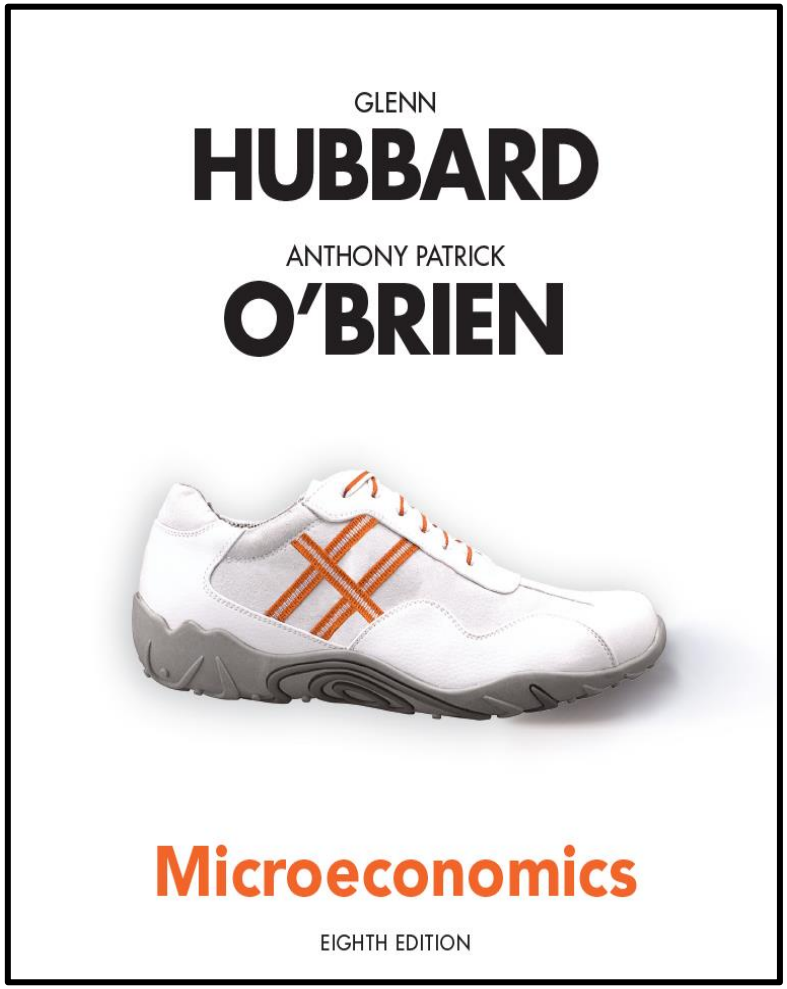
Microeconomics

Eighth Edition



Chapter 6

Elasticity: The Responsiveness of Demand and Supply

Pearson

Chapter Outline

6.1 The Price Elasticity of Demand and Its Measurement

6.2 The Determinants of the Price Elasticity of Demand

6.3 The Relationship between Price Elasticity of Demand and Total Revenue

6.4 Other Demand Elasticities

6.5 Using Elasticity to Analyze the Disappearing Family Farm

6.6 Price Elasticity of Supply and Its Measurement

Do Soda Taxes Work?

Recently a number of cities have enacted taxes on soda and other sweetened beverages. Why?

- To reduce sugar consumption, and hence obesity and diabetes
- To raise funds for public projects

Interestingly, these goals partially conflict: if beverage consumption decreases as intended, then less tax revenue will be collected.

- How can we know what the actual outcome will be?

6.1 The Price Elasticity of Demand and Its Measurement

Define and calculate price elasticity of demand.

As the price of sweetened beverages increase, we expect people will buy fewer of them. But how many fewer?

- How can we come up with a sensible way to measure how much quantity changes when price changes?

One idea is to look at the slope of the demand curve.

- But this won't work, since the value of the slope depends on the units used to measure on the axes.

Instead, we define an **elasticity**, a measure of how much one economic variable response to changes in another economic variable, based on **percentage changes** in the variables.

Price Elasticity of Demand

Our first elasticity to examine is the **price elasticity of demand**, the responsiveness of the quantity demanded to a change in price:

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

Although the slope and price elasticity of demand are related, they are not the same thing.

Since price and quantity change in opposite directions on the demand curve, the price elasticity of demand is a negative number.

- However we often refer to “more negative” elasticities as being “larger” or “higher”.

Price Elasticity of Demand Terminology

A “large” value for the price elasticity of demand means that quantity demanded changes a lot in response to a price change.

Formally, we say demand is **elastic** if its price elasticity of demand is larger (in absolute value) than 1.

- So a 10 percent increase in price would result in a greater than 10 percent decrease in quantity demanded.

Demand is **inelastic** if its price elasticity of demand is smaller (in absolute value) than 1.

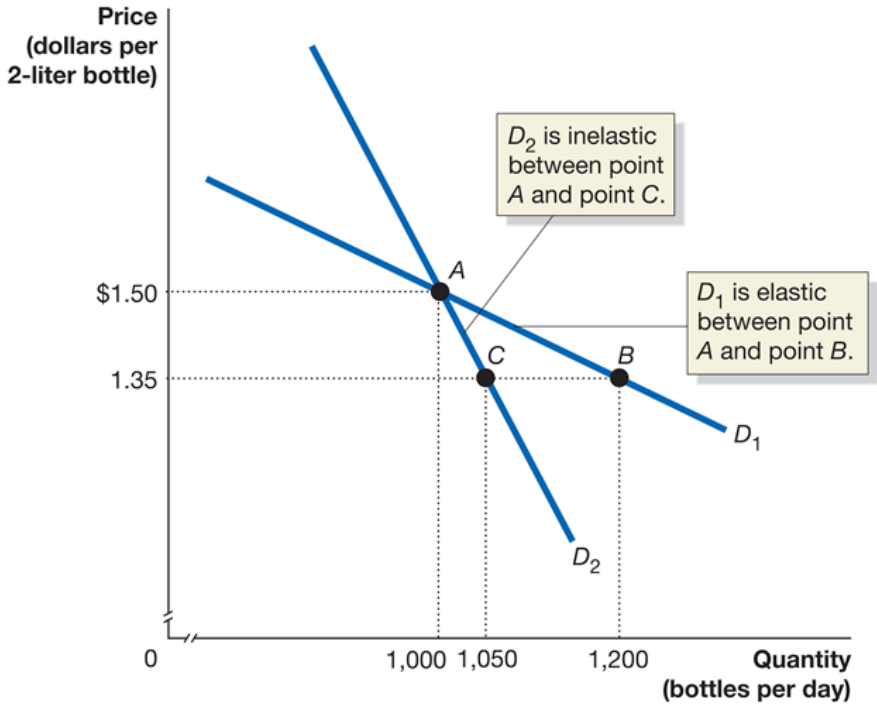
- That is, close to zero, indicating that quantity demanded changes little in response to a price change.

Demand is **unit-elastic** if the price elasticity of demand is exactly equal to 1.

Figure 6.1 Elastic and Inelastic Demand

Along D_1, cutting the price from \$1.50 to \$1.35 increases the number of bottles sold from 1,000 per day to 1,200 per day; demand is elastic between point *A* and point *B*.

Along D_2, cutting the price from \$1.50 to \$1.35 increases the number of bottles sold from 1,000 per day only to 1,050 per day; demand is inelastic between point *A* and point *C*.



Percentage Changes and the Midpoint Formula

Percentage changes have the unfortunate property that the percentage change from *A* to *B* is not the negative of the percentage change from *B* to *A*.

Example: On the previous slide, from point *A* to point *B*, quantity increased from 1,000 to 1,200, an increase of 20 percent.

However from *B* to *A*, quantity decreases by 16.7 percent.

This would mean the elasticity from *A* to *B* was different from the elasticity from *B* to *A*, and undesirable property.

To avoid this, we use the midpoint formula for percentage changes:

$$\text{Percentage change} = \frac{(A-B)}{\left(\frac{A+B}{2}\right)}$$

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The Midpoint Formula for Elasticity

The midpoint formula avoids the confusion of whether we are going from *A* to *B* or from *B* to *A*: we use the average of *A* and *B* in the denominator instead of choosing one of them.

Price elasticity of demand becomes:

$$\text{Price elasticity of demand} = \frac{(Q_2 - Q_1)}{\left(\frac{Q_1 + Q_2}{2}\right)} \div \frac{(p_2 - p_1)}{\left(\frac{p_1 + p_2}{2}\right)}$$

- This first term is the percentage change in quantity, using the midpoint formula.
- The second term is the percentage change in price, using the midpoint formula.

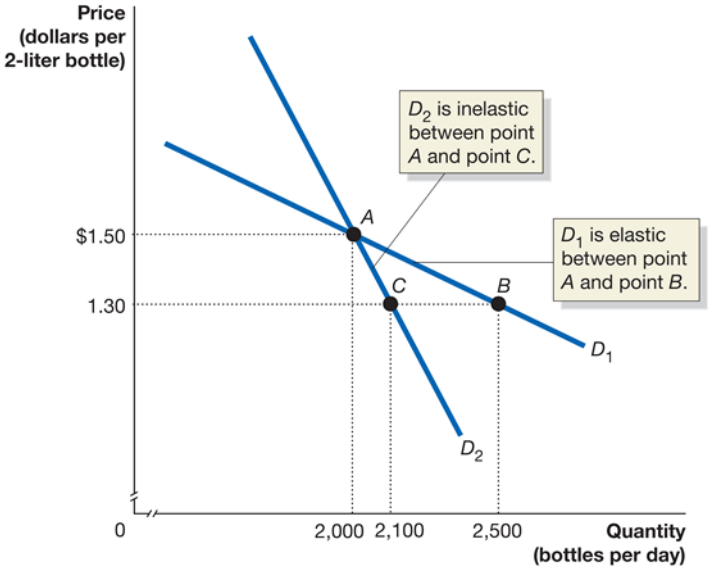
Calculating Price Elasticity of Demand (1 of 3)

At your grocery store, you cut the price of Coca-Cola from $1.50 per bottle to $1.30 per bottle. Coca-Cola sales went up from 2,000 to 2,500 gallons per day, as on demand curve D_1.

