participant wants to change its behavior).
- The *p* at which consumers can buy as much as they want and sellers can sell as much as they want is an equilibrium price.
- The resulting *q* is the equilibrium quantity because the quantity demanded equals the quantity supplied.

The *S* curve shows the *q* firms want to sell at various *p*

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2.3 Market Equilibrium

Using a Graph to Determine the Equilibrium

- In a graph, the market equilibrium is the point at which the demand and supply curves cross each other. This point gives the *q* and *p* of equilibrium.
- Graphical Presentation
  - ✓ Figure 2.5 shows the supply curve, *S*, and demand curve, *D*, for coffee.
  - ✓ The *D* and *S* curves intersect at point *e*, the market equilibrium.
  - ✓ The equilibrium price is $2 per lb, and the equilibrium quantity is 10 million tons per year, which is the quantity firms want to sell and the quantity consumers want to buy.

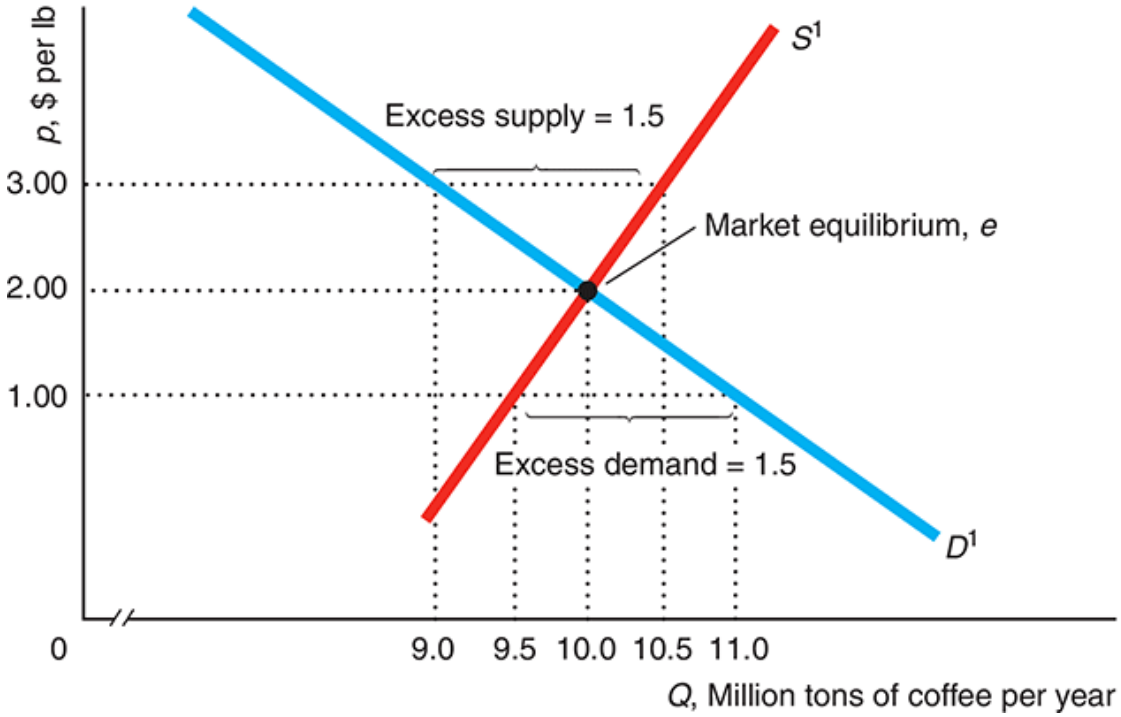
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2.3 Market Equilibrium

Figure 2.5 Market Equilibrium



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2.3 Market Equilibrium

Using Algebra to Determine the Equilibrium

- D and S Curves: $Q_d = 12 - p$ *and* $Q_s = 9 + 0.5p$
  - ✓ We want to find the p at which $Q_d = Q_s = Q$, the equilibrium quantity. In equilibrium, it must be that $Q_s = Q_d$
- In Equilibrium $Q_d = Q_s$: $12 - p = 9 + 0.5p$
  - ✓ We use algebra to find the equilibrium price: $3 = 1.5p$, so $p = \$2$. We can determine the equilibrium q by substituting this p into either Q_d or Q_s
- Using the D Curve: $Q = 12 - 2 = 10$
  - ✓ We find that the equilibrium quantity is 10 million tons per year. We can obtain the same result if we use the *S* curve

