Chapter 2: Market Forces: Demand and Supply

Answers to Questions and Problems

1. a. Since X is a normal good, a decrease in income will lead to a decrease in the demand for X (the demand curve for X will shift to the left).

   b. Since Y is an inferior good, an increase in income will lead to a decrease in the demand for good Y (the demand curve for Y will shift to the left).

   c. Since goods X and Y are substitutes, an increase in the price of good Y will lead to an increase in the demand for good X (the demand curve for X will shift to the right).

   d. No. The term "inferior good" does not mean "inferior quality," it simply means that income and consumption are inversely related.

2. a. The supply of good X will increase (shift to the right).

   b. The supply of good X will decrease. More specifically, the supply curve will shift vertically up by exactly $3 at each level of output.

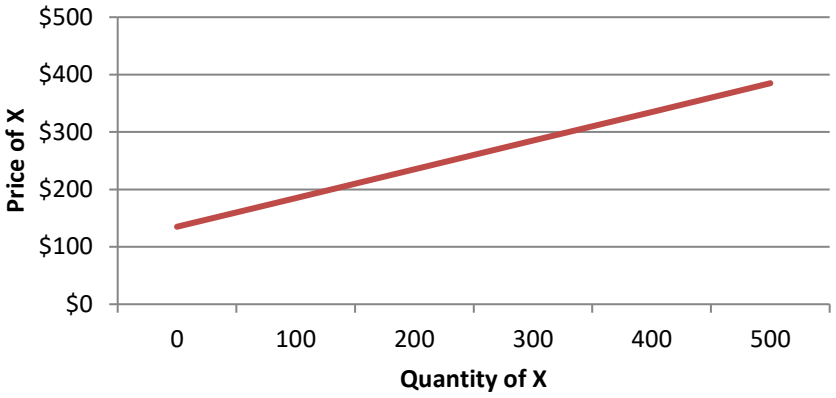
   c. The supply of good X will decrease. More specifically, the supply curve will rotate counter-clockwise.

   d. The supply curve for good X will increase (shift to the right).

3. a. $Q_x^S = -30 + 2(600) - 4(60) = 930$ units.

   b. Notice that although $Q_x^S = -30 + 2(80) - 4(60) = -110$, negative output is impossible. Thus, quantity supplied is zero.

   c. To find the supply function, insert $P_z = 60$ into the supply equation to obtain $Q_x^S = -30 + 2P_x - 4(60) = -270 + 2P_x$. Thus, the supply equation is $Q_x^S = -270 + 2P_x$. To obtain the inverse supply equation, simply solve this equation for P_x to obtain $P_x = 135 + 0.5Q_x^S$. The inverse supply function is graphed in the figure below.

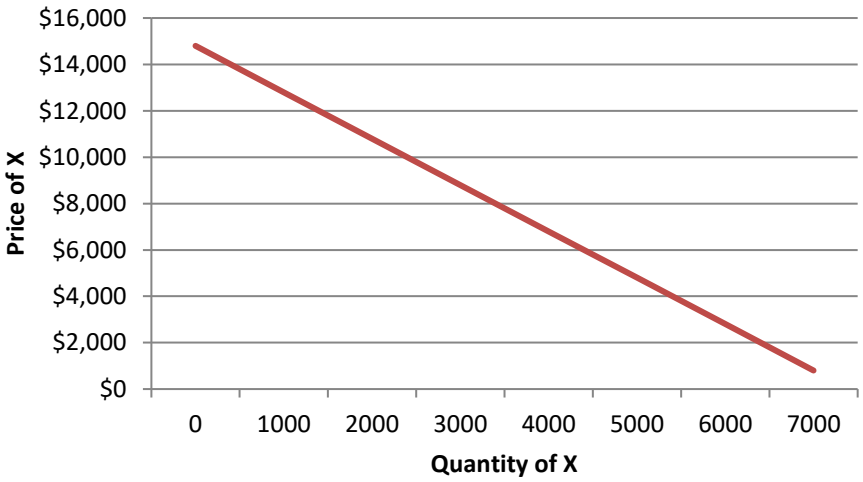


4. a. Good Y is a complement for X, while good Z is a substitute for X.

   b. X is a normal good.

   c. $Q_x^d = 6{,}000 - \frac{1}{2}(\$5{,}230) - \$6{,}500 + 9(\$100) + \frac{1}{10}(\$70{,}000) = 4{,}785$

   d. For the given income and prices of other goods, the demand function for good X is $Q_x^d = 6{,}000 - \frac{1}{2}P_x - \$6{,}500 + 9(\$100) + \frac{1}{10}(\$70{,}000)$ which simplifies to $Q_x^d = 7{,}400 - \frac{1}{2}P_x$. To find the inverse demand equation, solve for price to obtain $P_x = 14{,}800 - 2Q_x^d$. The demand function is graphed in the figure below.



5. a. Solve the demand function for P_x to obtain the following inverse demand function: $P_x = 150 - \frac{1}{2}Q_x^d$.

   b. Notice that when P_x = \$45, $Q_x^d = 300 - 2(45) = 210$ units. Also, from part a, we know the vertical intercept of the inverse demand equation is 150. Thus, consumer surplus is \$11,025 (computed as (0.5)(\$150-\$45)210 = \$11,025).

c. When price decreases to \$30, quantity demanded increases to 240 units, so consumer surplus increases to \$14,400 (computed as (0.5)(\$150-\$30)240 = \$14,400).

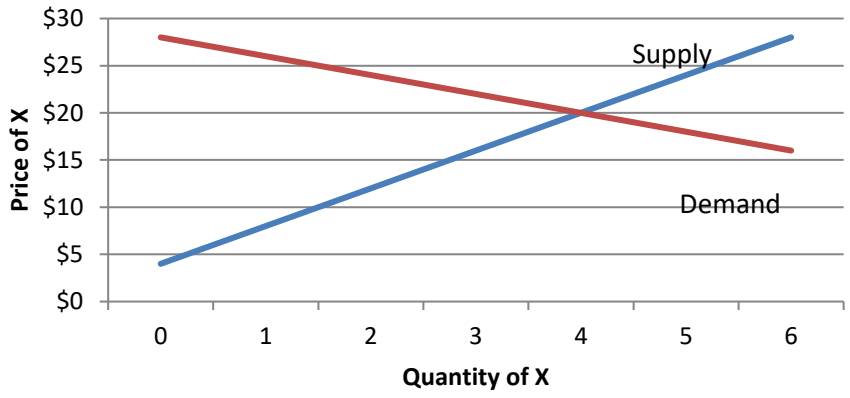
d. So long as the law of demand holds, a decrease in price leads to an increase in consumer surplus, and vice versa. In general, there is an inverse relationship between the price of a product and consumer surplus.

6. a. Equating quantity supplied and quantity demanded yields the equation 60 - P = P - 20. Solving for P yields the equilibrium price of \$40 per unit. Plugging this into the demand equation yields the equilibrium quantity of 20 units (since quantity demanded at the equilibrium price is $Q^d = 60 - (40) = 20$.

b. A price floor of \$50 is effective since it is above the equilibrium price of \$40. As a result, quantity demanded will fall to 10 units ($Q^d = 60 - 50$), while quantity supplied will increase to 30 units ($Q^s = 50 - 20$). That is, firms produce 30 units but consumers are willing and able to purchase only 10 units. Therefore, at a price floor of \$50, 10 units will be exchanged. Since $Q^d < Q^s$ there is a surplus amounting to 30-10 = 20 units.

c. A price ceiling of \$32 per unit is effective since it is below the equilibrium price of \$40 per unit. As a result, quantity demanded will increase to 28 units ($Q^d = 60 - 32 = 28$), while quantity supplied will decrease to 12 units ($Q^s = 32 - 20 = 12$). That is, while firms are willing to produce only 12 units consumers want to buy 28 units at the ceiling price. Therefore, at the price ceiling of \$32, only 12 units will be available to purchase. Since $Q^d > Q^s$, there is a shortage amounting to 28-12 = 16 units. Since only 12 units are available at a price of \$32, the full economic price is the price such that quantity demanded equals the 12 available units: $12 = 60 - P^F$. Solving yields the full economic price of \$48.

7. a. Equate quantity demanded and quantity supplied to obtain $14 - \frac{1}{2}P_x = \frac{1}{4}P_x - 1$. Solve this equation for P_x to obtain the equilibrium price of $P_x = 20$. The equilibrium quantity is 4 units (since at the equilibrium price quantity demanded is $Q^d = 14 - \frac{1}{2}(20) = 4$). The equilibrium is shown in the figure below.



b. A \$12 excise tax shifts the supply curve up by the amount of the tax. Mathematically, this means that the intercept of the inverse supply function increases by \$12. Before the tax, the inverse supply function is $P = 4 + 4Q^s$. After the tax the inverse supply function is $P = 16 + 4Q^s$, and the after tax supply function (obtained by solving for Q^s in terms of P) is given by $Q^s = \frac{1}{4}P - 4$. Equating quantity demanded to after-tax quantity supplied yields $14 - \frac{1}{2}P = \frac{1}{4}P - 4$. Solving for P yields the new equilibrium price of \$24. Plugging this into the demand equation yields the new equilibrium quantity, which is 2 units.

c. Since two units are sold after the tax and the tax rate is \$12 per unit, total tax revenue is \$24.

8. a. The shortage is 3 units (since at a price of \$6, $Q^d - Q^s = 4 - 1 = 3$ units). The full economic price is \$12.

b. The surplus is 1.5 units (since at a price of \$12, $Q^s - Q^d = 2.5 - 1 = 1.5$ units. The cost to the government is \$18 (computed as (\$12)(1.5) = \$18).

c. The excise tax shifts supply vertically by \$6. Thus, the new supply curve is S^1 and the equilibrium price increases to \$12. The price paid by consumers is \$12 per unit, while the amount received by producers is this \$12 minus the per unit tax. Thus, producers receive \$6 per unit. After the tax, the equilibrium quantity sold is 1 unit.

d. At the equilibrium price of \$10, consumer surplus is $.5(\$14 - \$10)2 = \$4$. Producer surplus is $0.5(\$10 - \$2)2 = \$8$.

e. No. At a price of \$2 no output is produced.

9. a. The inverse supply curve is $P = 26 + 0.05Q$.

b. When Q_x = 400, producer surplus is (46 – 26) × 400/2 = \$4,000. When Q_x = 1,200, producer surplus is (86 – 26) × 1,200/2 = \$36,000.

10. a. At a price of \$40, consumers will demand 12 units and produce 24 units, resulting in a surplus of 12 units. The cost of purchasing the surplus is \$40 × (24 – 12) = \$480.

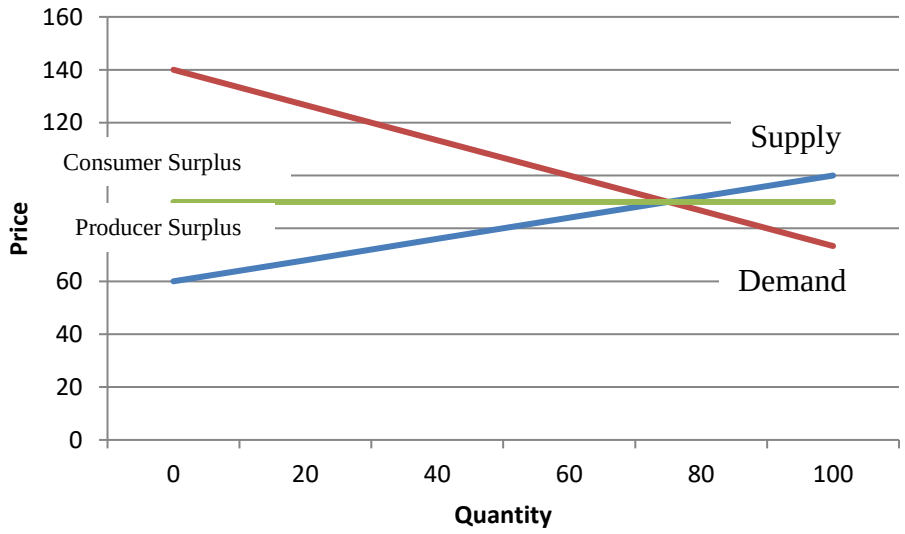
b. Because the government purchases and discards the surplus, there are two parts to the deadweight loss generated by the price floor. The first component is common to all price floors (i.e. the blue triangle in Figure 2-12). We compute the first component here as 0.5 × (40 – 28) × (20 – 12) = \$48. We compute the second component as \$480 – 0.5 × (40 – 28) × (24 – 12) = \$408. Thus, deadweight loss is \$48 + \$408 = \$456.