To calculate this price elasticity, we first need the average quantity and price:

$$\text{Average Quantity} = \frac{2{,}000 + 2{,}500}{2} = 2{,}250$$

$$\text{Average Price} = \frac{\$1.50 + \$1.30}{2} = \$1.40$$



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Calculating Price Elasticity of Demand (2 of 3)

Now calculate the percentage change in quantity and price:

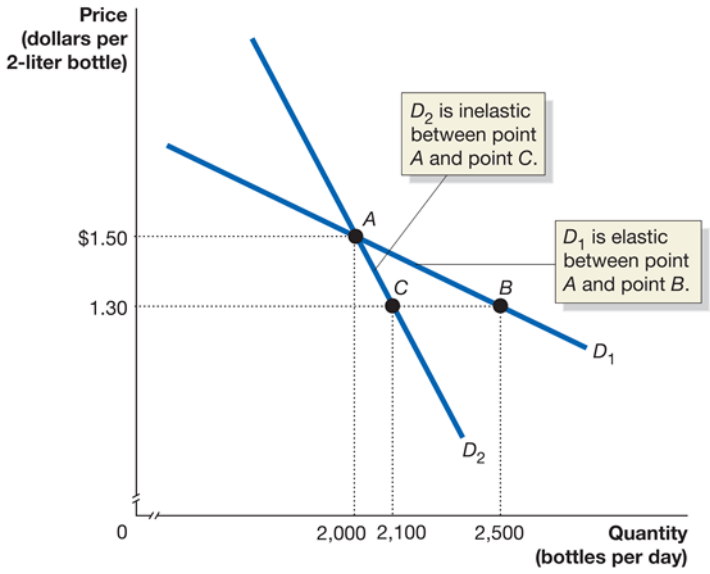
$$\text{Percentage change in quantity demanded} = \frac{2{,}500 - 2{,}000}{2{,}250} \times 100 = 22.2\%$$

$$\text{Percentage change in price} = \frac{\$1.30 - \$1.50}{\$1.40} \times 100 = -14.3\%$$

Then price elasticity of demand is the ratio of these two:

$$\text{Price elasticity of demand} = \frac{22.2\%}{-14.3\%} = -1.6$$

This is greater in absolute value than −1, So we say that demand in this range is price elastic.



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Calculating Price Elasticity of Demand (3 of 3)

What if quantity had only increased to 2,100 as in demand curve D_2?

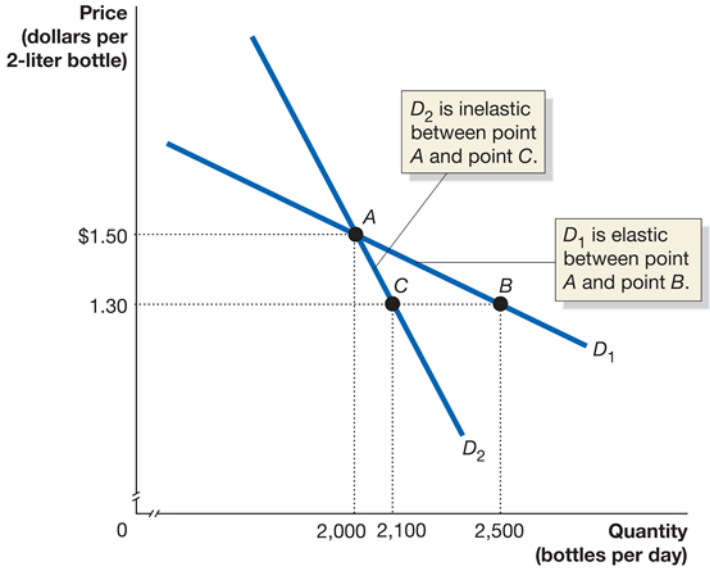
Percentage change in price remains the same (−14.3%); however

$$\text{Percentage changed in quantity demanded} = \frac{2{,}100 - 2{,}000}{2{,}050} \times 100 = 4.9\%$$

So price elasticity of demand is now:

$$\text{Price elasticity of demand} = \frac{4.9\%}{-14.3\%} = -0.3$$

This is smaller (in absolute value) than −1, so demand is inelastic.



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Observations About Elasticity (1 of 2)

While slope and elasticity are not the same, they **are** related:

- If two demand curves go through the same point, the one with the higher slope also has the higher (more negative) elasticity.

A vertical demand curve means that quantity demanded does not change as price changes.

- So elasticity is **zero**.
- A vertical demand curve is **perfectly inelastic**.

Perfectly inelastic demand: The case where the quantity demanded is completely unresponsive to price and the price elasticity of demand equals zero.

Observations About Elasticity (2 of 2)

A horizontal demand curve means quantity demanded is infinitely responsive to price changes.

- Elasticity is **infinite**.
- A horizontal demand curve is **perfectly elastic**.

Perfectly elastic demand: The case where the quantity demanded is infinitely responsive to price and the price elasticity of demand equals infinity.

Another special case occurs when a decrease in price results in the same percentage increase in quantity demanded; in this case we say demand is **unit elastic**.

Table 6.1 Summary of the Price Elasticity of Demand (1 of 5)

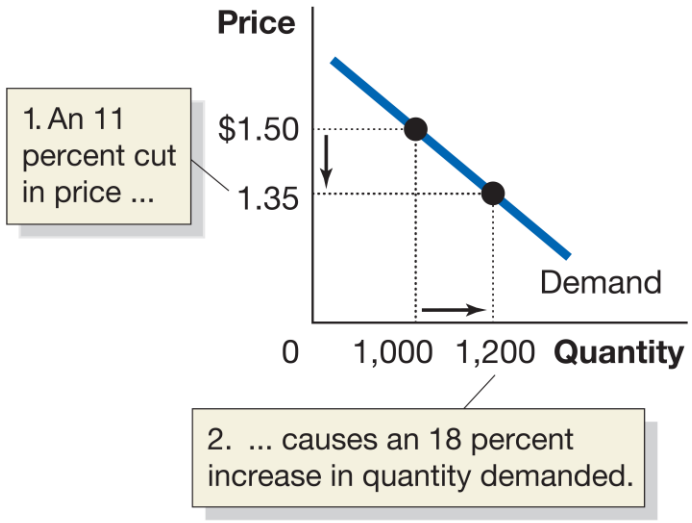
If demand is . . .	then the absolute value of price elasticity is . . .	
elastic	greater than 1	

Table 6.1 Summary of the Price Elasticity of Demand (2 of 5)

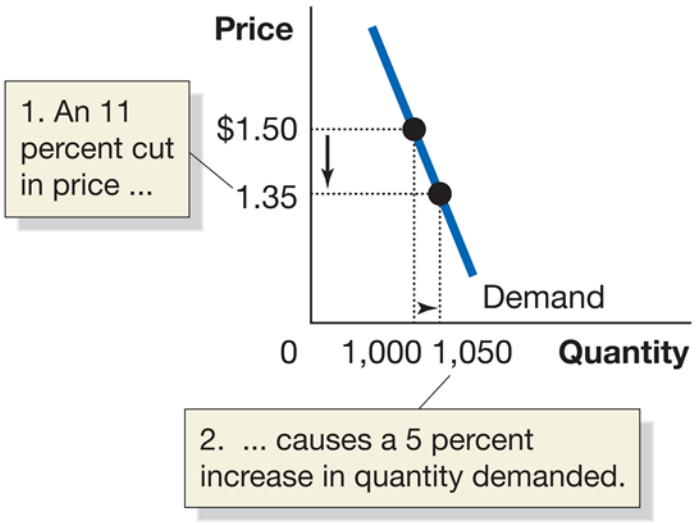
If demand is . . .	then the absolute value of price elasticity is . . .	
inelastic	less than 1	

Table 6.1 Summary of the Price Elasticity of Demand (3 of 5)

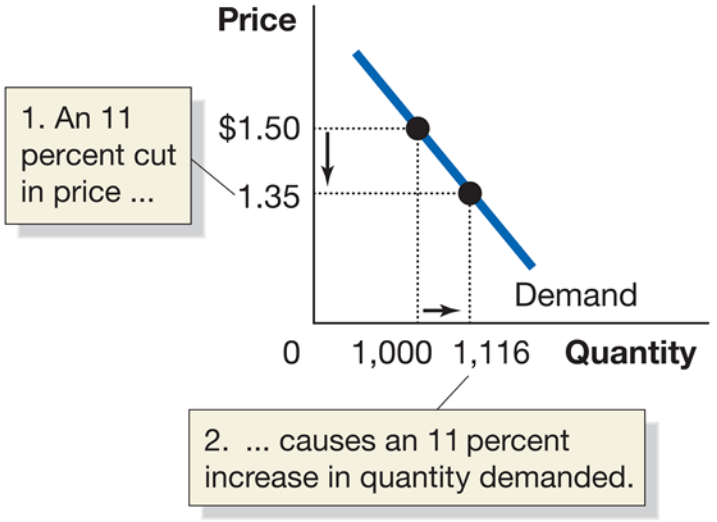
If demand is . . .	then the absolute value of price elasticity is . . .	
unit elastic	equal to 1	