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2.3 Market Equilibrium

Forces That Drive the Market to Equilibrium: Excess *D*

- Figure 2.5 shows the supply curve, *S*, and demand curve, *D*, for coffee.
- If the price of coffee were $1, firms are willing to supply 9.5 million tons per year but consumers demand 11 million tons. The market is in disequilibrium and there is excess demand … but not for long.
- Frustrated consumers may offer to pay suppliers more than $1 per lb and some suppliers might raise their prices. Such actions cause the market price to rise until it reaches the equilibrium price, $2 (excess demand eliminated).

Forces That Drive the Market to Equilibrium: Excess S

- If instead, the price were $3, firms are willing to supply 10.5 million tons per year but consumers demand 9 million tons. The market is in disequilibrium again, and there is excess supply … but not for long.
- To avoid unsold coffee to stail, firms lower the price to attract additional customers. The price falls until it reaches the equilibrium level, $2, where the excess supply is eliminated and there is no pressure to lower the price further.

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2.4 Shocks to the Equilibrium

The *D* curve shows the *q* consumers want to buy at various *p*

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

The *S* curve shows the *q* firms want to sell at various *p*

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2.4 Shocks to the Equilibrium

Effects of a Shift in the Demand Curve

- Suppose that the average annual income in developed countries increases by $15,000 from $35,000 to $50,000, so consumers can buy more coffee at any given price. As a result, the demand curve for coffee shifts to the right from D^1 to D^2 in Figure 2.6, panel (a).
  - ✓ At the original equilibrium, e_1, price is $2 and there is excess demand of 11 million lbs per month. Market pressures drive the price up until it reaches $2.20 at the new equilibrium, e_2.
  - ✓ Here the increase in income causes a shift of the demand curve, which in turn causes a movement along the supply curve from e_1 to e_2.

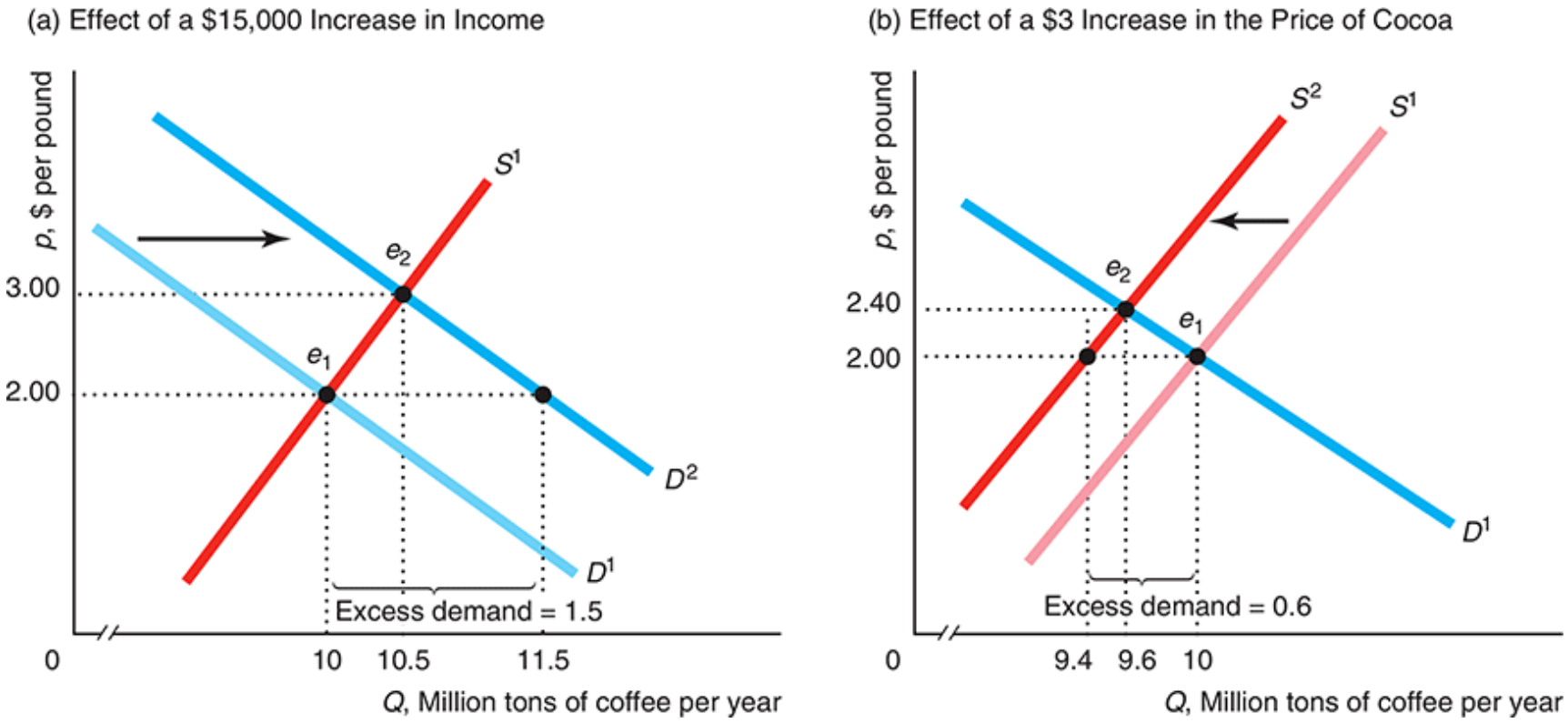
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2.4 Shocks to the Equilibrium