11. Rising input prices that increase production costs will lead to a leftward shift in the supply curve for RAM chips, resulting in a higher equilibrium price of RAM chips. If in addition, income falls, the demand for RAM chips will decrease since they are a normal good. This decrease in demand would tend to decrease the price of RAM chips. The ultimate effect of both of these changes in supply and demand on the equilibrium price of RAM chips is indeterminate. Depending on the relative magnitude of the decreases in supply and demand, the price you will pay for chips may rise or fall.

12. The tariff reduces the supply of raw sugar, resulting in a higher equilibrium price of sugar. Since sugar is an input in making generic soft drinks, this increase in input prices will decrease the supply of generic soft drinks (putting upward pressure on the price of generic soft drinks and tend to reduce quantity). Coke and Pepsi's advertising campaign will decrease the demand for generic soft drinks (putting downward pressure on the price of generic soft drinks and further reducing the quantity). For these reasons, the equilibrium quantity of generic soft drinks sold will decrease. However, the equilibrium price may rise or fall, depending on the relative magnitude of the shifts in demand and supply.

13. Disagree. This confuses a change in demand with a change in quantity demanded. Higher cigarette prices will not reduce (shift to the left) the demand for cigarettes.

14. To find the equilibrium price and quantity, equate quantity demanded and quantity supplied to obtain 210 – 1.5P = 2.5P – 150. Solving yields the new equilibrium price of \$90 per pint. The equilibrium quantity is 75 units (since Q^d = 210 – 1.5 × 90 = 75 units at that price). Consumer surplus is $\frac{1}{2}(\$140 - \$90) \times 75 = \$1{,}875$. Producer surplus is $\frac{1}{2}(\$90 - \$60) \times 75 = \$1{,}125$. See the figure below.

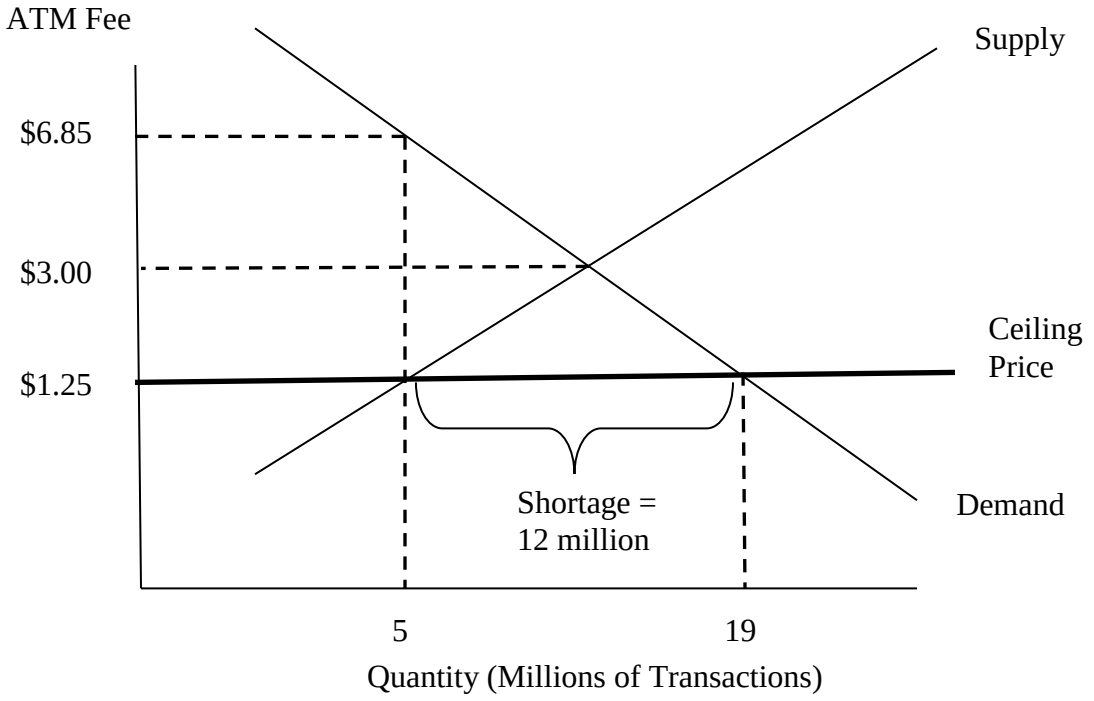


15. This decline represents a leftward shift in the supply curve for oil, and will result in an increase in the equilibrium price of crude oil. Since oil is an input in producing gasoline, this will decrease the supply of gasoline, resulting in a higher equilibrium price of gasoline and a lower equilibrium quantity. Furthermore, the higher price of gasoline will increase the demand for substitutes, such as small cars. The equilibrium price of small cars is likely to increase, as is the equilibrium quantity of small cars.

16. Equating the initial quantity demanded and quantity supplied gives the equation: $300 – 4P = 3P – 120$. Solving for price, we see that the initial equilibrium price is \$60 per month. When the tax rate is reduced, equilibrium is determined by the following equation: $300 – 4P = 3.2P - 120$. Solving, we see that the new equilibrium price is about \$58.33 per month. In other words, a typical subscriber would save about \$1.67 (the difference between \$60.00 and \$58.33).

17. Dry beans and rice are probably inferior goods. If so, an increase in income shifts demand for these goods to the left, resulting in a lower equilibrium price. Therefore, G.R. Dry Foods will likely have to sell its products at a lower price.

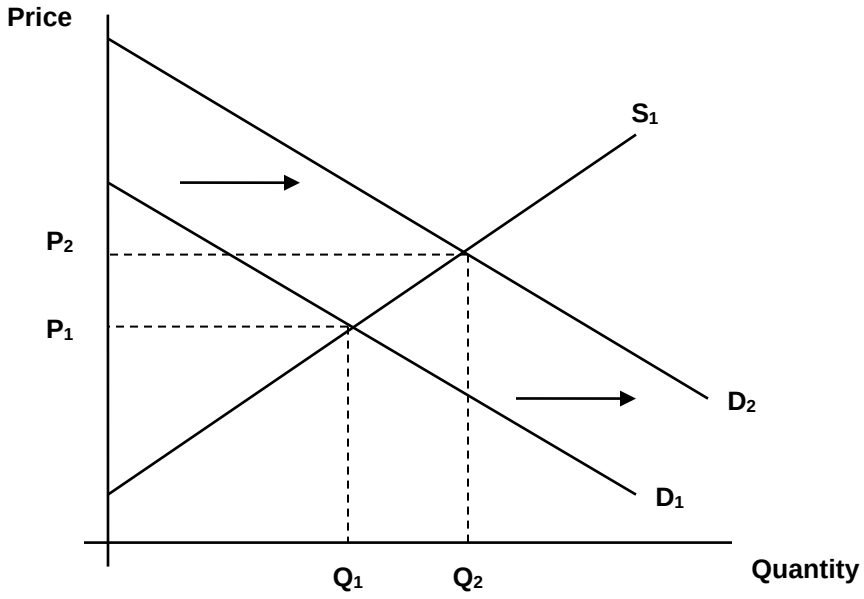
18. The figure below illustrates the relevant situation. The equilibrium price is \$3.00, but the ceiling price is \$1.25. Notice that, given the shortage of 14 million transactions caused by the ceiling price of \$1.25, the average consumer spends an extra 14 minutes traveling to another ATM machine. Since the opportunity cost of time is \$24 per hour, the non-pecuniary price of an ATM transaction is \$5.60 (the \$24 per hour wage times the fractional hour, 14/60, spent searching for another machine). Thus, the full economic price under the price ceiling is \$6.85 per transaction.



19. The unusually cold temperatures have caused a decrease in the supply of grapes used to produce Chilean wine, resulting in higher prices. These grapes are an input in making wine, so the supply of Chilean wine decreases and its price increases. Since California and Chilean wines are substitutes, an increase in the price of Chilean wine will increase the demand for Californian wines causing an increase in both the price and quantity of Californian wines.

20. Substituting $P_{desktop} = 980$ into the demand equation yields $Q^d_{memory} = 9240 - 100P_{memory}$. Similarly, substituting N = 100 into the supply equation yields $Q^s_{memory} = 1100 + 25P_{memory}$. The competitive equilibrium level of industry output and price occurs where $Q^d_{memory} = Q^s_{memory}$, which occurs when industry output $Q^*_{memory} = 2728$ (in thousands) and the market price is $P^*_{memory} = \$65.12$ per unit. Since 100 competitors are assumed to equally share the market, Viking should produce 27.28 thousand units. If $P_{desktop} = \$1{,}080$, $Q^d_{memory} = 9040 - 100P_{memory}$. Under this condition, the new competitive equilibrium occurs when industry output is 2688 thousand units and the per-unit market price is $63.52. Therefore, Viking should produce 26.88 thousand units. Since demand decreased (shifted left) when the price of desktops increased, memory modules and desktops are complements.

21. Mid Towne IGA aimed to educate consumers that its contract with Local 655 union members was different than its rivals, so it engaged in informative advertising. Mid Towne IGA's informative advertising increases demand (demand shifts rightward) resulting from (1) Local 655 union members locked out of rival supermarkets (2) consumers who are sympathetic to the Local 655 union, and (3) consumers who do not like the aggravation of picketing employees and other disruptions at the supermarket. This shift is depicted in the figure below, where the equilibrium price and quantity both increase. It is unlikely that demand will remain high for Mid Towne IGA. As contracts are renegotiated and Local 655 union members are back to work, demand will likely settle back around its original level.



22. The price gouging statute imposes an effective price ceiling on necessary commodities during times of emergencies; legally retailers cannot raise prices by a significant amount. When a natural disaster occurs, the demand for necessary commodities such as food and water can dramatically increase, as people want to be stocked-up on emergency items. In addition, since it can be difficult for retailers to receive shipments during emergency periods, the supply of these items is often reduced. Given the simultaneous reduction in supply and increase in demand, one would expect the price to increase during times of emergencies. However, since the price gouging statute acts as a price ceiling, the price will probably remain at its normal level, and a shortage will result.

23. While there is undoubtedly a link between unemployment and crime, the governor's plan is likely flawed since it only examines one side of the market. Raising the minimum wage will make the prospect of working more appealing for teenagers, but it will also have an effect on business owners and managers in the state. The minimum wage is a price floor. Raising the minimum wage will reduce the quantity demand for labor within the state, and result in a labor surplus. More teenagers will seek jobs, but fewer businesses will hire teenagers. It is very likely that the governor's plan will result in greater juvenile delinquency.

Time Warner Cable Solution to MEMO 2: Pricing against Google

In deciding whether to exit a market, we need to identify the appropriate costs. The $550 million fiber upgrade should be considered a sunk cost, and any monthly costs associated with payments will still need to be made even if we exit the market. So those costs should not factor into our decision.

The relevant costs are the $41.50 per subscriber for programming fees, and the $9.20 monthly service costs. Therefore, our incremental profits are positive as long as we can charge a price greater than $50.70.

Teaching Notes for the Time Warner Cable Case

While the Time Warner Cable case may be used in a variety of ways, our preference is to use it early in the course because this permits us to refer back to it throughout the course to illustrate a plethora of economic concepts.

Week 1:

During the first week of the course (after covering the basic five forces model in Chapter 1), we suggest assigning *Memo 3* to the students. If the class is small, we suggest having teams give formal presentations of their recommendations (limited to 10 minutes each); otherwise, simply call on students using the case method to address questions such as:

- Which TWC business segments provide the best opportunity to grow the company's profits?
- Which business segments are more susceptible to competitive pressures?
- What other risks to profitability and/or growth are present for our business lines?
- What strategic moves do you recommend?