Table 6.1 Summary of the Price Elasticity of Demand (4 of 5)

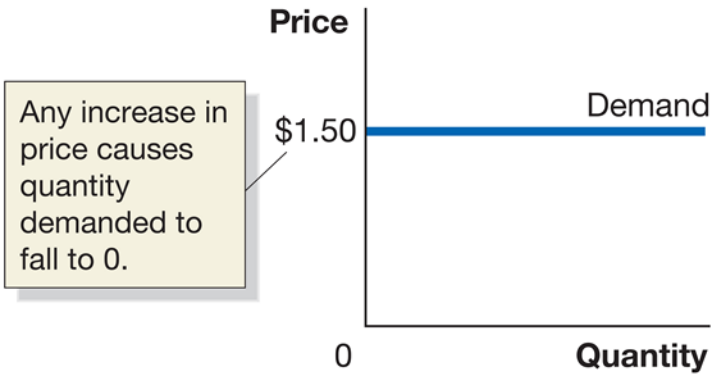
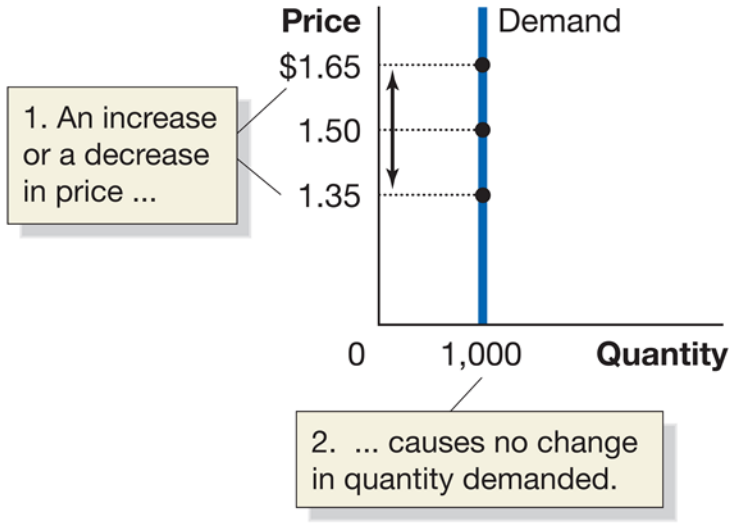
If demand is . . .	then the absolute value of price elasticity is . . .	
perfectly elastic	equal to infinity	

Table 6.1 Summary of the Price Elasticity of Demand (5 of 5)

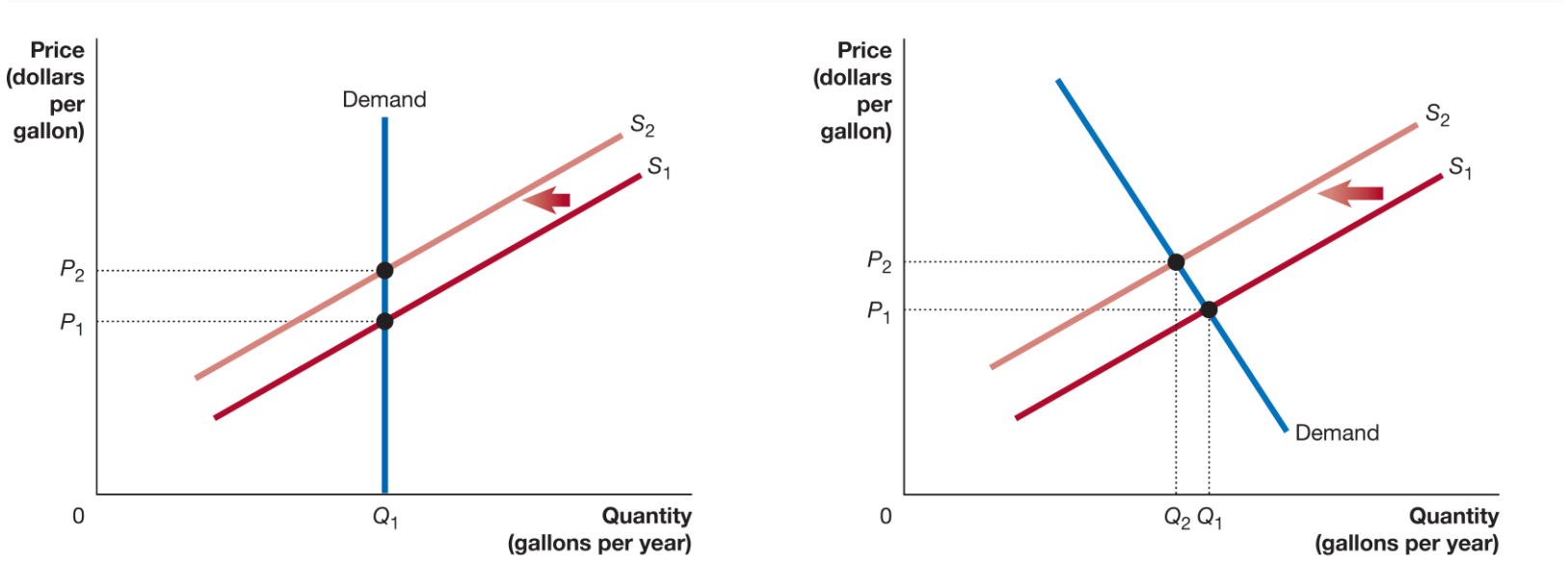
If demand is . . .	then the absolute value of price elasticity is . . .	
perfectly inelastic	equal to 0	

Don’t Confuse “Inelastic” with “Perfectly Inelastic”

For example, gasoline demand is **inelastic**; the quantity demanded does not change much as the price of gasoline changes.

- It is not **perfectly inelastic**; it is **somewhat** responsive to price.

Which panel shows this?



6.2 The Determinants of the Price Elasticity of Demand

List and explain the determinants of the price elasticity of demand.

Why do some goods have a high price elasticity of demand, while others have a low price elasticity of demand?

There are several characteristics of the good, of the market, etc. that determine this.

1. **The availability of close substitutes**

If a product has more substitutes available, it will have more elastic demand.

- **Example: There are few substitutes for gasoline, so its price elasticity of demand is low.**
- **Example: There are many substitutes for Nikes (Reeboks, Adidas, etc.), so their price elasticity of demand is high.**

More Determinants of the Price Elasticity of Demand

2. **The passage of time**

Over time, people can adjust their buying habits more easily. Elasticity is higher in the long run than the short run.

Example: If the price of gasoline rises, it takes a while for people to adjust their gasoline consumption. How might they do that?

- **Buying a more fuel-efficient car**
- **Moving closer to work**

3. **Whether the good is a luxury or a necessity**

People are more flexible with luxuries than necessities, so price elasticity of demand is higher for luxuries.

Example: Many people consider milk and bread necessities; they will buy them every week almost regardless of the price.

Still More Determinants of the Price Elasticity of Demand

4. **The definition of the market**

The more narrowly defined the market, the more substitutes are available, and hence the more elastic is demand.

Example: You might believe there is no good substitute for jeans, so your demand for jeans is very inelastic.

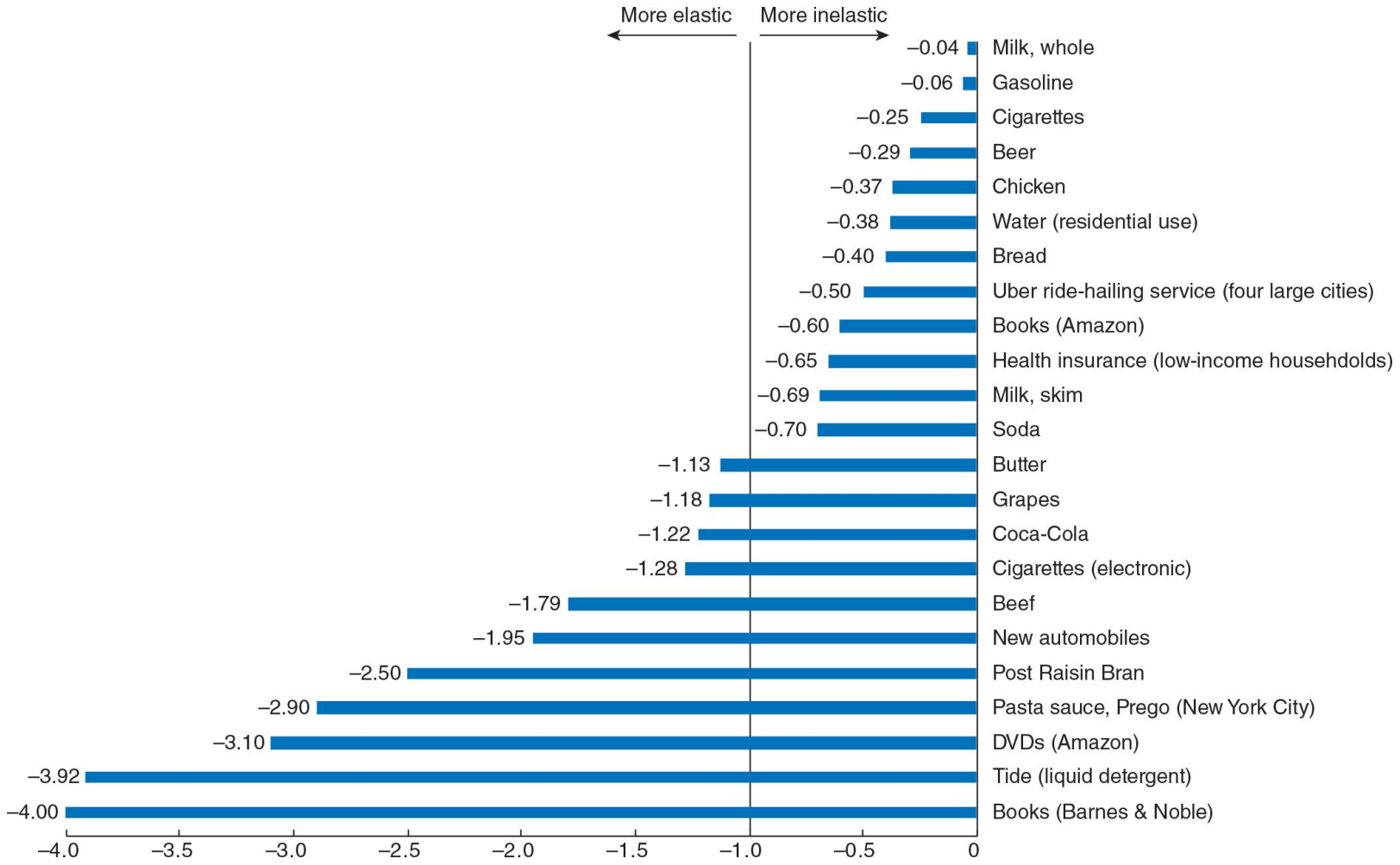
But if you consider different brands of jeans, you might be more sensitive to the price of a particular brand.