Figure 2.6 Equilibrium Effects of a Shift of a Demand or Supply Curve



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2.4 Shocks to the Equilibrium

Effects of a Shift in the Supply Curve

- Assuming that income remains at its $35,000 original level, an increase in the price of cocoa from $3 to $6 per lb causes some coffee producers to switch to cocoa production. So there are fewer suppliers and less coffee at every price. The supply curve for coffee shifts to the left from S^1 to S^2,in Figure 2.6, panel (b).
  - ✓ At the original equilibrium, e_1, price is $2 per lb, and there is excess demand of 0.6 million tons per year. Market pressures drive the price up until it reaches $2.40 at the new equilibrium, e_2.
  - ✓ Here a shift of the supply curve results in a movement along the demand curve.

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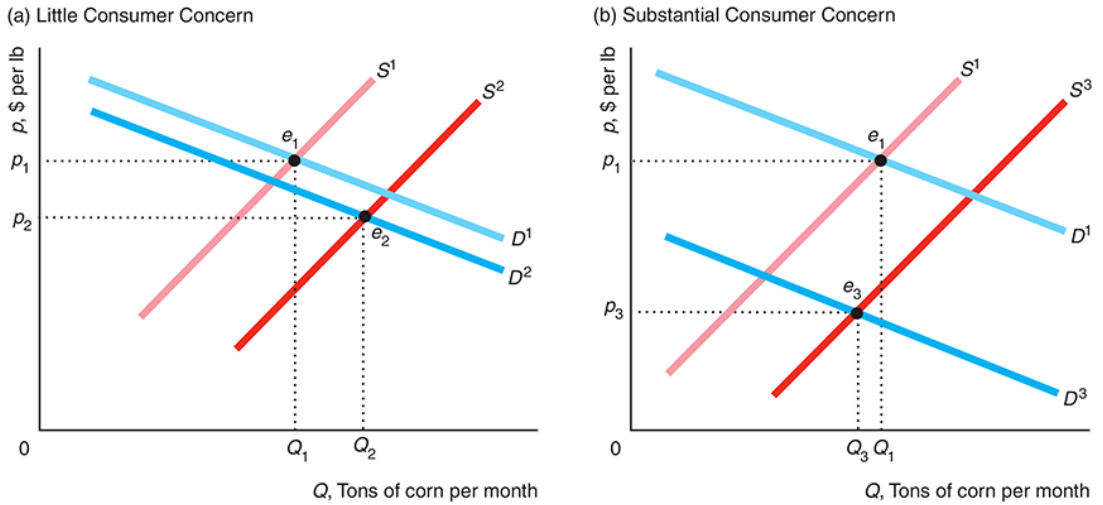


2.4 Shocks to the Equilibrium

Effects of Shifts in both Supply and Demand Curves

- Some events cause both the supply curve and the demand curve to shift.
- If both shift, then the qualitative effect on the equilibrium price and quantity may be difficult to predict, even if we know the direction in which each curve shifts.
- Changes in the equilibrium price and quantity depend on exactly how much the curves shift.