What we look for at this early point in the semester is whether students have thoughtfully considered the entry, the power of buyers and suppliers, industry rivalry, and substitutes/complements.

Many students look at TWC as a company in a dying industry. With fewer households subscribing to video services (especially among young consumers) and increasing costs of programming, profitability is not strong. However, by focusing on its position within the high speed data market, we see that there is significant growth potential and a defensible market position.

However, TWC has been very active in seeking a strategic partnership. The case can be used to ask the questions of what business should a company be in, why it makes sense to combine certain services, and what the fundamental job of managers really is. If students have already taken a strategy class, you can build off this material, but try to ensure that economic concepts are taken into account as well. Press the students on why it is important for TWC to grow, or why they need to be in certain lines of business.

Remaining Weeks:

Assigning the students to read the case during week one not only permits them to see how various economic forces work together to influence firm profits, but also provides a working example that can be used throughout the semester to motivate the chapter material as well as the quantitative approach that distinguishes managerial economics from management strategy. The following is a brief summary of links between selected chapters of the text and the TWC case:

Chapter 1: The TW case complements the text's treatment of the five forces framework, present value analysis, and opportunity cost.

Chapter 2: The case can easily be linked to consumer surplus, and demand/supply analysis. One reason consumer groups favor a la carte pricing is that the bundling practices of cable companies extract too much surplus from consumers. Changes in technology, consumer tastes, and competition are likely to dramatically change the equilibrium prices of broadband and cable networks.

Chapter 3: The case facilitates links to elasticities of demand and quantitative demand analysis. Are premium and basic cable normal or inferior goods? Is broadband a substitute or complement for cable television? A number of memos (discussed below) permit hands-on quantitative analysis of additional issues.

Chapter 4: College (and graduate) students are among those most likely to have cut the cord and rely heavily on Internet based entertainment. Ask students whether they think they are more likely to subscribe to cable once they are out of college. You can then discuss whether cord-cutting is due to budget constraints or different preferences for a particular service.

Chapter 5: Ask the students to identify specific cost-complementarities and economies of scope within TWC (for example, the cost of providing broadband service to a household is lower if that customer subscribes to its cable service – this is an example of economies of scope). Many other examples are present in the case.

Chapter 6: One way to assess the issues of vertical integration is to analyze Time Warner, Inc.'s decision in 2009 to divest Time Warner Cable. What factors led to that divestment and what arguments can be made either for or against a more vertically integrated company.

Chapter 7: This is a good opportunity to review the five forces framework with feedback effects. The case can also be used to discuss the DOJ/FTC horizontal merger guidelines.

Chapter 8: While the cable television market is largely oligopolistic, comparisons can also be drawn from monopolistically competitive markets, as well as some local monopolies.

Chapter 9: The cable market in each geographic area is an oligopoly. Students should be asked to identify the type of oligopoly and the basis for the competition in each market. Most students identify the services as Bertrand. You can then ask them whether prices are driven to marginal cost, and what factors prevent this from happening.

Chapter 10: There are a number of game theoretic applications that can be drawn from the case. TWC is constantly in bargaining situations with its suppliers. Further, virtually

every market is an oligopoly with pricing decisions that can be modeled using game theory tools.

Chapter 11: Various pricing strategies are used by TWC. These include standard pricing, bundling (cable networks bundle programs into packages consisting of several networks). Also, TWC can price its services differently in different regions. In regions where competition is keener (and hence demand is more elastic), it can charge lower prices; in other areas in can charge higher prices. This is third-degree price discrimination. A variety of memos, discussed below, give students hands-on practice implementing these strategies.

Chapter 13: Network externalities potentially play a large role in the cable industry. As more content providers provide their programming directly to consumers, the value of cable decreases. This leads fewer consumers to subscribe and more incentive for content providers to go direct.

Chapter 14: TWC faces government regulations and oversight in a variety of business segments. Ask the students to identify these and to explain how they shape optimal business strategy.

Assigning Individual Memos on a Chapter-by-Chapter Basis

The text includes 13 memos. The following provides an overview of the chapters with which the memos may be assigned, the concepts involved with each memo, and a synopsis of what is required to conduct the analysis.

Memo	Relevant Chapters	Concepts	Synopsis of the exercise
1	3	Elasticity, Total Revenue Test, Regression Analysis	Students are required to use the data to estimate a demand function and determine the revenue maximizing price.
2	5, 8, 11	Irrelevance of Sunk Costs, Covering Variable Costs	This memo contains a lot of information that might lead students down the path of doing present value analysis, but these costs are sunk. But all that is required for this memo is to recognize that only variable costs are relevant.
3	1, 7	Five Forces Analysis	This is an open-ended memo that requires a five forces analysis and ranking of business lines (from most sustainable profits to least). As discussed above, this can be used the first week of class or as a capstone exercise.
4	3, 5, 8	Elasticity, Revenue, Marginal Cost, Profit Maximization	Students are asked to use data to calculate the profit maximizing price for a service. This memo is similar to #1 and can be used to generally compare the revenue-maximizing price with the profit-maximizing price in the presence of positive marginal cost.
5	10, 11	Price Discrimination, Sequential Move Games	Students identify whether offering discounts to customers that are planning to cancel their service will be effective. Offering lower prices is a form of price discrimination, however, they should raise concerns about cannibalization of existing full-price customers.

6	3	Elasticity, income elasticity, revenue	Students are given regression output that they need to interpret based on income levels. Two different service tiers are provided (Favored and Basic) and one service is a normal good while the other is inferior.
7	10, 13	Dominant Strategy, Nash equilibrium, Game theory	Students are given information that they must put into a bi-matrix game to make a pricing decision.
8	1, 6, 7, 14	Strategy, vertical integration	Students are asked about potential vertical integration by acquiring a media company (Viacom) that owns a number of cable television networks. While the anti-trust issues are not as strong, there is an open issue as to whether this would make strategic sense.
9	1, 7, 14	Strategy, mergers and acquisition, government regulation, anti-trust.	An open-ended scenario in which students are asked to analyze the "failed" Comcast Time Warner merger from 2015. A quick internet search should provide plenty of reasons/criticisms of the merger. Students should be able to put that in economic terms and then recommend some other potential M&A targets that will create value and avoid some of the pitfalls of that merger.
10	10	Game theory, Nash bargaining, credible commitment	An open-ended memo that asks how TWC should deal with increasing network retransmission fees. Students should see that TWC has an incentive to reach an agreement, but that the recommended fee will be a significant cost increase. Students should recommend negotiating strategies.
11	3, 11	Elasticity, mark-up pricing.	Elasticity estimates and marginal cost are provided for several cable channels. Based on this, students need to calculate the optimal mark-up price.
12	13	Network Externalities	Students are asked to explore network externalities in the decision of consumers to cut the cord as well as networks to go "over the top" and provide services directly to consumers. Students should see that there is the potential of a "death spiral" where networks increasingly offer services directly to consumers, and the number of consumers subscribing to cable declines significantly.
13	7	Industry Concentration, horizontal merger guidelines.	Students are given market share data (based on number of households) over a two-year period and asked to make calculations for industry concentration. A hypothetical merger is proposed and the post-merger concentration must be calculated and compared to anti-trust guidelines.

If you have questions or comments on the TWC case, memos, or teaching note, I would appreciate your feedback. I can be reached at kyjander@indiana.edu.

CHAPTER 2

Market Forces: Demand and Supply

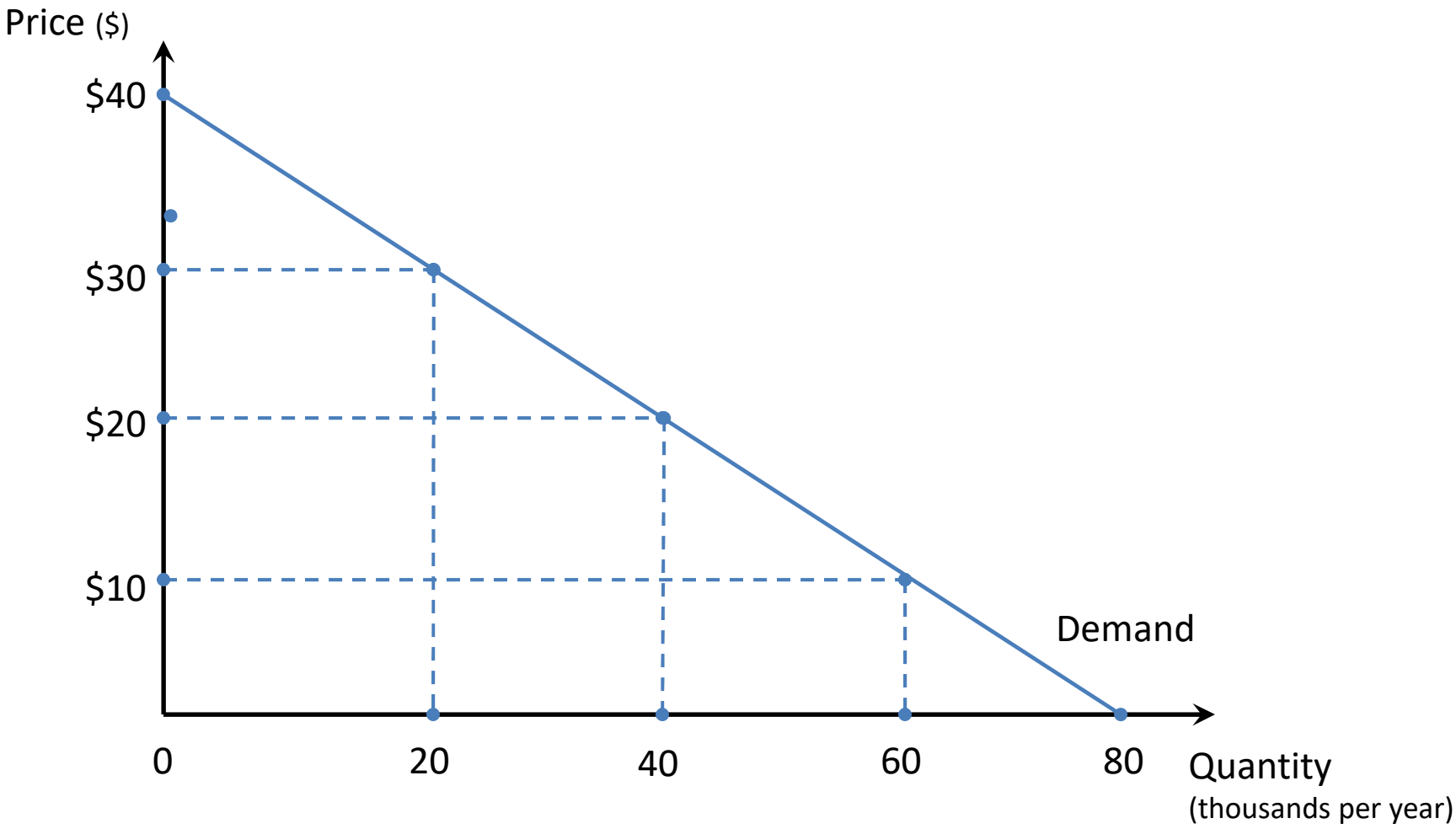
Learning Objectives

1. Explain the laws of demand and supply, and identify factors that cause demand and supply to shift.
2. Calculate consumer surplus and producer surplus, and describe what they mean.
3. Explain price determination in a competitive market, and show how equilibrium changes in response to changes in determinates of demand and supply.
4. Explain and illustrate how excise taxes, ad valorem taxes, price floors, and price ceilings impact the functioning of a market.
5. Apply supply and demand analysis as a qualitative forecasting tool to see the “big picture” in competitive markets.

Demand

- **Market demand curve**
  - Illustrates the relationship between the total quantity and price per unit of a good all consumers are *willing* and *able* to purchase, holding other variables constant.
- **Law of demand**
  - The quantity of a good consumers are *willing* and *able* to purchase increases (decreases) as the price falls (rises).
  - Price and quantity demanded are inversely related.