5. **The share of a good in a consumer's budget**

If a good is a small portion of your budget, you will likely not be very sensitive to its price.

Example: You might buy table salt once a year or less; changes in its price will not affect very much how much you buy.

Figure 6.2 Estimated Real-World Price Elasticities of Demand



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6.3 The Relationship Between Price Elasticity of Demand and Total Revenue

Explain the relationship between the price elasticity of demand and total revenue.

If you are a business owner, you need to decide how to price your product.

- "How many customers will I gain if I cut my price?"
- "What will happen to my **total revenue** if I cut my price?"

Knowing the price elasticity of demand for your product can help to answer these questions.

Total revenue: The total amount of funds a seller receives from selling a good or service, calculated by multiplying price per unit by the number of units sold.

Effect of Cutting Price with Different Elasticities

Suppose demand for your product is relatively price inelastic:

- Customers are not very sensitive to the price of your product.
- As you decrease the price, you expect to gain few additional customers.
- The few additional customers do not compensate for the lost revenue, so overall revenue goes down.

Suppose demand for your product is relatively price elastic:

- Customers are very sensitive to the price of your product.
- As you decrease the price, you expect to gain many additional customers.
- The many additional customers more than compensate for the lost revenue, so overall revenue goes up.

Figure 6.3 The Relationship Between Price Elasticity and Total Revenue (1 of 2)

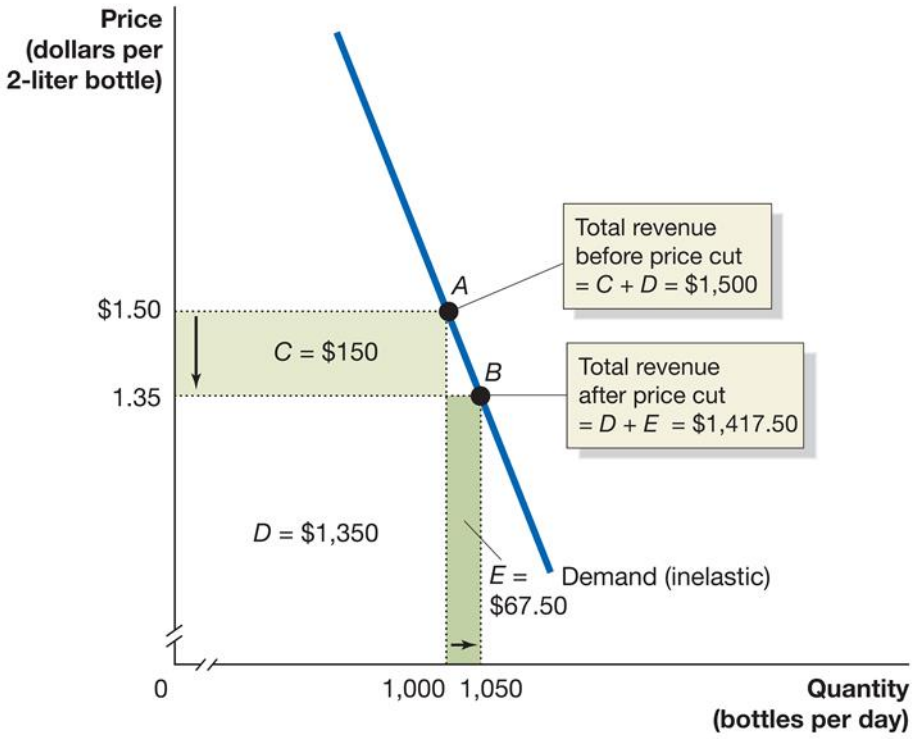
Revenue before price cut (at *A*):

$$1{,}000 \times \$1.50 = \$1{,}500$$

Revenue after price cut (at *B*):

$$1{,}050 \times \$1.35 = \$1{,}417.50$$

The decrease in price does not generate enough extra customers (area *E*) to offset revenue loss (area *C*).



(a) Cutting price when demand is inelastic reduces total revenue.

Figure 6.3 The Relationship Between Price Elasticity and Total Revenue (2 of 2)

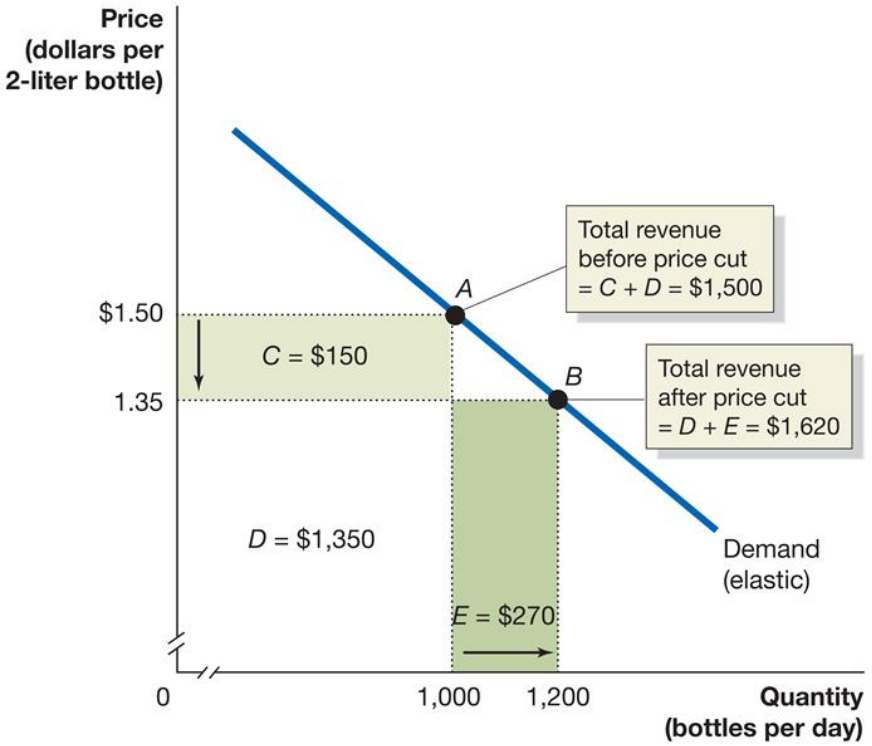
Revenue before price cut (at *A*):

$$1{,}000 \times \$1.50 = \$1{,}500$$

Revenue after price cut (at *B*):

$$1{,}200 \times \$1.35 = \$1{,}620$$

The decrease in price **does** generates enough extra customers (area *E*) to more than offset revenue loss (area *C*).



(b) Cutting price when demand is elastic increases total revenue.

Table 6.2 The Relationship Between Price Elasticity and Revenue

If demand is …	then …	because …
elastic	an increase in price reduces revenue	the decrease in quantity demanded is proportionally **greater** than the increase in price.
elastic	a decrease in price increases revenue	the increase in quantity demanded is proportionally **greater** than the decrease in price.
inelastic	an increase in price increases revenue	the decrease in quantity demanded is proportionally **smaller** than the increase in price.
inelastic	a decrease in price reduces revenue	the increase in quantity demanded is proportionally **smaller** than the decrease in price.
unit elastic	an increase in price does not affect revenue	the decrease in quantity demanded is proportionally **the same as** the increase in price.
unit elastic	a decrease in price does not affect revenue	the increase in quantity demanded is proportionally **the same as** the decrease in price.

Why Are Elasticity and Total Revenue Related?

The formula for price elasticity of demand is :

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

So if this is greater than 1 (in absolute terms) then quantity demanded goes up by a higher percentage than price, raising the revenue.

A special case occurs when price elasticity of demand is −1: the percentage change in quantity demanded equals the percentage change in price so revenue does not change.

Figure 6.4 Elasticity Is Not Constant Along a Linear Demand Curve (1 of 2)

Suppose we have a linear demand curve.

What happens to total revenue as price increases?

- Initially, total revenue rises, suggesting demand is inelastic.
- But then total revenue starts to fall, suggesting demand is elastic!