Example: In the mini-case, Genetically Modified Foods, the new equilibrium depends on how big is the Demand shift. Panels a and b of the figure differ in the length of the demand shift.



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2.5 Effects of Government Interventions

Policies that Shift Curves

- Limits on Who can Buy
  - ✓ For example, governments usually forbid selling cigarettes or alcohol to children. This decreases the quantity demanded for those goods at each price and thereby shifts their demand curves to the left.
- Restriction of Imports
  - ✓ The effect of this governmental restriction is to decrease the quantity supplied of imported goods at each price and shifts the importing country's supply curve to the left.
- Start buying a good
  - ✓ The effect of governments starting to buy goods is to increase the quantity demanded at each price for the good and shifts the demand curve to the right.

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2.5 Effects of Government Interventions

Price Controls: Price Ceiling

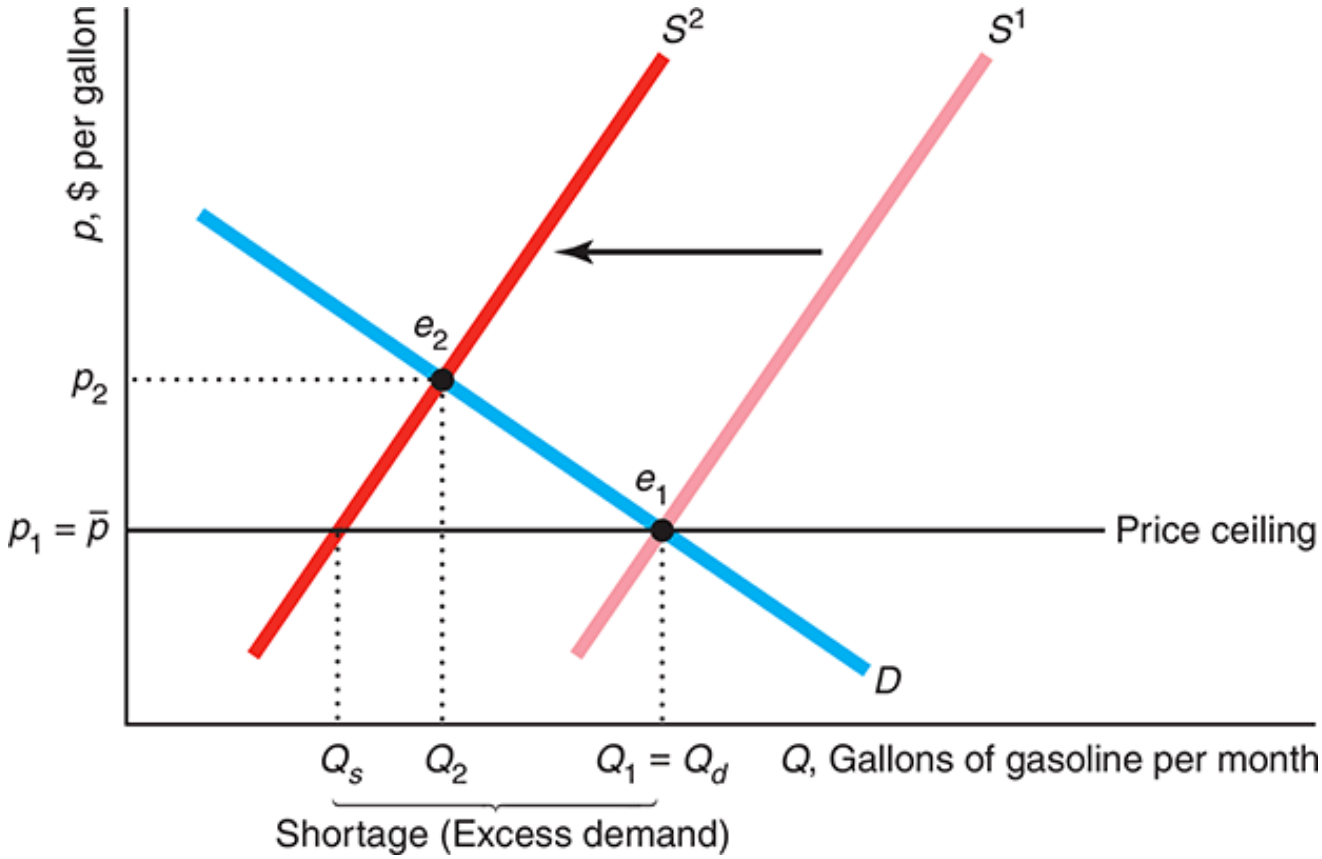
- When the government sets a price ceiling at $\bar{p}$ and the unregulated equilibrium price is above it, the price that is actually observed in the market is the price ceiling.
  - ✓ Price ceilings have no effect if they are set above the equilibrium price that would be observed in the absence of the price controls.
  - ✓ In Figure 2.7, the new equilibrium gasoline price would be p_2 but a price ceiling of p_1 is imposed, then the ceiling price of p_1 is charged.
- With a binding price ceiling, the supply-and-demand model predicts an equilibrium with a shortage*:* a persistent excess demand.
  - ✓ The new equilibrium with a shortage in Figure 2.7 occurs with a quantity Q_s and price p_1 (the excess demand is Q_s-Q_1). If the price ceiling were removed the new equilibrium would be e_2.
  - ✓ Deacon & Sonstelie (1989) found that for every dollar consumers saved during the 1980 gasoline price controls, they lost $1.16 in waiting time and other factors.