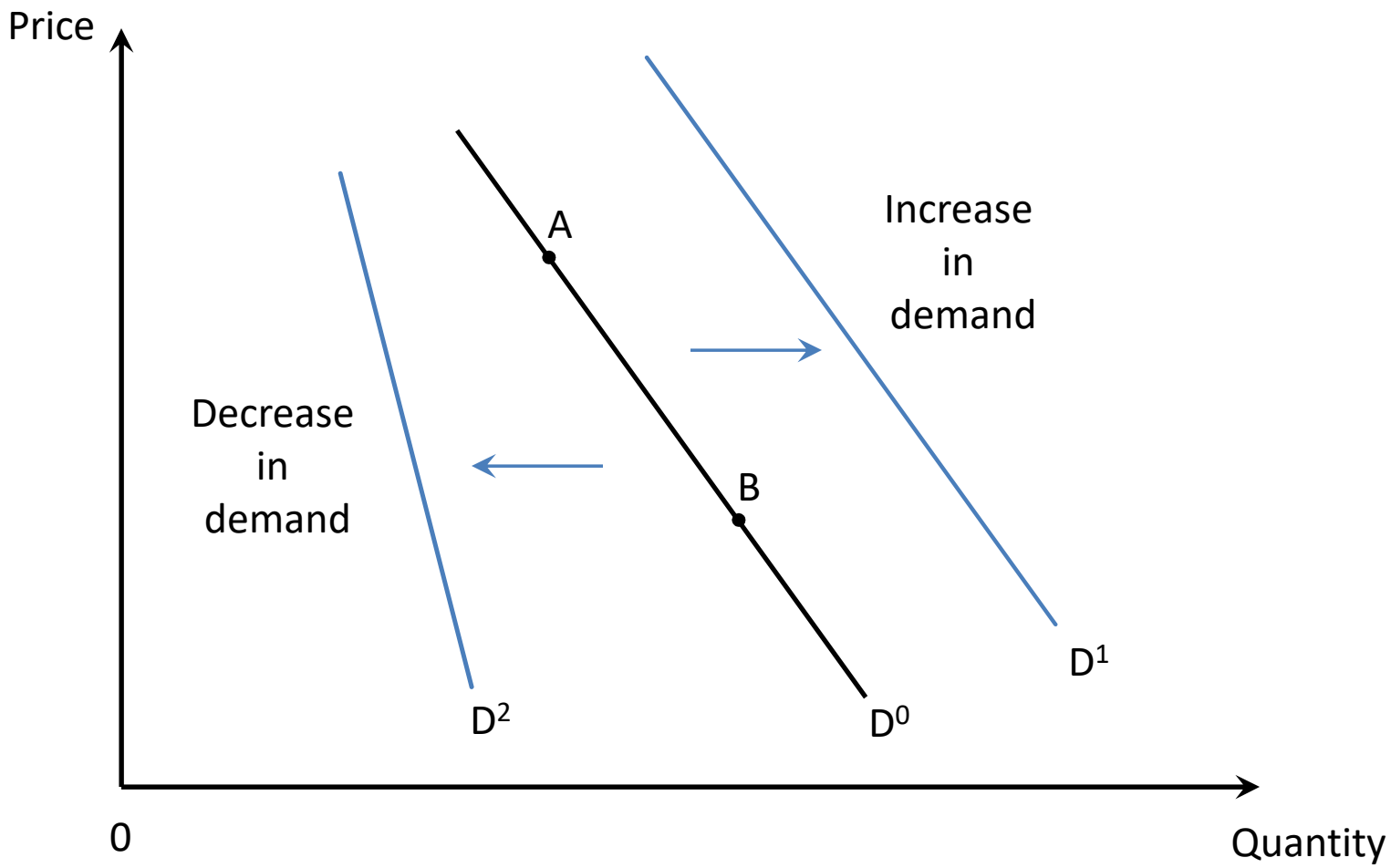
Market Demand Curve



Shift in Quantity Demanded versus a Shift in Demand

- Changing *only* price leads to **changes in *quantity demanded***.
  - This type of change is graphically represented by a movement along a given demand curve, holding other factors that impact demand constant.
- Changing factors other than price lead to ***changes in demand***.
  - These types of changes are graphically represented by a shift of the entire demand curve.

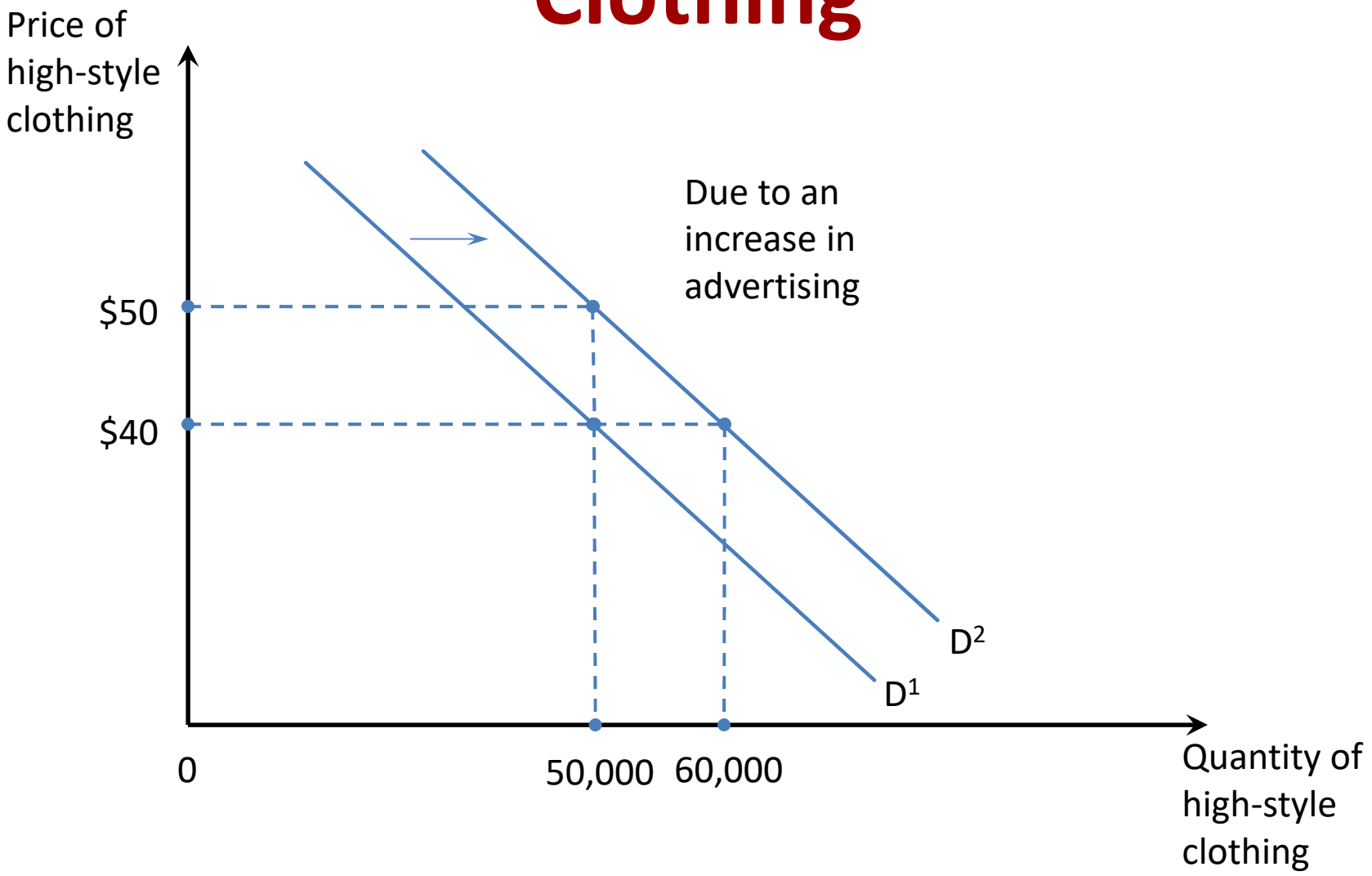
Changes in Demand



Demand Shifters

- Income
  - Normal good
  - Inferior good
- Prices of related goods
  - Substitute goods
  - Complement goods
- Advertising and consumer tastes
  - Informative advertising
  - Persuasive advertising
- Population
- Consumer expectations
- Other factors

Advertising and the Demand for Clothing



The Demand Function

- The ***demand function*** for good *X* is a mathematical representation describing how many units will be purchased at different prices for *X*, the price of a related good *Y*, income and other factors that affect the demand for good *X*.

The Linear Demand Function

- One simple, but useful, representation of a demand function is the *linear demand function*:

$$Q_X{}^d = \alpha_0 + \alpha_X P_X + \alpha_Y P_Y + \alpha_M M + \alpha_H H$$

where:

  - $Q_X{}^d$ is the number of units of good X demanded;
  - P_X is the price of good X;
  - P_Y is the price of a related good Y;
  - M is income;
  - H is the value of any other variable affecting demand.

Understanding the Linear Demand Function

- The signs and magnitude of the α coefficients determine the impact of each variable on the number of units of X demanded.

$$Q_X{}^d = \alpha_0 + \alpha_X P_X + \alpha_Y P_Y + \alpha_M M$$

- For example:
  - $\alpha_X < 0$ by the law of demand;
  - $\alpha_Y > 0$ if good Y is a substitute for good X;
  - $\alpha_M < 0$ if good X is an inferior good.

The Linear Demand Function in Action

- Suppose that an economic consultant for X Corp. recently provided the firm's marketing manager with this estimate of the demand function for the firm's product:

$$Q_X{}^d = 12{,}000 - 3P_X + 4P_Y - 1M + 2A_X$$

Question: How many of good X will consumers purchase when $P_X = \$200$ per unit, $P_Y = \$15$ per unit, $M = \$10{,}000$ and $A_X = 2{,}000$? Are goods X and Y substitutes or complements? Is good X a normal or an inferior good?

Answer:

$Q_X{}^d = 12{,}000 - 3(200) + 4(15) - 1(10{,}000) + 2(2{,}000) = 5{,}460$ units. Goods X and Y are substitutes. Good X is an inferior good.

Inverse Demand Function

- By setting $P_Y = \$15$ and $M = \$10{,}000$ and $A = 2{,}000$ the demand function is