Price	Quantity Demanded	Total Revenue
$8	0	$0
7	2	14
6	4	24
5	6	30
4	8	32
3	10	30
2	12	24
1	14	14
0	16	0

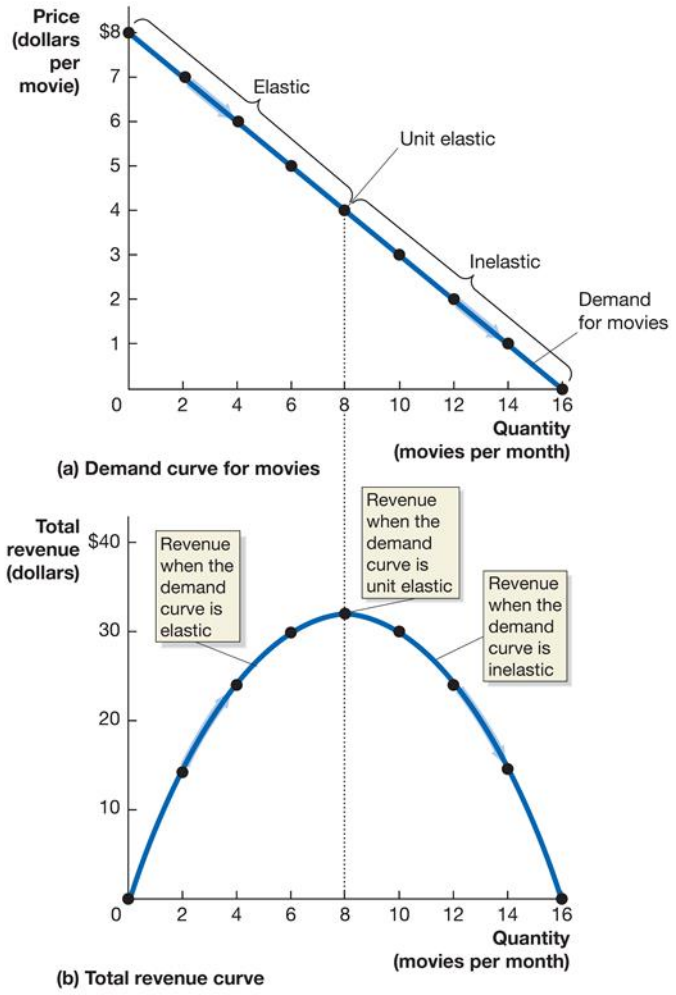
Figure 6.4 Elasticity Is Not Constant Along a Linear Demand Curve (2 of 2)

The data from the table are plotted in the graphs.

As price decreases from $8, revenue rises—hence demand is elastic.

As price continues to fall, revenue eventually flattens out—demand is unit elastic.

Then as price falls even further, revenue begins to fall—demand is inelastic.



Apply the Concept: Amazon and Netflix Test the Price Elasticity of Demand for Their Services (1 of 2)

In its early years, Amazon kept the price of Amazon Prime low.

- What do you think it have believed about the price elasticity of demand for Amazon Prime?

Recently Amazon has raised the price of Amazon Prime (from $79 to $99 in 2014, and to $119 in 2018).

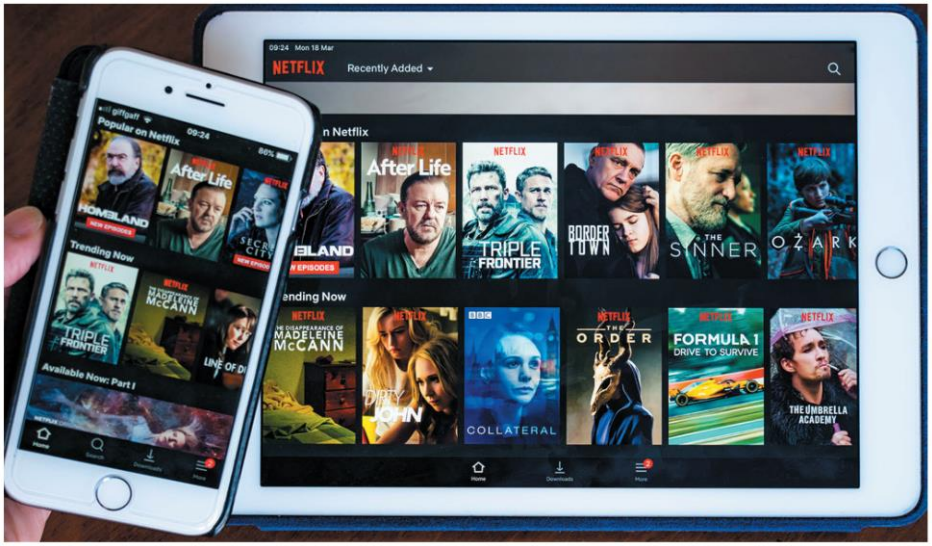
- What does this suggest about how Amazon believed the price elasticity of demand had changed?

Apply the Concept: Amazon and Netflix Test the Price Elasticity of Demand for Their Services (2 of 2)

Do you think the same pattern of elasticity changes has happened with Netflix?

- Netflix has raised the price of its two-device plan from $8.99 to $12.99 from 2015-2019. This is consistent with it believing demand has been price inelastic recently.

With more (substitute) streaming options, do you think Netflix will be able to continue raising its price without losing customers?



6.4 Other Demand Elasticities

Define and calculate the cross-price elasticity of demand and the income elasticity of demand and explain their determinants.

When we examined demand in Chapter 3, we discussed substitutes and complements:

- **Substitutes**: Goods and services that can be used for the same purpose.
- **Complements**: Goods and services that are used together.

Cross-price elasticity of demand is the percentage change in the quantity demanded of one good divided by the percentage change in the price of another good.

- It measures the **strength** of substitute or complement relationships between goods.

Table 6.3 Summary of Cross-Price Elasticity of Demand

If the products are …	then the cross-price elasticity of demand will be …	Example
substitutes	positive.	Two brands of smartphones
complements	negative.	iPhones and applications downloaded from online stores
unrelated	zero.	iPhones and peanut butter

Income Elasticity of Demand

When we examined demand in Chapter 3, we discussed normal and inferior goods.

- **Normal goods**: Goods and services for which the quantity demanded increases as income increases
- **Inferior goods**: Goods and services for which the quantity demanded falls as income increases

Income elasticity of demand is a measure of the responsiveness of the quantity demanded to changes in income, measured by the percentage change in the quantity demanded divided by the percentage change in income.

Table 6.4 Summary of Income Elasticity of Demand

If the income elasticity of demand is …	then the good is …	Example
positive but less than 1	normal and a necessity.	Bread
positive and greater than 1	normal and a luxury.	Caviar
negative	inferior.	High-fat meat

Apply the Concept: Elasticities of Alcoholic Beverages

Christopher Ruhm of the University of Virginia and colleagues estimated elasticities for various alcoholic beverages. According to their study:

- Demand for beer is price inelastic.
- Beer and wine are complements.
- Beer and spirits are also complements, but the relationship is not as strong.
- Beer is a normal good; a **necessity**.

Are any of these results surprising to you? Why or why not?

Price elasticity of demand for beer	−0.30
Cross-price elasticity of demand between beer and wine	−0.83
Cross-price elasticity of demand between beer and spirits	−0.50
Income elasticity of demand for beer	0.09

6.5 Using Elasticity to Analyze the Disappearing Family Farm

Use price elasticity and income elasticity to analyze economic issues.

Over the last century farms have become much more efficient at producing food.

- This might appear to make farming more profitable, and hence encourage more people into farming.

But the number of people in farming has fallen substantially (>23 million in 1950, <3 million in 2019).

- Why have productivity gains in farming led to fewer people choosing to farm?

Figure 6.5 Elasticity and the Disappearing Family Farm (1 of 3)

In 1950, U.S. farmers produced 1.0 billion bushels of wheat at a price of $20.01 per bushel.

Over the next seven decades, rapid increases in farm productivity caused a large shift to the right in the supply curve for wheat.

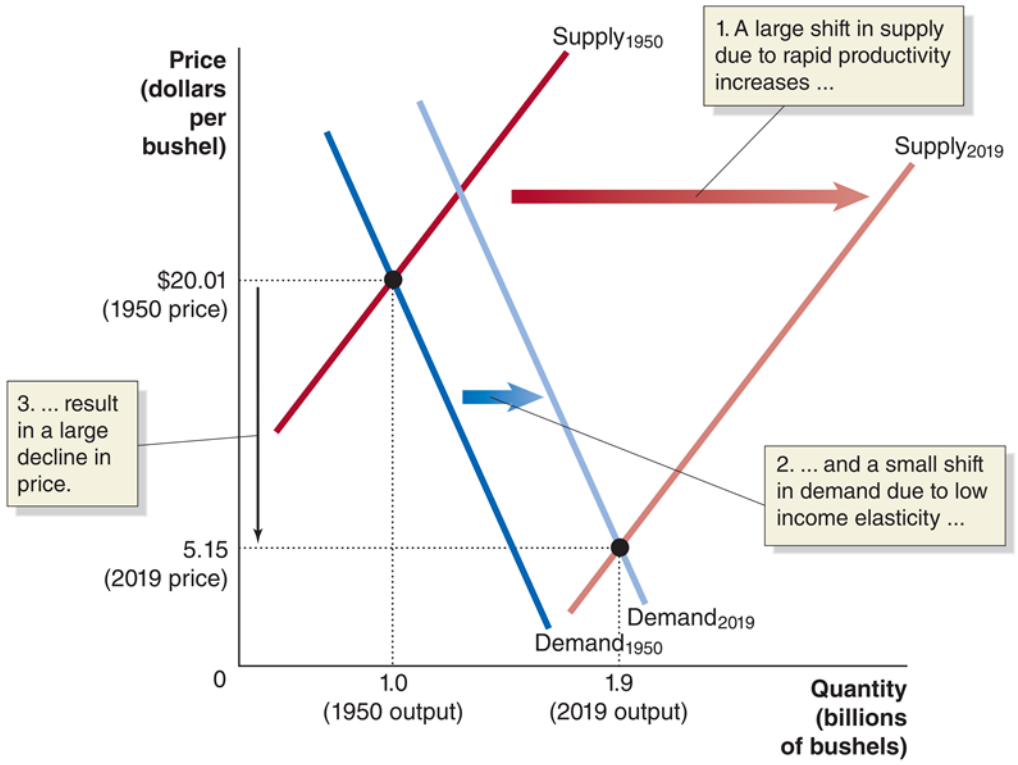


Figure 6.5 Elasticity and the Disappearing Family Farm (2 of 3)

Income elasticity of demand for wheat is low, so demand for wheat increased little over this period.