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2.5 Effects of Government Interventions

Figure 2.7 Price Ceiling on Gasoline



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2.5 Effects of Government Interventions

Price Controls: Price Floor

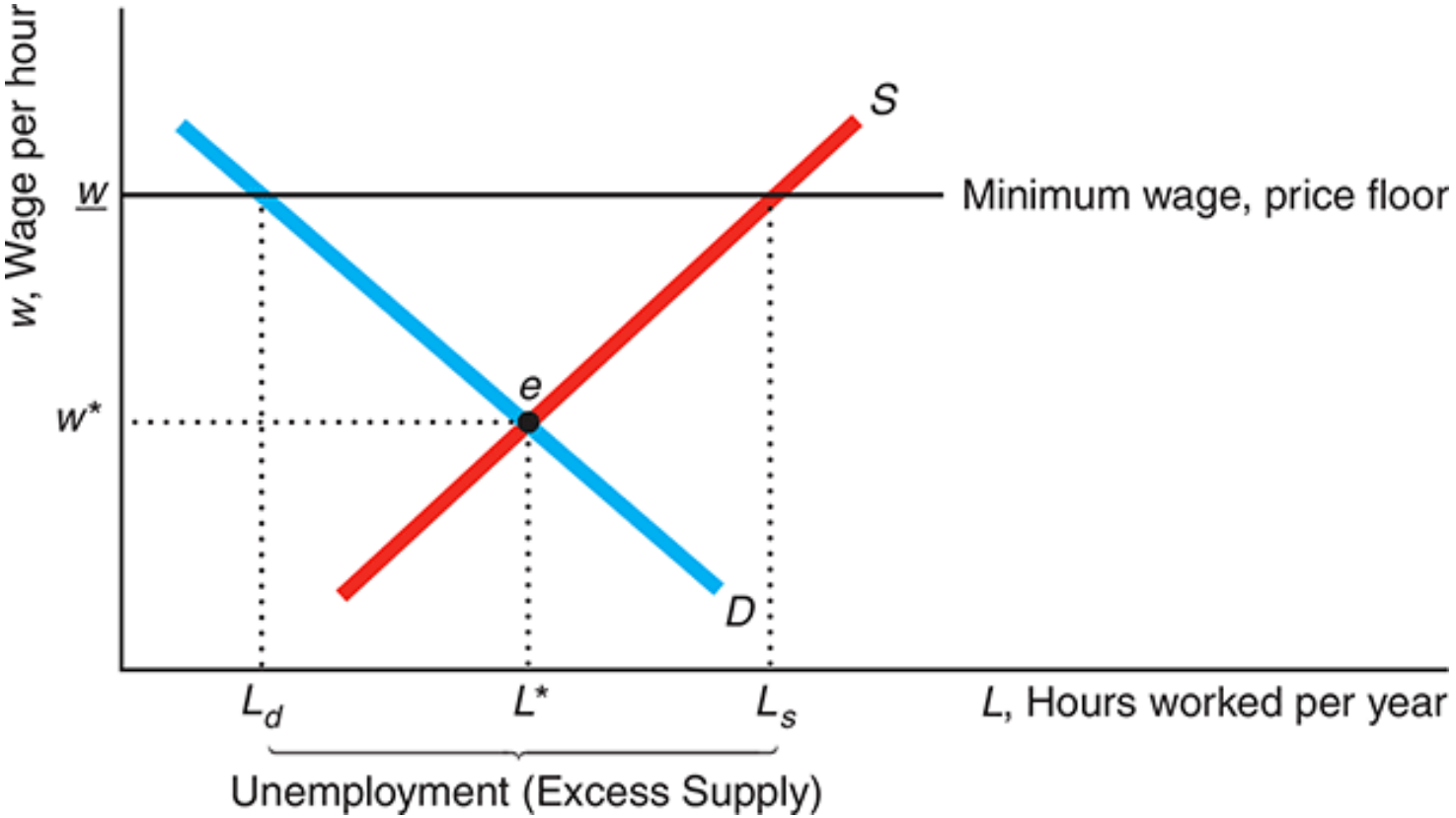
- When the government sets a price floor below the unregulated equilibrium price, the price that is actually observed in the market is the price floor.
  - ✓ A minimum wage law forbids employers from paying less than the minimum wage, $\underline{w}$.
- With a binding price floor, the supply-and-demand model predicts an equilibrium with a persistent excess supply.
  - ✓ The minimum wage prevents market forces from eliminating this excess supply, so it leads to an equilibrium with unemployment.
  - ✓ The new equilibrium with unemployment in Figure 2.8 occurs with a quantity L_d and wage $\underline{w}$ (the excess supply is L_s-L_d). If the price ceiling were removed the new equilibrium would be e_2