  $Q_X{}^d = 12{,}000 - 3P_X + 4(15) - 1(10{,}000) + 2(2{,}000)$

  the linear demand function simplifies to

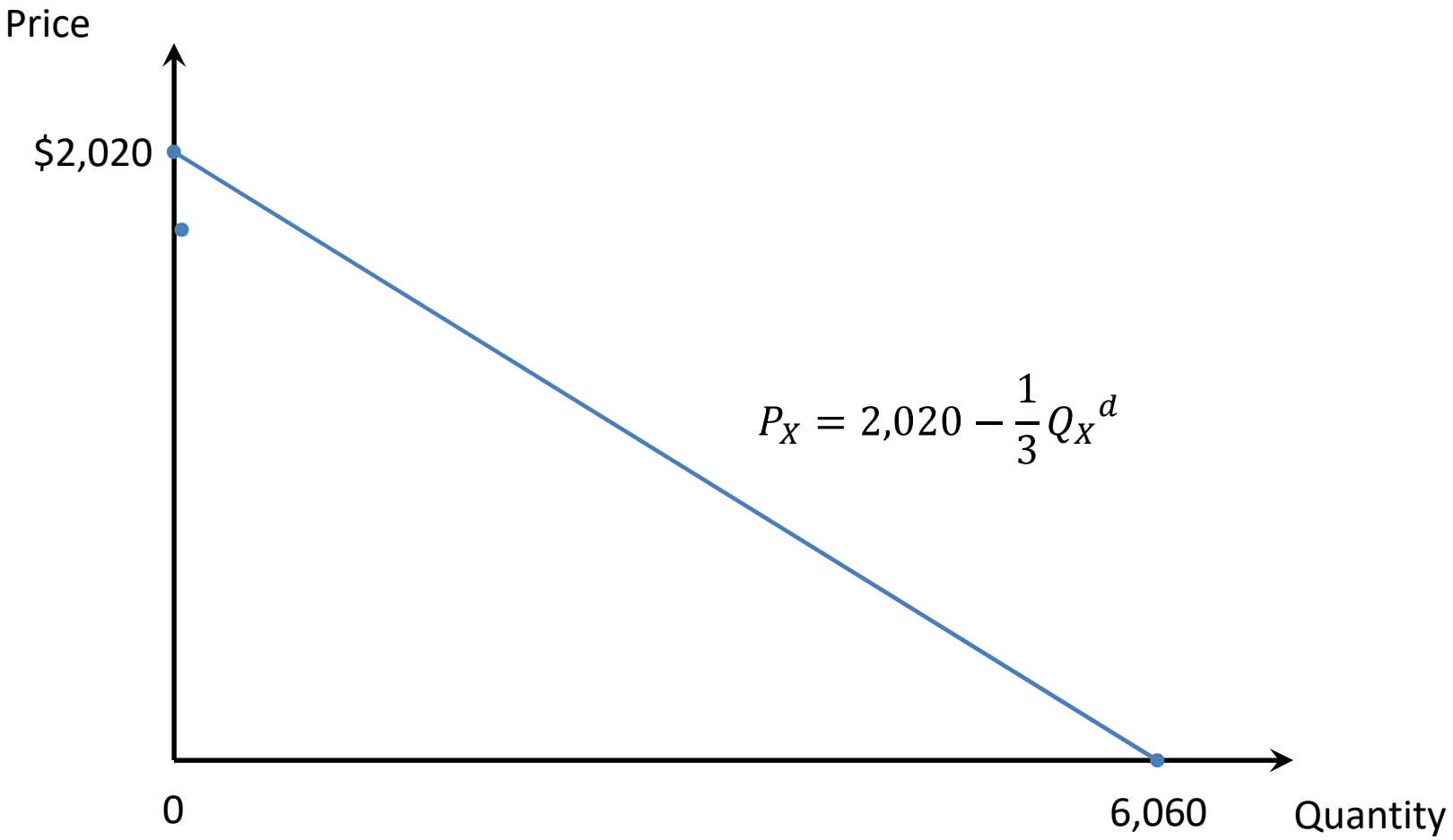
  $$Q_X{}^d = 6{,}060 - 3P_X$$

  Solving this for P_X in terms of $Q_X{}^d$ results in

  $$P_X = 2{,}020 - \frac{1}{3}Q_X{}^d$$

  which is called the ***inverse demand function***. This function is used to construct a *market demand curve*.

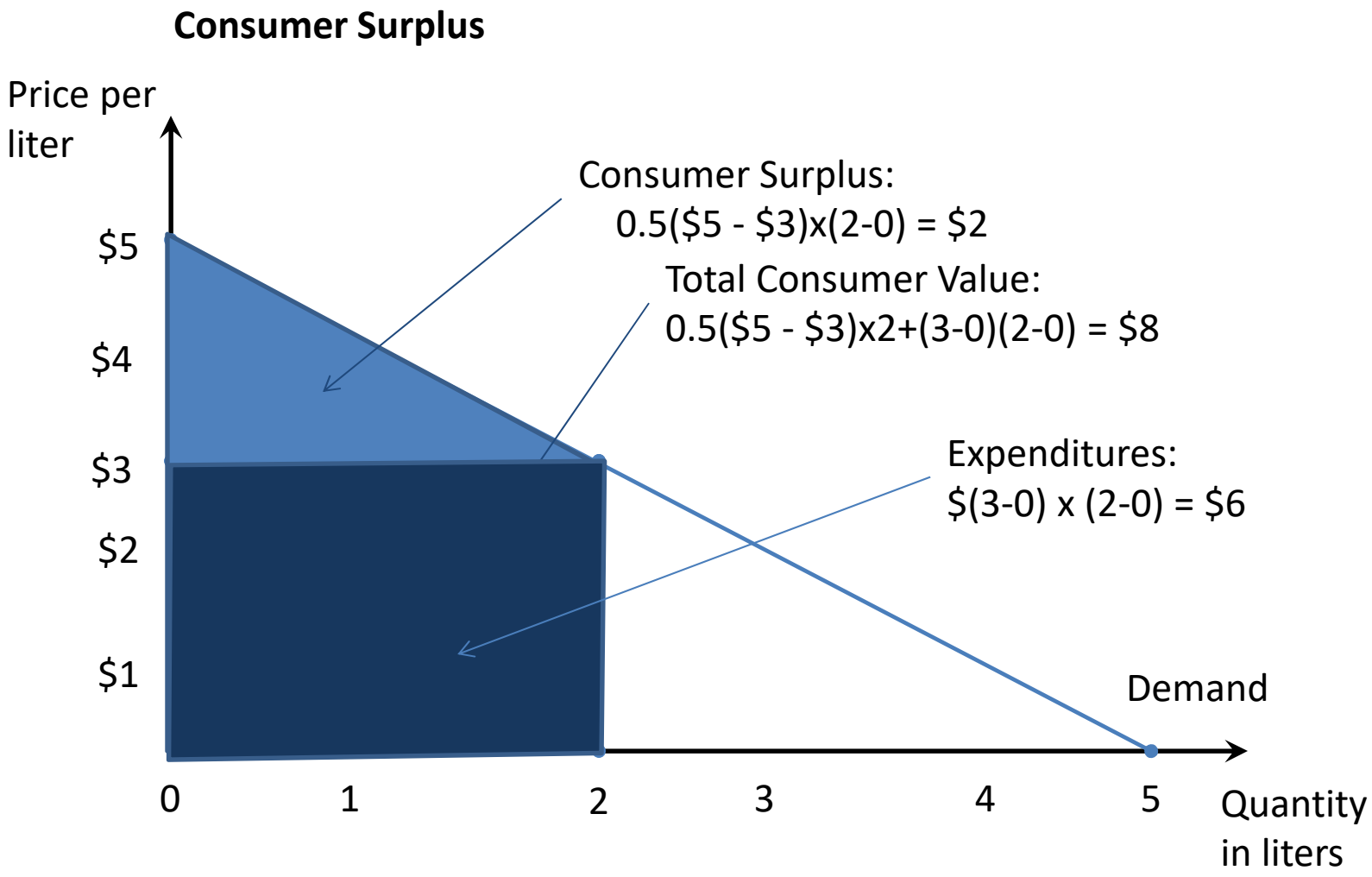
Graphing the Inverse Demand Function in Action



Consumer Surplus

- Marketing strategies – like value pricing and price discrimination – rely on understanding consumer value for products.
  - ***Total consumer value*** is the sum of the maximum amount a consumer is willing to pay at different quantities.
  - ***Total expenditure*** is the per-unit market price times the number of units consumed.
  - ***Consumer surplus*** is the extra value that consumers derive from a good but do not pay extra for.

Market Demand and Consumer Surplus in Action



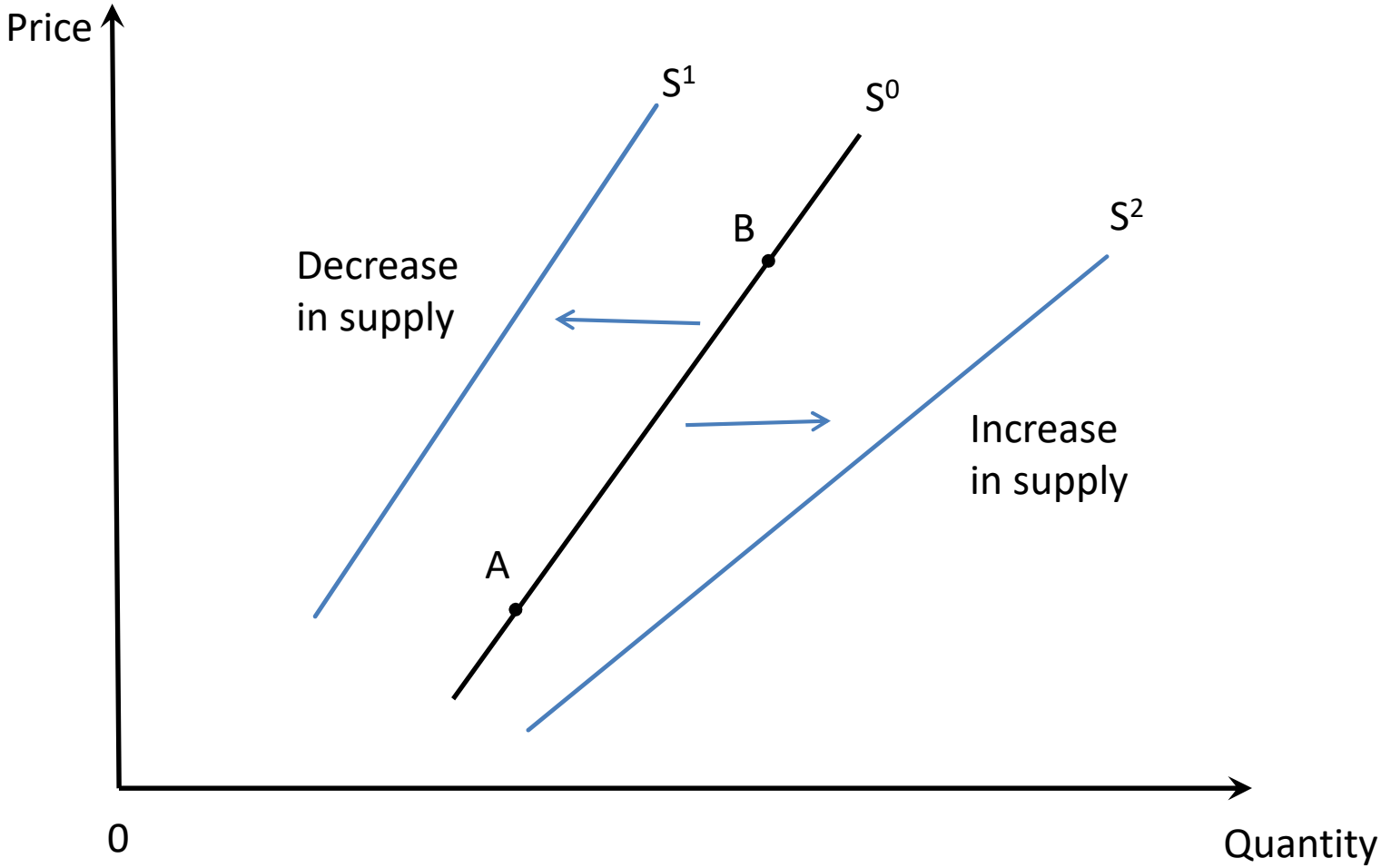
Supply

- **Market supply curve**
  - A curve indicating the total quantity of a good that all producers in a competitive market would produce at each price, holding input prices, technology, and other variables affecting supply constant.
- **Law of supply**
  - As the price of a good rises (falls), the quantity supplied of the good rises (falls), holding other factors affecting supply constant.

Changes in Quantity Supplied versus Changes in Supply

- Changing only price leads to c**hanges in *quantity supplied***.
  - This type of change is graphically represented by a movement along a given supply curve, holding other factors that impact supply constant.
- Changing factors other than price lead to ***changes in supply***.
  - These types of changes are graphically represented by a shift of the entire supply curve.