Demand for wheat is also inelastic, so the large shift in the supply curve and the small shift in the demand curve resulted in a sharp decline in the price of wheat.

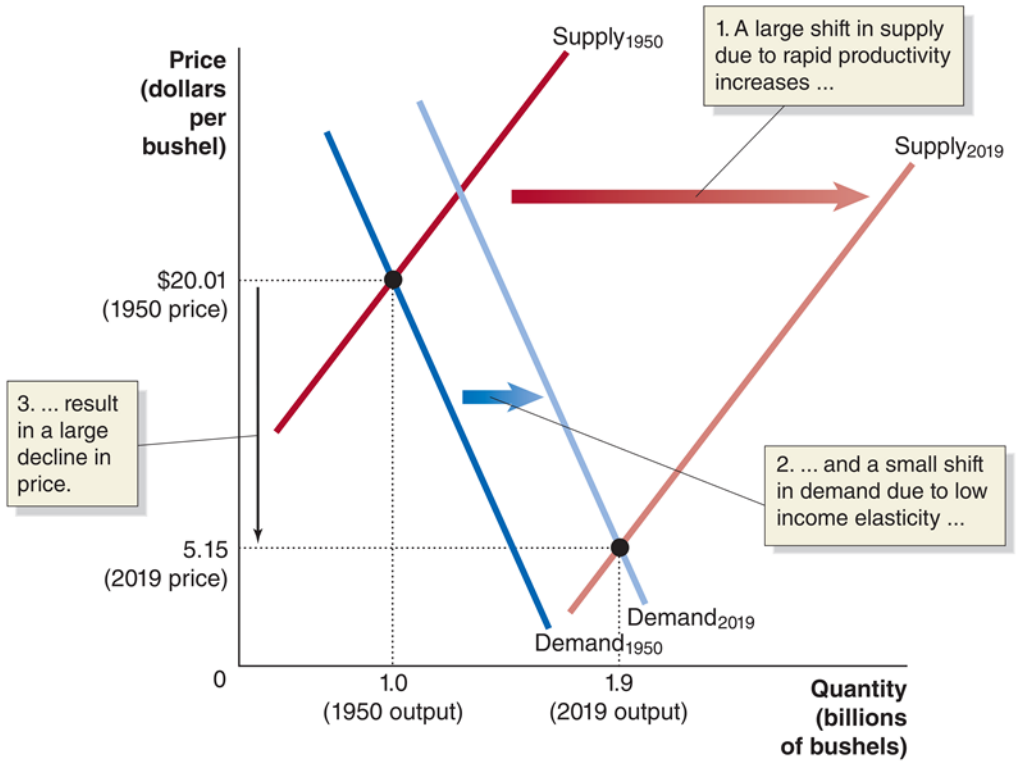
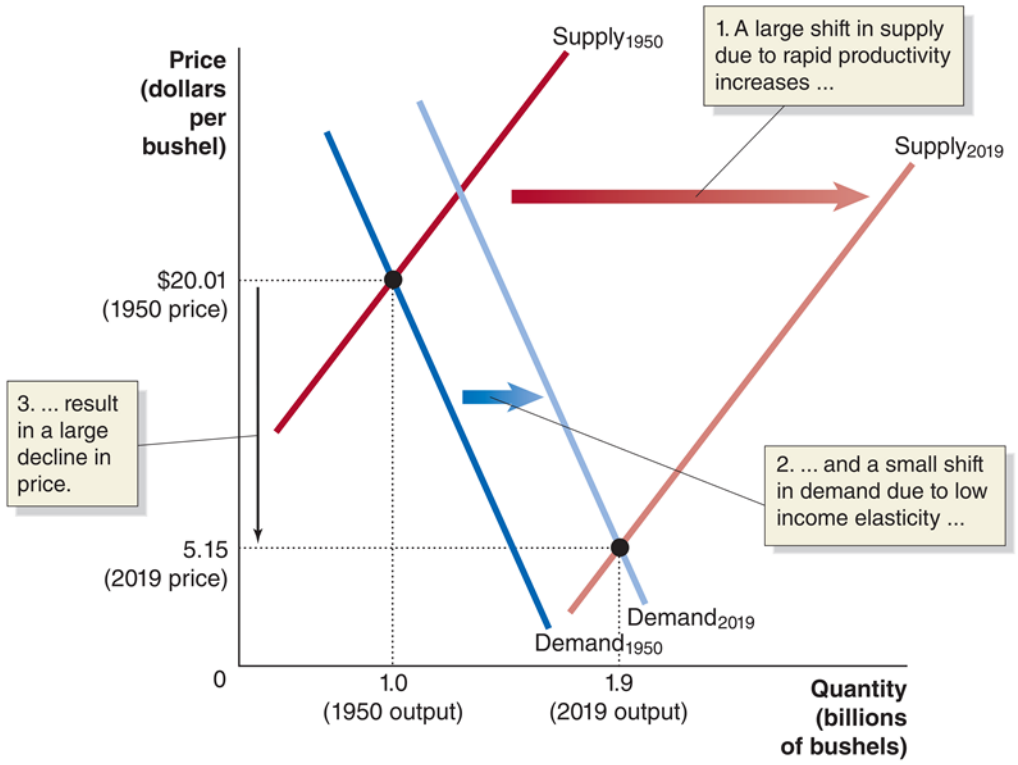


Figure 6.5 Elasticity and the Disappearing Family Farm (3 of 3)

In combination, this led to a dramatic fall in the price of the farmers' output.

Making a living on a small farm has become harder and harder, so the increase in output is supplied by fewer and fewer large-scale farmers.



6.6 The Price Elasticity of Supply and Its Measurement

Define price elasticity of supply and explain its determinants and how it is measured.

Price elasticity of supply is the responsiveness of the quantity supplied to a change in price, measured by dividing the percentage change in the quantity supplied of a product by the percentage change in the product's price.

It is very much analogous to price elasticity of demand:

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$\text{Price elasticity of supply} = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

So the same sort of calculation methods apply (midpoint formula, etc.).

Determinants of the Price Elasticity of Supply

Price elasticity of supply depends on the ability and willingness of firms to alter the quantity they produce as price increases.

The time period in question is critically important for determining the price elasticity of supply.

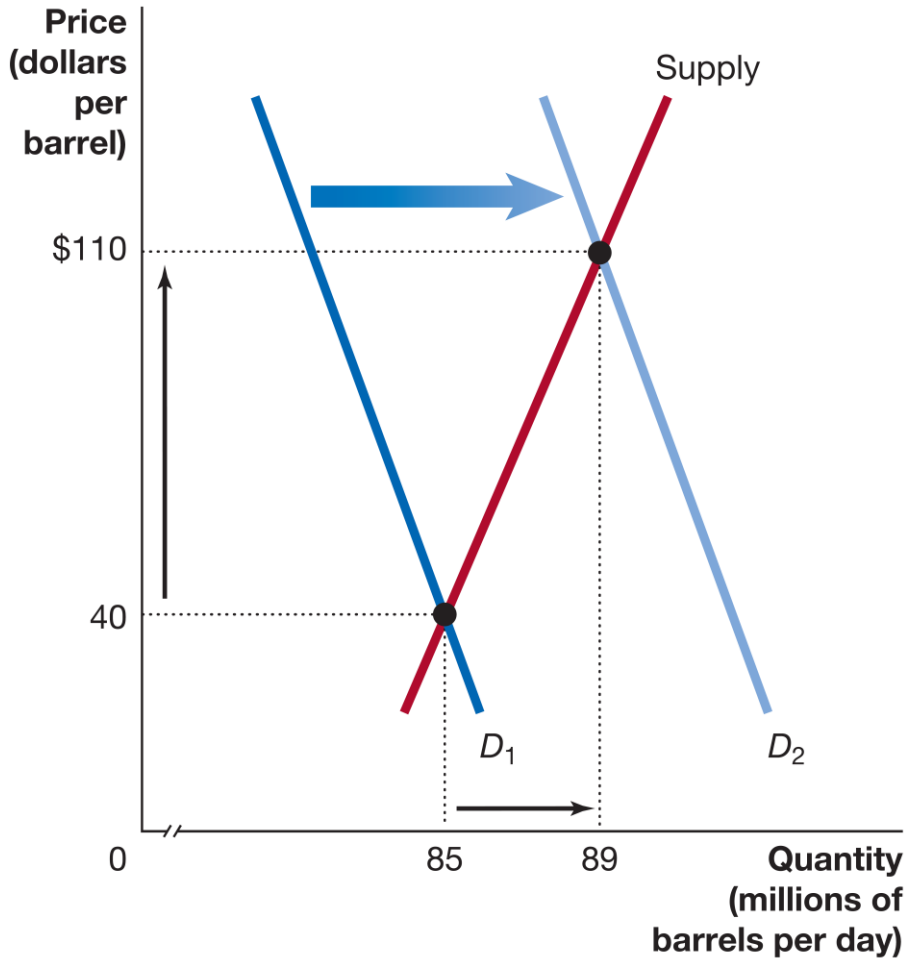
Suppose the wholesale price of grapes doubled overnight:

- Farmers could do little to increase their quantity immediately; the initial price elasticity of supply would be close to 0.
- Over time, farmers could plant more fields in grapes; so over the course of several years, the price elasticity of supply would rise.