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2.5 Effects of Government Interventions

Figure 2.8 Minimum Wage: A Price Floor



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2.5 Effects of Government Interventions

Why Supply Need Not Equal Demand

- The theory says that the price and quantity in a market are determined by the intersection of the supply curve and the demand curve and the market clears if the government does not intervene.
- However, the theory also tells us that government intervention can prevent market-clearing.
  - ✓ The price ceiling and price floor examples show that the quantity supplied does not necessarily equal the quantity demanded in a supply-and-demand model.
  - ✓ The quantity that sellers want to sell and the quantity that buyers want to buy at a given price need not equal the actual quantity that is bought and sold.

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2.5 Effects of Government Interventions

Sales Taxes

Equilibrium Effects of a Specific Tax

- The specific sales tax causes the equilibrium price consumers pay to rise, the equilibrium quantity that firms receive to fall, and the equilibrium quantity to fall (p_2, Q_2 and T in Figure 2.9)
- Although the consumers and producers are worse off because of the tax, the government acquires new tax revenue, $27.84 billion in Figure 2.9.

The Same Equilibrium No Matter Who is Taxed

- It doesn't matter whether the specific tax is collected from firms or consumers, as it is shown in Figure 2.9, a and b panels.
- The market outcome is the same regardless of who is taxed, e_2 in Figure 2.9.

Pass-Through

- The belief that a tax is fully passed to consumers is not true in general. Full pass-through can occur but partial pass-through is more common.
- The degree of the pass through depends on the *S* and *D* shapes.