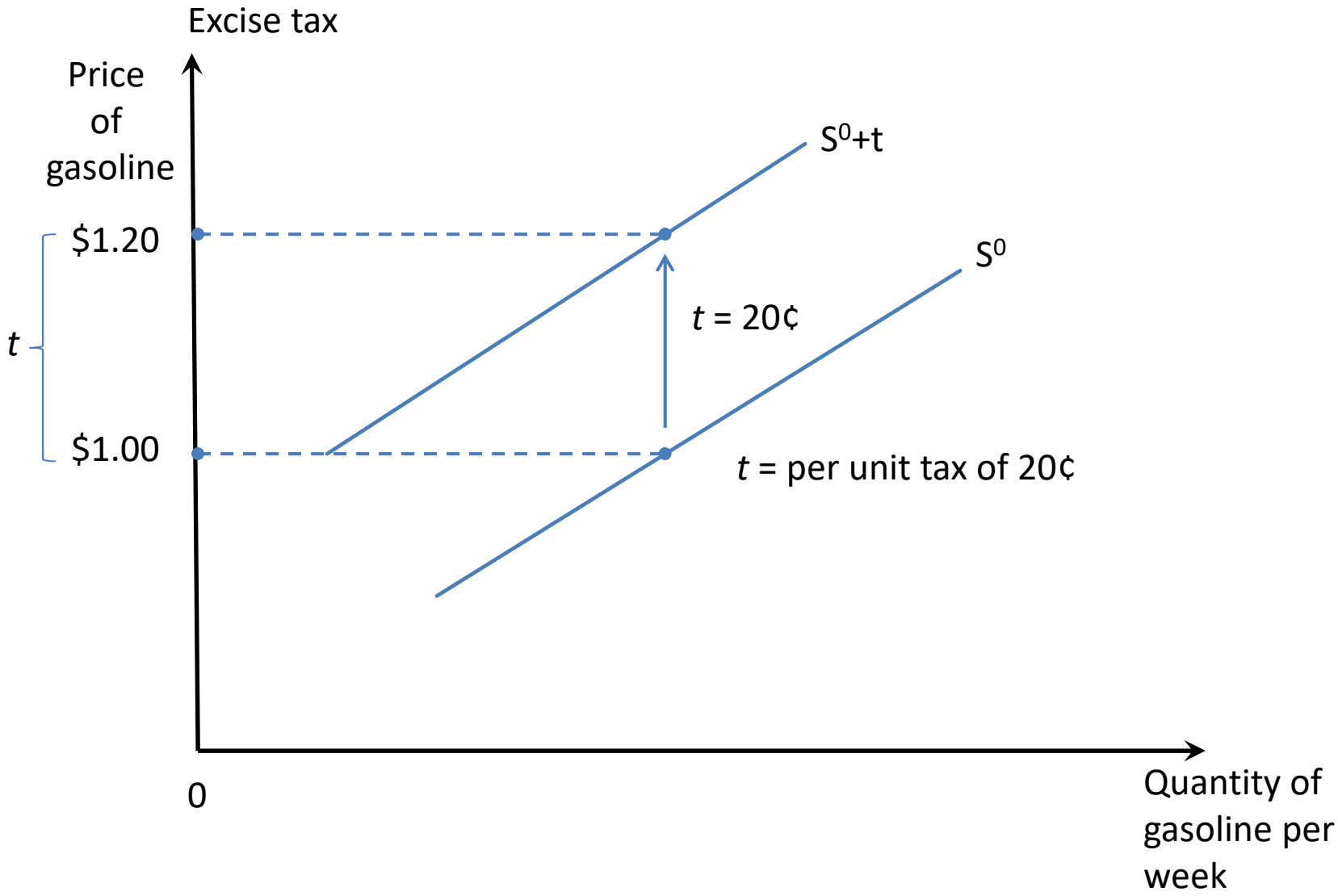
Changes in Supply



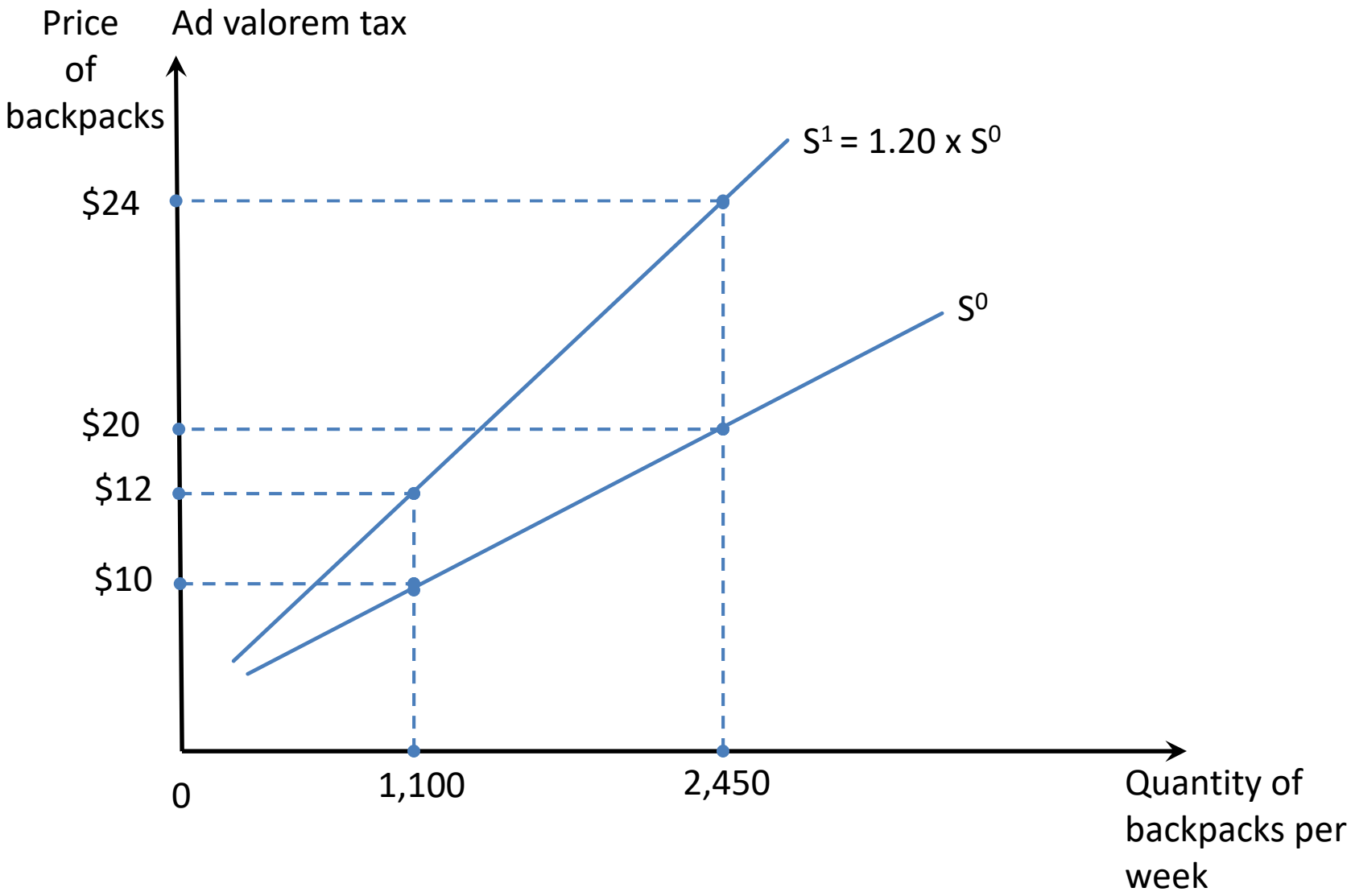
Supply Shifters

- Input prices
- Technology or government regulation
- Number of firms
  - Entry
  - Exit
- Substitutes in production
- Taxes
  - ***Excise tax***: a tax on each unit of output sold, where tax revenue is collected from the supplier
  - ***Ad valorem tax***: percentage tax
- Producer expectations

A Per Unit (Excise) Tax



An Ad Valorem Tax



The Supply Function

- The **supply function** for good *X* is a mathematical representation describing how many units will be produced at alternative prices for *X*, alternative input prices *W*, and alternative values of other variables that affect the supply for good *X*.

The Linear Supply Function

- One simple, but useful, representation of a supply function is the **linear supply function**:

$$Q_X{}^S = \beta_0 + \beta_X P_X + \beta_W W + \beta_r P_r + \beta_H H$$

  - $Q_X{}^S$ is the number of units of good X produced;
  - P_X is the price of good X;
  - W is the price of an input;
  - P_r is price of technologically related goods;
  - H is the value of any other variable affecting supply.

Understanding the Linear Supply Function

- The signs and magnitude of the β coefficients determine the impact of each variable on the number of units of X produced.

$$Q_X{}^s = \beta_0 + \beta_X P_X + \beta_W W + \beta_r P_r$$

- For example:
  - $\beta_X > 0$ by the law of supply.
  - $\beta_W < 0$ increasing input price.
  - $\beta_r > 0$ technology lowers the cost of producing good X.

The Linear Supply Function in Action

- Your research department estimates that the supply function for televisions sets is given by:

$$Q_X{}^S = 2{,}000 + 3P_X - 4P_R - 1P_W$$

Question: How many televisions are produced when $P_X = \$400$, $P_R = \$100$ per unit, and $P_W = \$2{,}000$?

Answer:

$Q_X{}^S = 2{,}000 + 3(400) - 4(100) - 1(2{,}000) = 800$ television sets.

Inverse Supply Function

- By setting $P_W = \$2{,}000$ and $P_r = \$100$ in $Q_X{}^S = 2{,}000 + 3P_X - 4(100) - 1(2{,}000)$ the linear supply function simplifies to

$$Q_X{}^S = 3P_X - 400$$

Solving this for P_X in terms of $Q_X{}^S$ results in

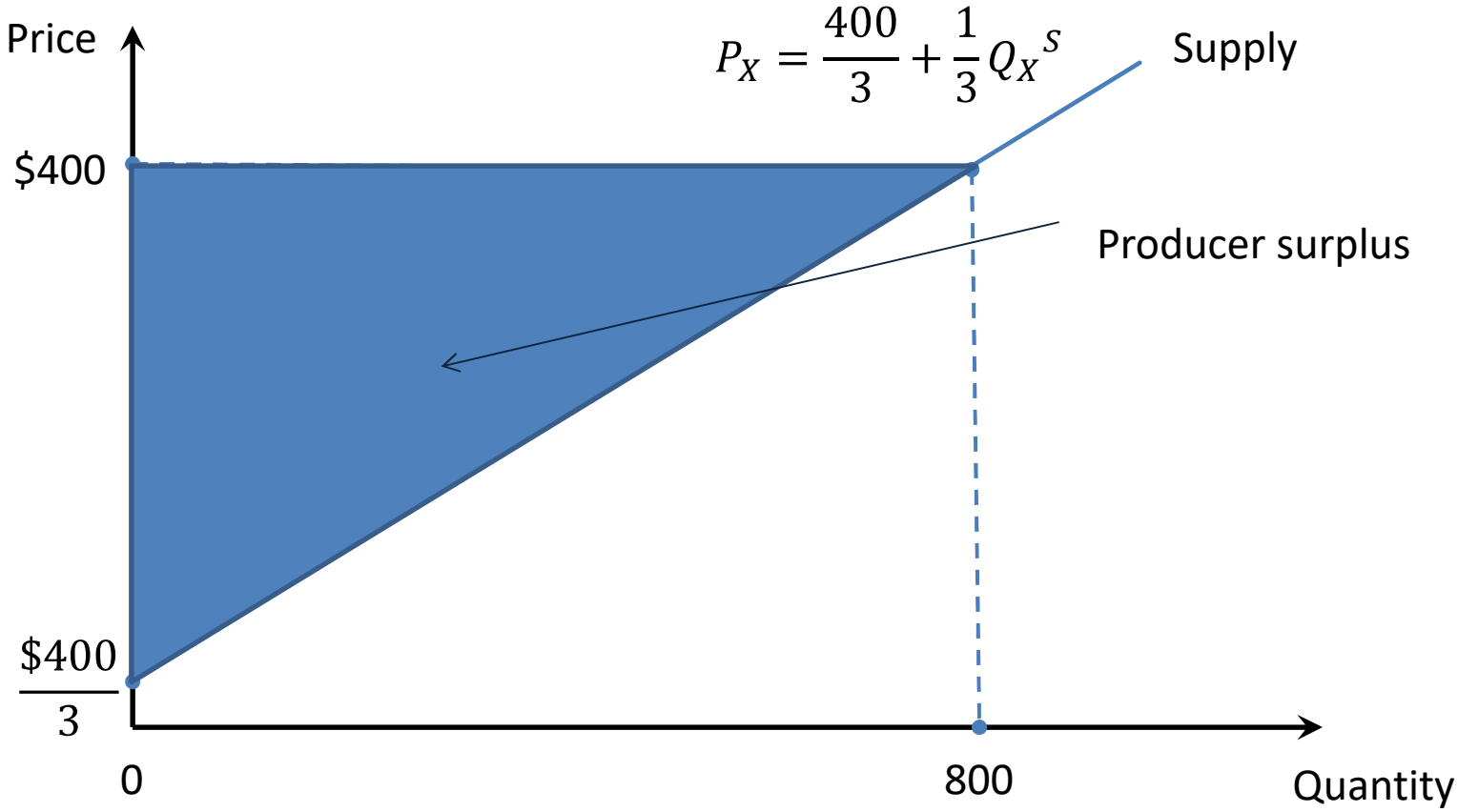
$$P_X = \frac{400}{3} + \frac{1}{3}Q_X{}^S$$

which is called the ***inverse supply function***. This function is used to construct a *market supply curve*.