Apply the Concept: Why Are Oil Prices So Unstable? (1 of 2)

Oil producers cannot change output very quickly.

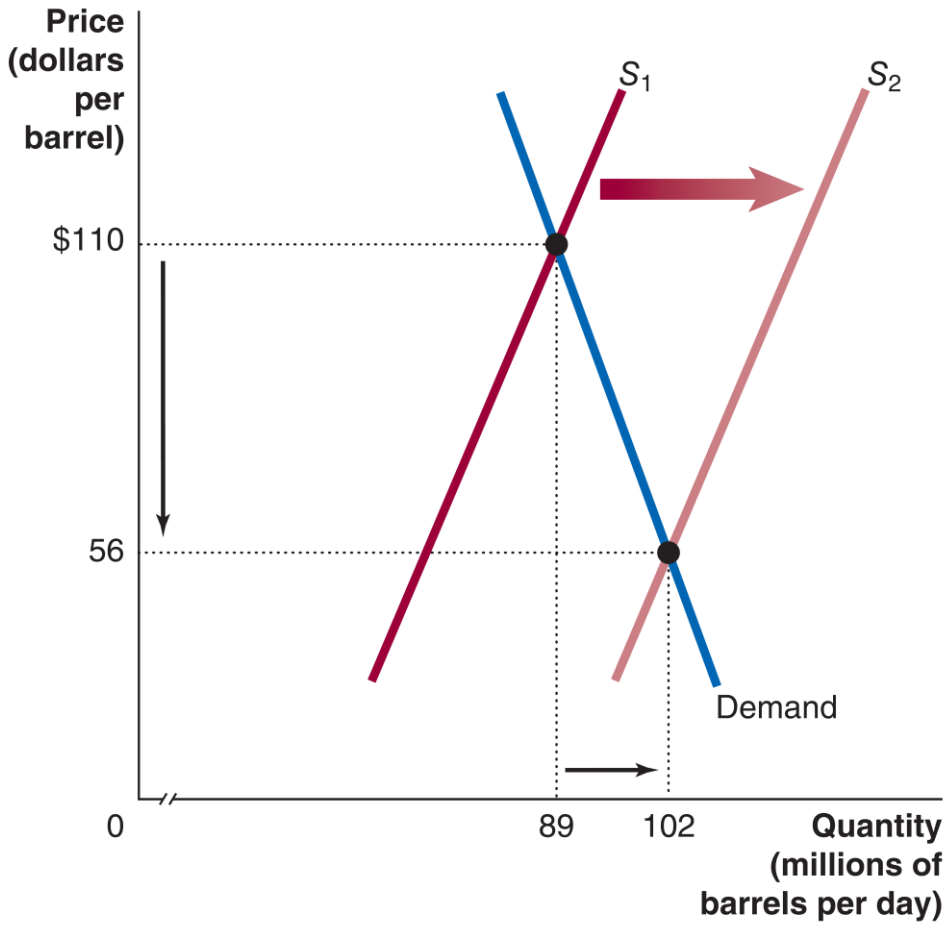
When demand increases suddenly, price rises, acting as a rationing mechanism for the increased demand.



Apply the Concept: Why Are Oil Prices So Unstable? (2 of 2)

Similarly, consumers of oil are relatively inflexible, responding little to short-run changes in price.

During the 2010s, new oil production technology known as **fracking** increased the supply of oil; consequently, the price fell dramatically to maintain equilibrium.



Polar Cases: Perfectly Elastic and Perfectly Inelastic Supply

If a supply curve is a vertical line, we say it is **perfectly inelastic**.

- Quantity supplied is completely unresponsive to price.
- Price elasticity of supply equals zero.
- **Example: Fixed number of spaces in a parking lot.**

If a supply curve is a horizontal line, we say it is **perfectly elastic**.

- Supply is infinitely responsive to price.
- Price elasticity of supply equals infinity.
- **Example: Long-run production of agricultural products is (approximately) perfectly elastic: at prices above the cost of production, farmers will supply as much as is demanded.**

Table 6.5 Summary of the Price Elasticity of Supply (1 of 5)

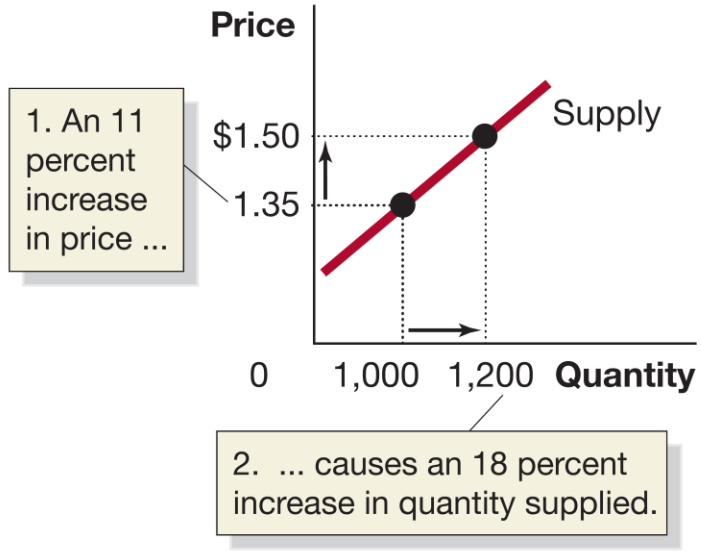
If supply is . . .	then the value of price elasticity is . . .	
elastic	greater than 1	

Table 6.5 Summary of the Price Elasticity of Supply (2 of 5)

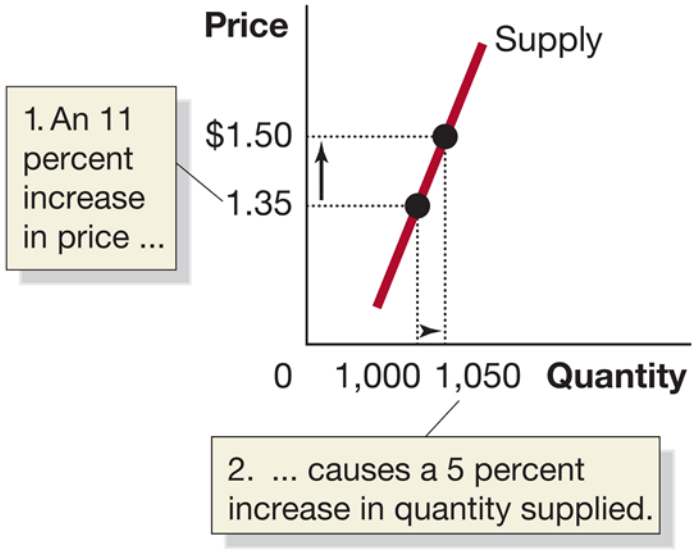
If supply is . . .	then the value of price elasticity is . . .	
inelastic	less than 1	

Table 6.5 Summary of the Price Elasticity of Supply (3 of 5)

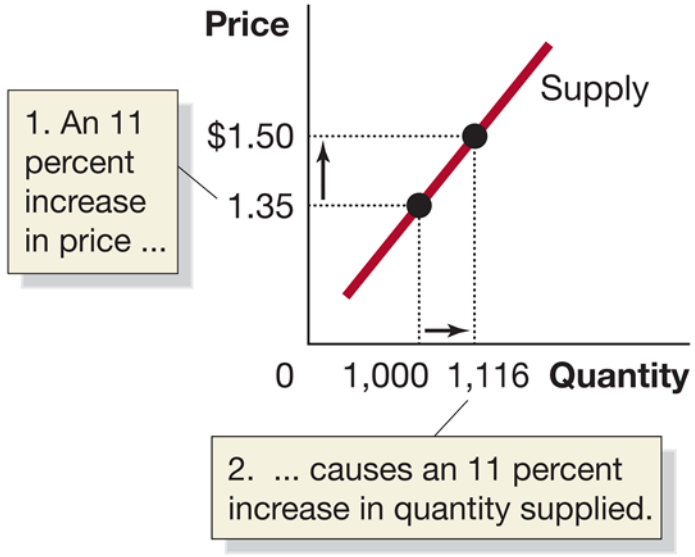
If supply is . . .	then the value of price elasticity is . . .	
unit elastic	equal to 1	

Table 6.5 Summary of the Price Elasticity of Supply (4 of 5)