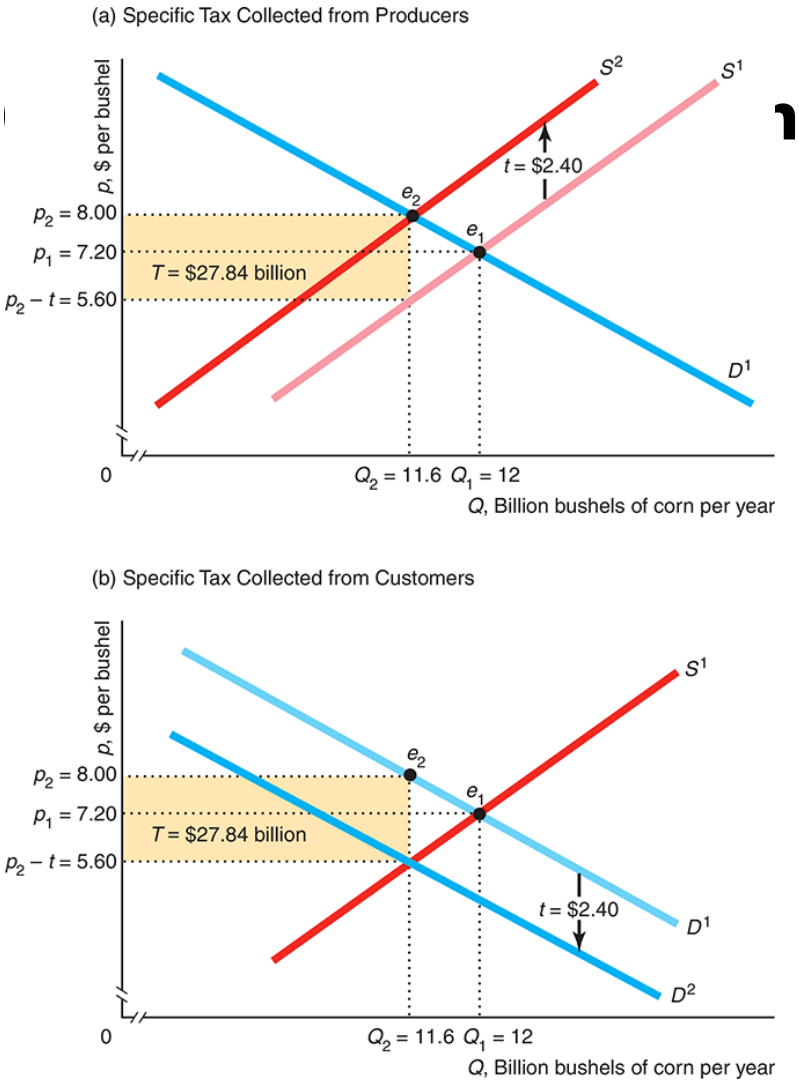
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2.5 Effects of Government Interventions

Figure 2.9 Effect of a $.2.4 Collected from Producers



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2.6 When to Use the Supply-and-Demand Model

- The S-D model can help us to understand and predict real-world events in many markets. Like a map, it need not be perfect to be useful.
- The model is useful if the market to be analyzed is 'competitive enough.'
- It is reliable in markets, such as those for agriculture, financial products, labor, construction, many services, real estate, wholesale trade, and retail trade.
- The S-D model is accurate for perfectly competitive markets
  - ✓ It is precisely accurate in perfectly competitive markets, which are markets in which all firms and consumers are price takers (no market participant can affect the market price).
  - ✓ See next slide for characteristics of perfectly competitive markets.
- The S-D model is not accurate for non-competitive markets
- In markets with firms that are price setters, the market price is usually higher than that predicted by the S-D model.
  - ✓ Monopoly and oligopoly markets have few sellers that are price setters. These markets need a different model.

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2.6 When to Use the Supply-and-Demand Model

- Five characteristics of a perfect competitive market:
  - ✓ Many buyers and sellers, all relatively small with respect to the size of the market.
  - ✓ Consumers believe all firms produce identical products, so they only care about price.
  - ✓ All market participants have full information about price and product characteristics, so no participant can take advantage of each other.
  - ✓ Transaction costs (expenses over and above the price) are negligible.
  - ✓ Firms can easily enter and exit the market over time, so competition is very high.

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Managerial Solution

Managerial Problem

- What will be the effect of imposing a carbon tax on the price of gasoline?

Solution

- The degree to which a tax is passed through to consumers depends on the shapes of the demand and supply curves. Typically, short-run supply and demand curves differ from the long-run curves.
- In the long-run, the supply curve is upward sloping, as in our typical figure. However, the U.S. short-run supply curve of gasoline is very close to vertical.
- From empirical studies, we know that the U.S. federal gasoline specific tax of t = 18.4¢ per gallon is shared roughly equally between gasoline companies and consumers in the long run. However, based on what we learned, we expect that most of the tax will fall on firms that sell gasoline in the short run.
- Manufacturing and other firms that ship goods are consumers of gasoline. They can expect to absorb relatively little of a carbon tax when it is first imposed, but half of the tax in the long run.

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