Producer Surplus

- **Producer surplus**: the amount producers receive in excess of the amount necessary to induce them to produce the good.

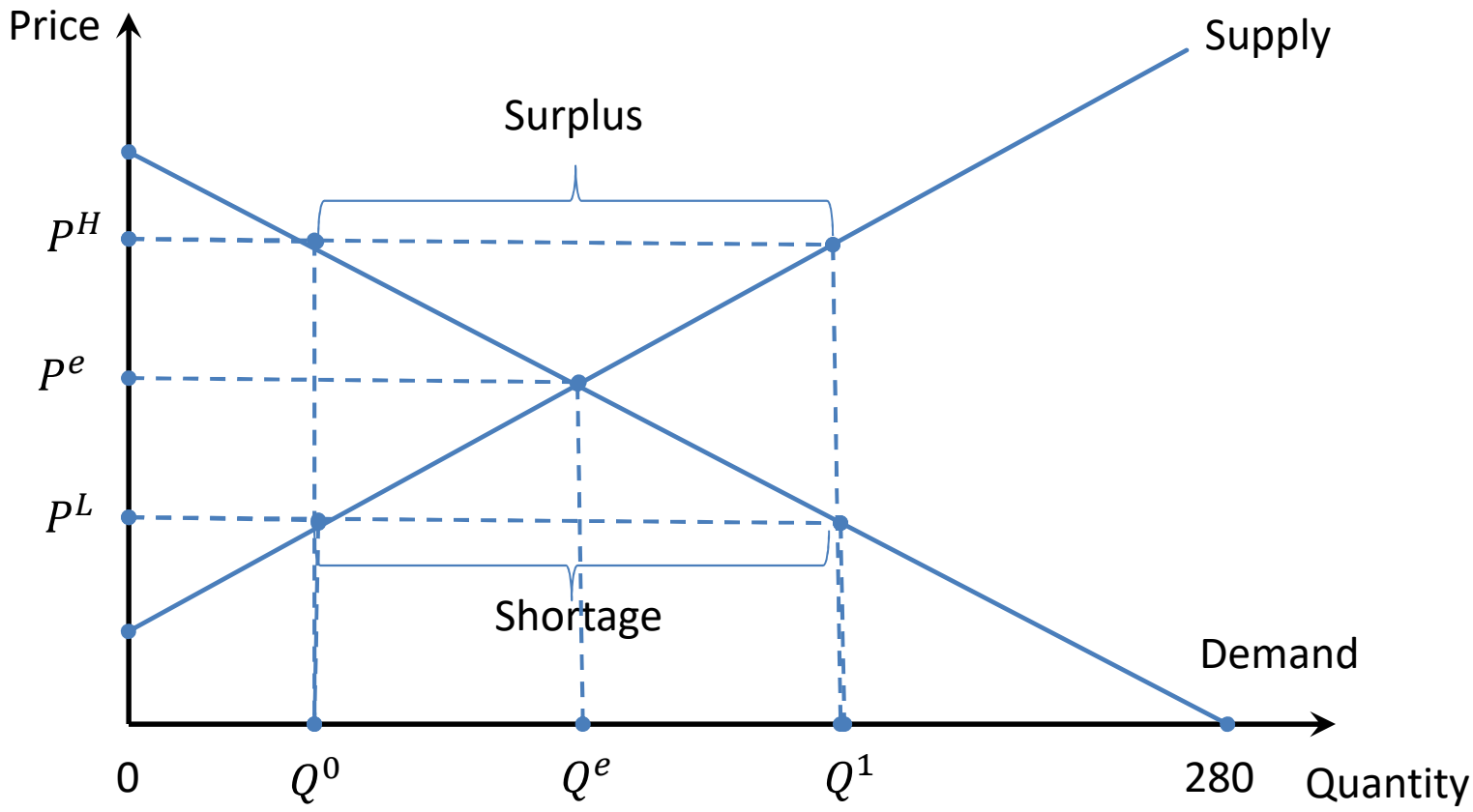
Producer Surplus in Action



Market Equilibrium

- **Competitive Market Equilibrium**
  - Determined by the intersection of the market demand and market supply curves.
  - A price and quantity such that there is no shortage or surplus in the market.
  - Forces that drive market demand and market supply are balanced, and there is no pressure on prices or quantities to change.
  - The equilibrium price is the price that equates quantity demanded with quantity supplied

Market Equilibrium



Market Equilibrium in Action

- Consider a market with demand and supply functions, respectively, as

$$Q^d = 10 - 2P \text{ and } Q^s = 2 + 2P$$

- A competitive market equilibrium exists at a price, P^e, such that $Q^d(P^e) = Q^s(P^e)$. That is,

$$10 - 2P = 2 + 2P$$

$$8 = 4P$$

$$P^e = \$2$$

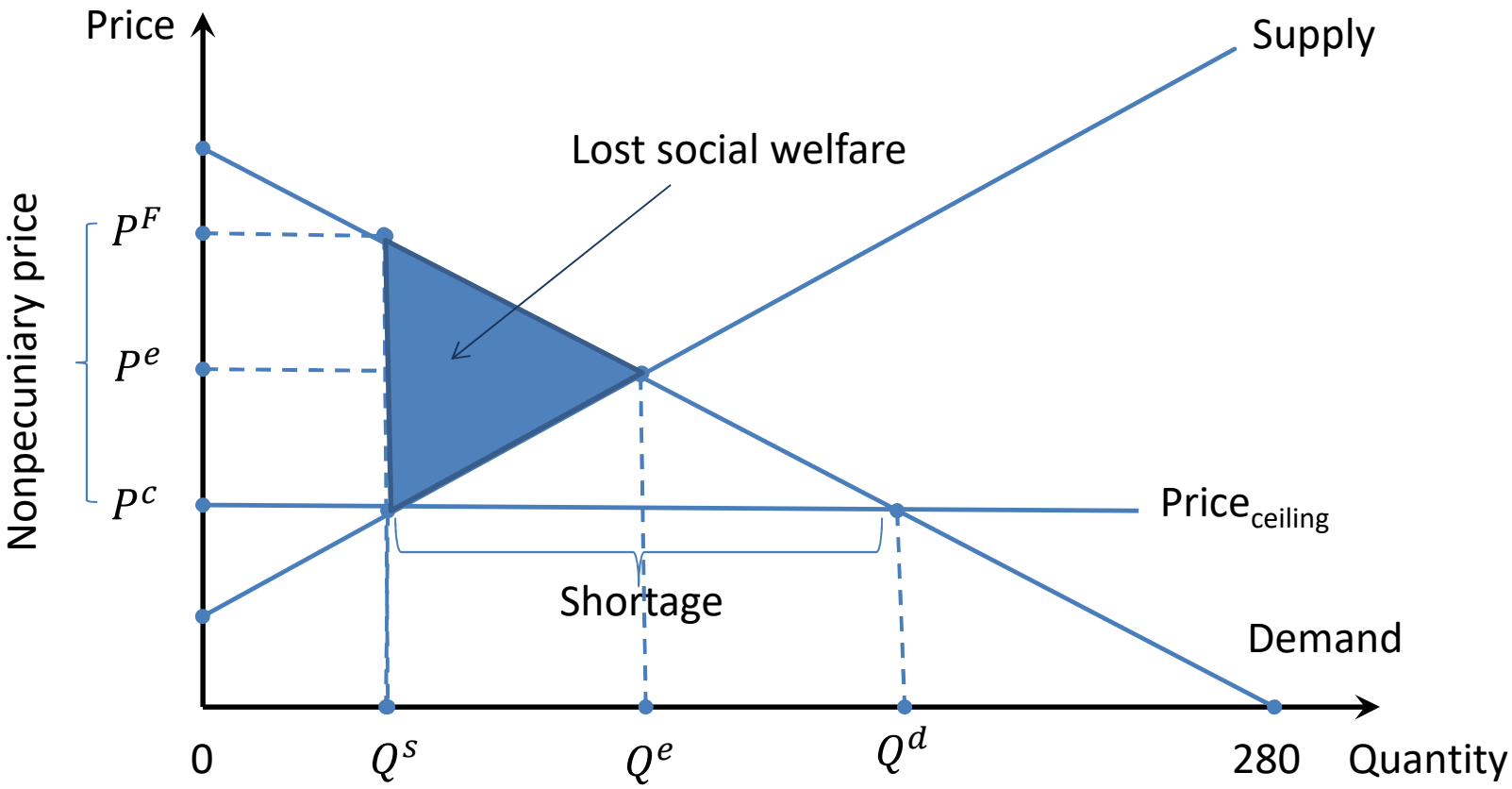
$$Q^e = 10 - 2(\$2) = 6 \text{ and } Q^e = 2 + 2(\$2) = 6$$

$$Q^e = 6 \text{ units}$$

Price Restrictions and Market Equilibrium

- In a competitive market equilibrium, price and quantity freely adjust to the forces of demand and supply.
- Sometime government restricts how much prices are permitted to rise or fall.
  - Price ceiling
  - Price floor