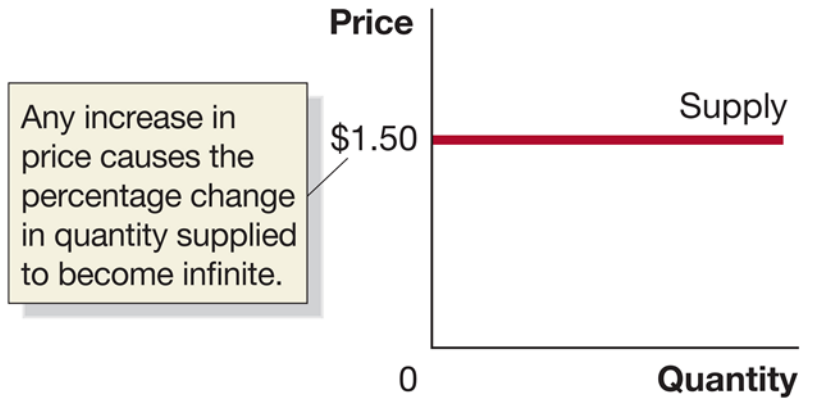
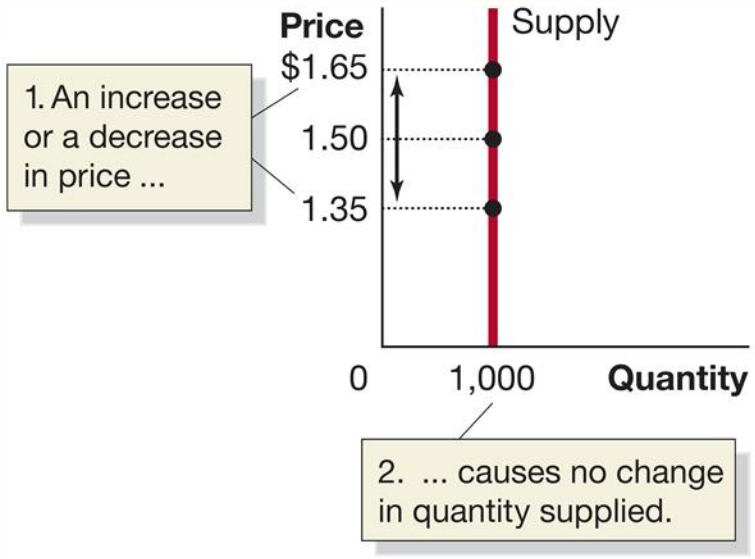
If supply is . . .	then the value of price elasticity is . . .	
perfectly elastic	equal to infinity	

Table 6.5 Summary of the Price Elasticity of Supply (5 of 5)

If supply is . . .	then the value of price elasticity is . . .	
perfectly inelastic	equal to 0	

Why Is Knowing the Price Elasticity of Supply Useful?

Knowing the price elasticity of supply can help us to predict the effect that a change in demand will have:

- When demand increases, we know equilibrium price and quantity will increase.
- But if supply is **inelastic**, quantity supplied cannot change much in response to the demand change, so price will rise a lot.
- If supply is **elastic**, price will rise much less.

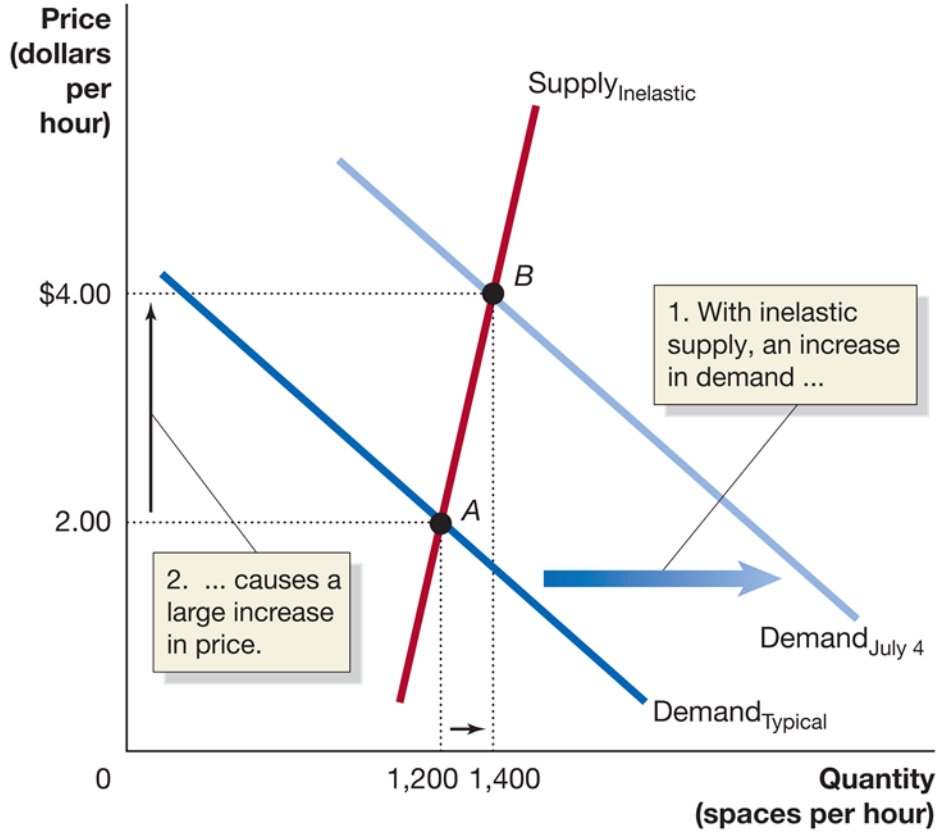
The next two slides illustrate these statements.

Figure 6.6 Changes in Price Depend on the Price Elasticity of Supply (1 of 2)

$Demand_{Typical}$ represents the typical demand for parking spaces on a summer weekend at a beach resort.

$Demand_{July\ 4}$ represents demand on the 4th of July.

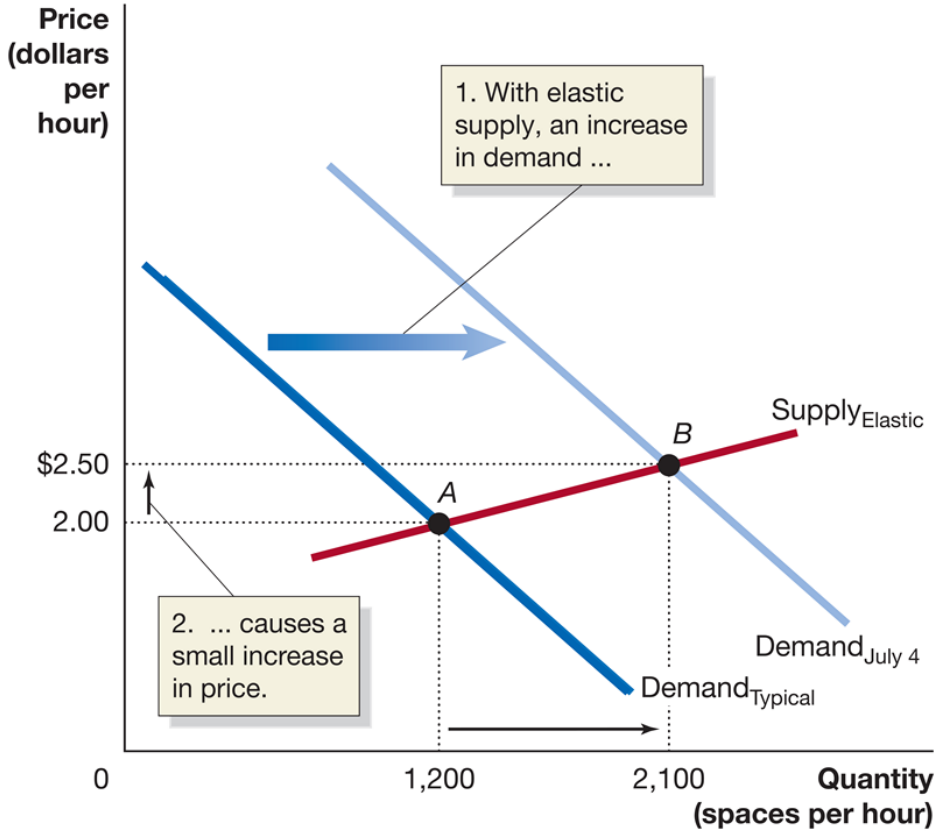
When supply is inelastic, the price increase will be large.



(a) Price increases more when supply is inelastic.

Figure 6.6 Changes in Price Depend on the Price Elasticity of Supply (2 of 2)

If supply is elastic instead, then the resulting price change will be much smaller.



(b) Price increases less when supply is elastic.

Table 6.6 Summary of Elasticities (1 of 3)

Price Elasticity of Demand

$$\text{Formula}: \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$\text{Midpoint formula}: \frac{(Q_2 - Q_1)}{\left(\frac{Q_1 + Q_2}{2}\right)} \div \frac{(P_2 - P_1)}{\left(\frac{P_1 + P_2}{2}\right)}$$

	Absolute Value of Price Elasticity	**Effect on Total Revenue of an Increase in Price**
Elastic	Greater than 1	Total revenue falls
Inelastic	Less than 1	Total revenue rises
Unit elastic	Equal to 1	Total revenue unchanged

Table 6.6 Summary of Elasticities (2 of 3)

Cross-Price Elasticity of Demand

$$\text{Formula}: \frac{\text{Percentage change in quantity demanded of one good}}{\text{Percentage change in price of another good}}$$

Types of Products	Value of Cross-Price Elasticity
Substitutes	Positive
Complements	Negative
Unrelated	Zero

Income Elasticity of Demand

$$\text{Formula}: \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

Types of Products	Value of Income Elasticity
Normal and a necessity	Positive but less than 1
Normal and a luxury	Positive and greater than 1
Inferior	Negative

Table 6.6 Summary of Elasticities (3 of 3)

Price Elasticity of Supply

$$\text{Formula}: \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

	Value of Price Elasticity
Elastic	Greater than 1
Inelastic	Less than 1
Unit elastic	Equal to 1

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