A Price Ceiling



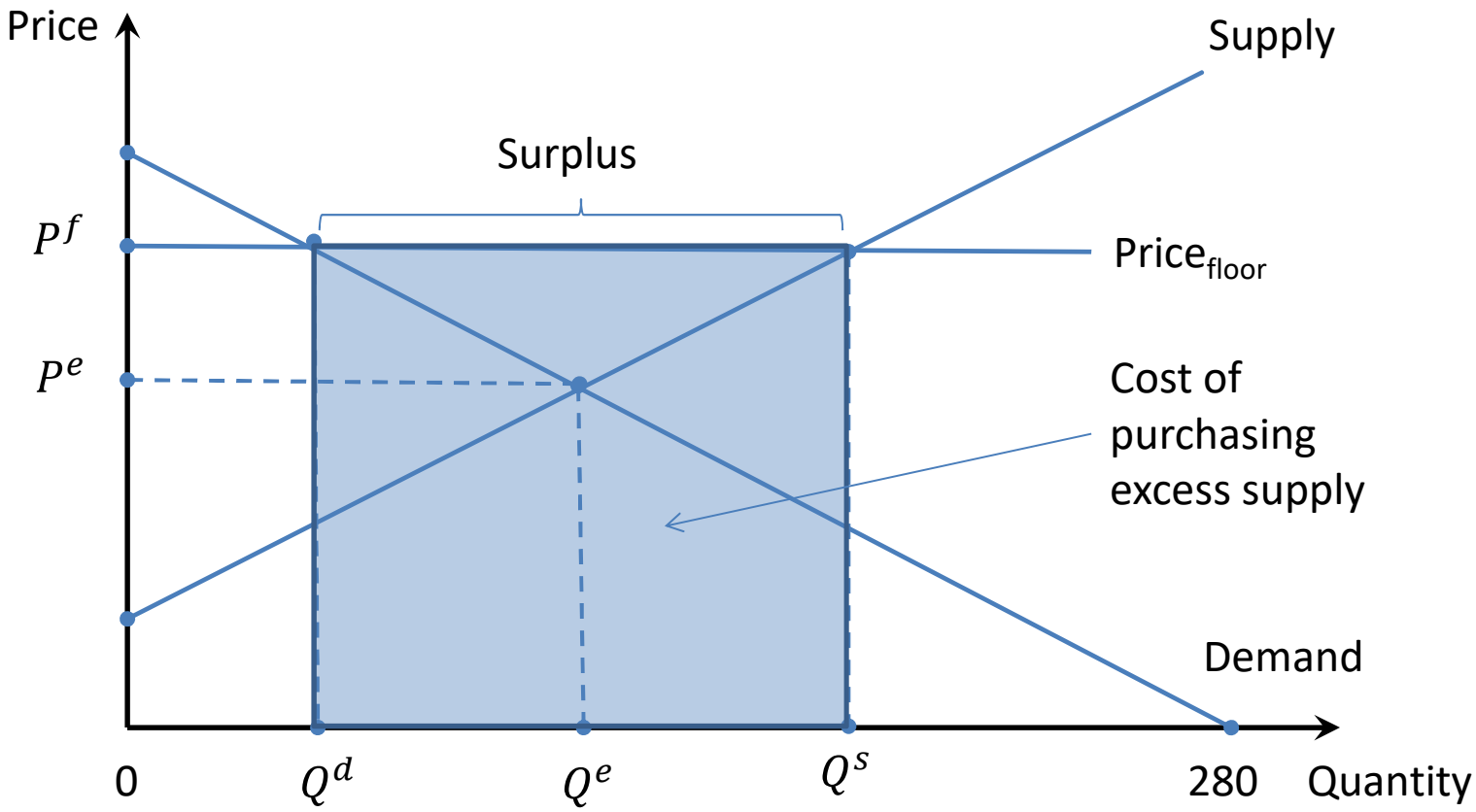
Price Ceiling in Action

- Consider a market with demand and supply functions, respectively, as

$$Q^d = 10 - 2P \text{ and } Q^s = 2 + 2P$$

- Suppose a \$1.50 price ceiling is imposed on the market.
  - $Q^d = 10 - 2(\$1.50) = 7$ units.
  - $Q^s = 2 + 2(\$1.50) = 5$ units.
  - Since $Q^d > Q^s$ a shortage of $7 - 5 = 2$ units exists.
  - Full economic price of $5th$ unit is $5 = 10 - 2P_{full}$, or $P_{full} = \$2.50$. Of this,
    - \$1.50 is the dollar price
    - \$1 is the nonpecuniary price

A Price Floor



Price Floor in Action

- Consider a market with demand and supply functions, respectively, as

$$Q^d = 10 - 2P \text{ and } Q^s = 2 + 2P$$

- Suppose a \$3.50 price floor is imposed on the market.
  - $Q^d = 10 - 2(\$3.50) = 3$ units
  - $Q^s = 2 + 2(\$3.50) = 9$ units
  - Since $Q^s > Q^d$ a surplus of $9 - 3 = 6$ units exists
  - The cost to the government of purchasing the surplus is $\$3.50 \times 6 = \$21.$

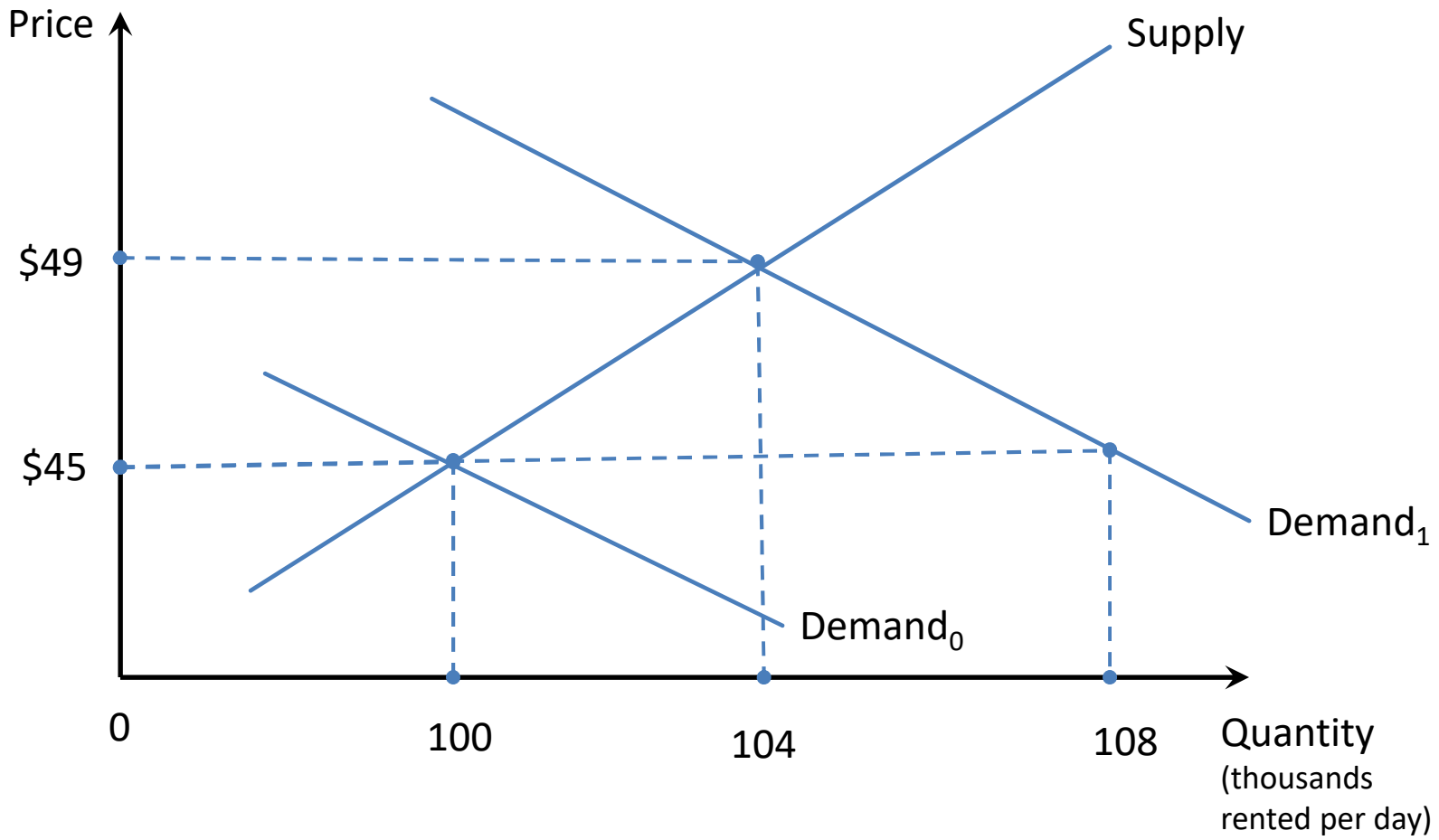
Comparative Statics

- ***Comparative static analysis***
  - The study of the movement from one equilibrium to another.
- Competitive markets, operating free of price restraints, will be analyzed when:
  - Demand changes
  - Supply changes
  - Demand and supply simultaneously change

Changes in Demand

- Increase in demand only
  - Increase equilibrium price
  - Increase equilibrium quantity
- Decrease in demand only
  - Decrease equilibrium price
  - Decrease equilibrium quantity
- Example of change in demand
  - Suppose that consumer incomes are projected to increase 2.5% and the number of individuals over 25 years of age will reach an all time high by the end of next year. What is the impact on the rental car market?

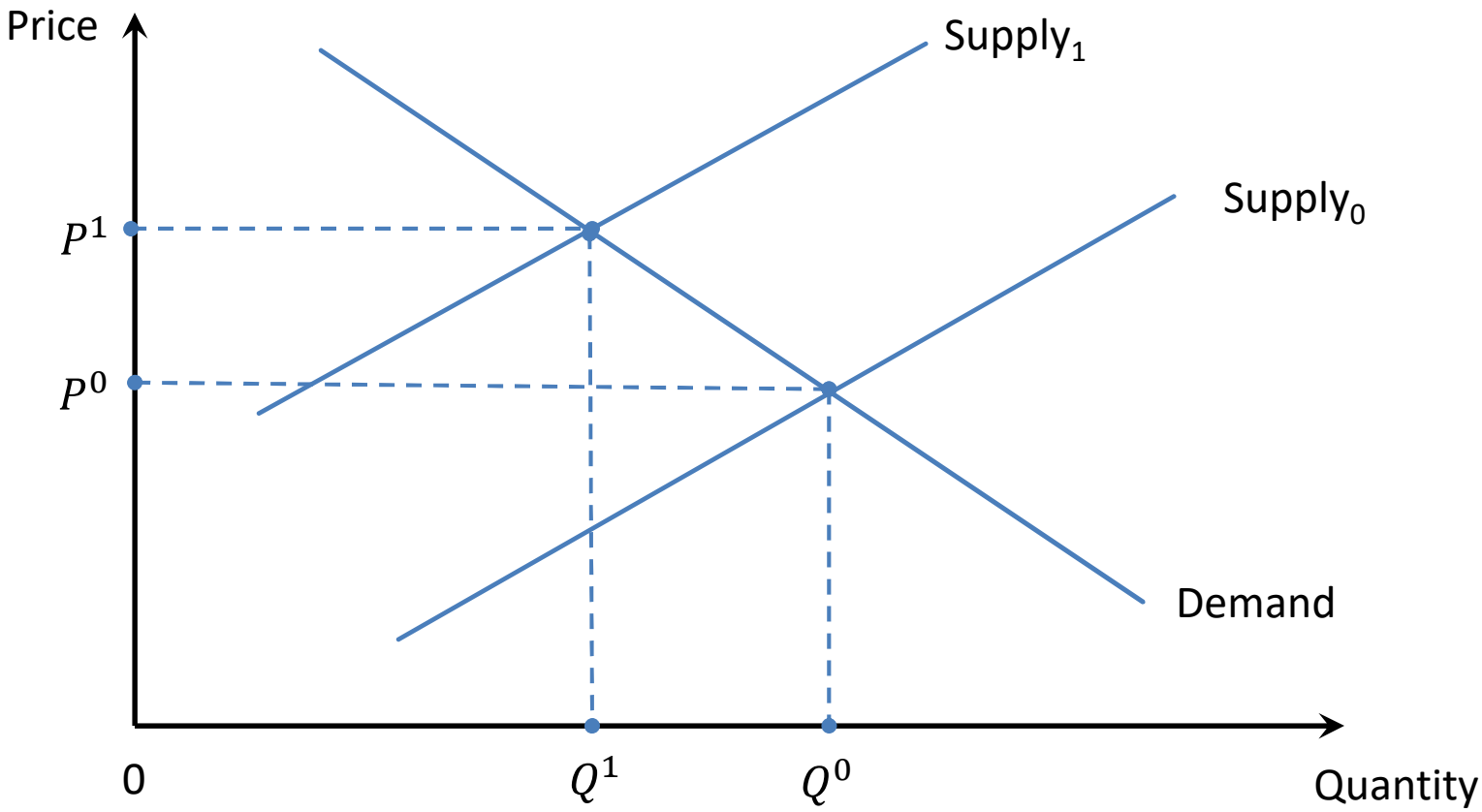
Effect of a Change in Demand for Rental Cars



Changes in Supply

- Increase in supply only
  - Decrease equilibrium price
  - Increase equilibrium quantity
- Decrease in supply only
  - Increase equilibrium price
  - Decrease equilibrium quantity
- Example of change in supply
  - Suppose that a bill before Congress would require all employers to provide health care to their workers. What is the impact on retail markets?

Effect of a Change in Supply



Simultaneous Shifts in Supply and Demand

- Suppose that simultaneously the following events occur:
  - An earthquake hit Kobe, Japan and decreased the supply of fermented rice used to make sake wine.
  - The stress caused by the earthquake led many to increase their demand for sake, and other alcoholic beverages.
- What is the combined impact on Japan's sake market?

Simultaneous Shifts in Supply and Demand in Action