

chapter:

6

>> Elasticity

**Krugman/Wells
Economics**

WHAT YOU WILL LEARN IN THIS CHAPTER

- What is the definition of **elasticity**?
- What is the meaning and importance of
 - **price elasticity of demand**?
 - **income elasticity of demand**
 - **price elasticity of supply**?
- What factors influence the size of these various elasticities?
- How the cross-price elasticity of demand measures the responsiveness of demand for one good to changes in the price of another good

Defining and Measuring Elasticity

- The **price elasticity of demand** is the ratio of the percent change in the quantity demanded to the percent change in the price as we move along the demand curve (dropping the minus sign).

The Price Elasticity of Demand

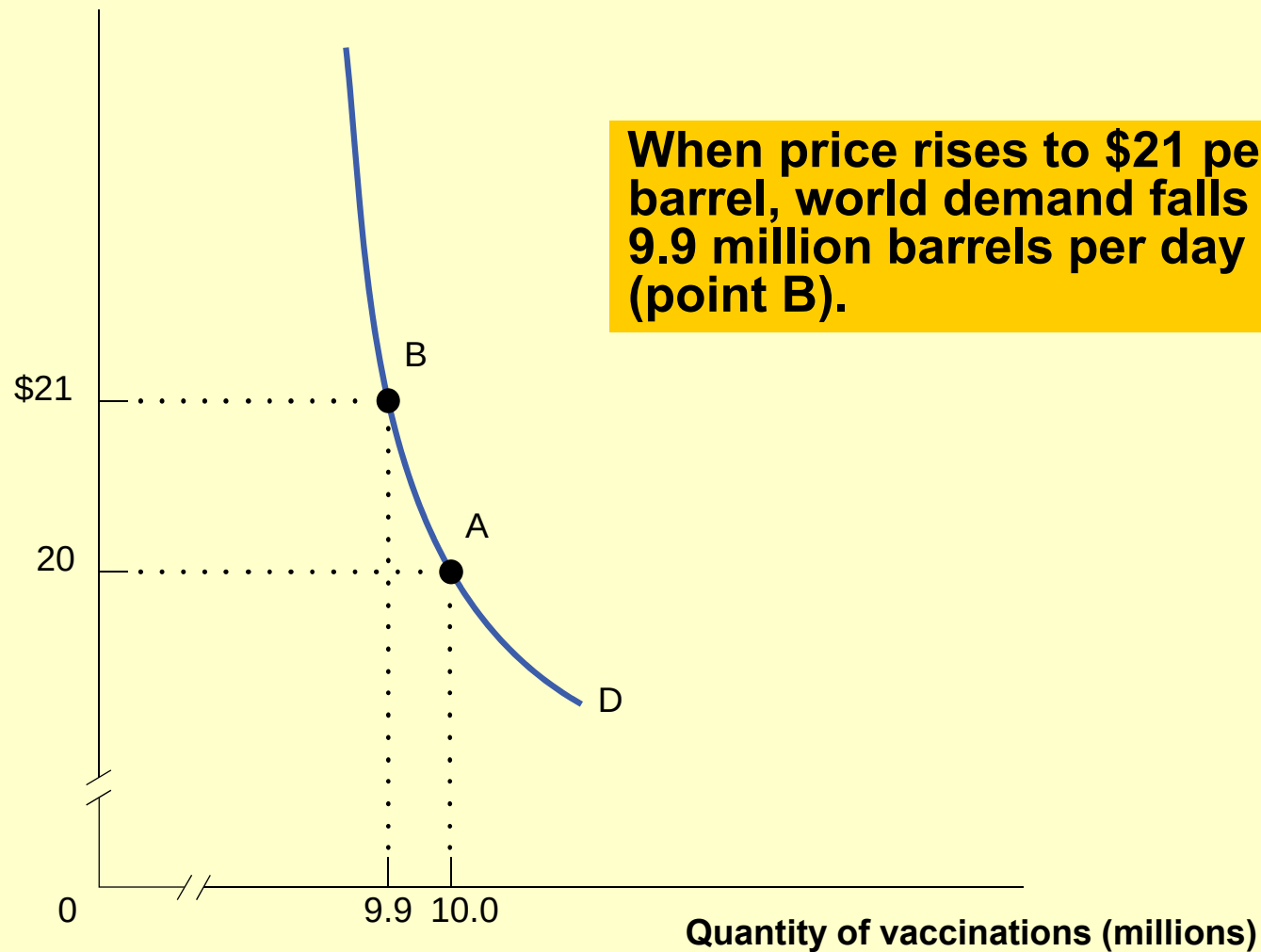
$$\% \text{ change in quantity demanded} = \frac{\text{Change in quantity demanded}}{\text{Initial quantity demanded}} \times 100$$

$$\% \text{ change in price} = \frac{\text{Change in price}}{\text{Initial price}} \times 100$$

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

Demand for Vaccinations

Price of vaccination



Calculating the Price Elasticity of Demand

$$\% \text{ change in quantity demanded} = \frac{-0.1 \text{ million vaccinations}}{10 \text{ million vaccinations}} \times 100 = -1\%$$

$$\% \text{ change in price} = \frac{\$1}{\$20} \times 100 = 5\%$$

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

$$\text{Price elasticity of demand} = \frac{1\%}{5\%} = 0.2$$

Using the Midpoint Method to Calculate Elasticities

- The **midpoint method** is a technique for calculating the percent change. In this approach, we calculate changes in a variable compared with the average, or midpoint, of the starting and final values.

Using the Midpoint Method to Calculate Elasticities

$$\% \text{ change in } X = \frac{\text{Change in } X}{\text{Average value of } X} \times 100$$

$$\text{Average value of } X = \frac{\text{Starting value of } X + \text{final value of } X}{2}$$

$$\text{Price elasticity of demand} = \frac{\frac{Q_2 - Q_1}{(Q_1 + Q_2)/2}}{\frac{P_2 - P_1}{(P_1 + P_2)/2}}$$

Using the Midpoint Method to Calculate Elasticities

	Price	Quantity demanded
Situation A	\$0.90	1,100
Situation B	\$1.10	900

$$\% \text{ change in quantity demanded} = \frac{-200}{(1,100 + 900)/2} \times 100 = \frac{-200}{1,000} \times 100 = -20\%$$

$$\% \text{ change in price} = \frac{\$0.20}{(\$0.90 + \$1.10)/2} \times 100 = \frac{\$0.20}{\$1.00} \times 100 = 20\%$$

$$\text{Price elasticity of demand} = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}} = \frac{20\%}{20\%} = 1$$

Some Estimated Price Elasticities of Demand

Good

Price elasticity

Inelastic demand

- | | |
|--------------|-----|
| ▪ Eggs | 0.1 |
| ▪ Beef | 0.4 |
| ▪ Stationery | 0.5 |
| ▪ Gasoline | 0.5 |

Price elasticity of demand < 1

Elastic demand

- | | |
|--------------------|-----|
| ▪ Housing | 1.2 |
| ▪ Restaurant meals | 2.3 |
| ▪ Airline travel | 2.4 |
| ▪ Foreign travel | 4.1 |

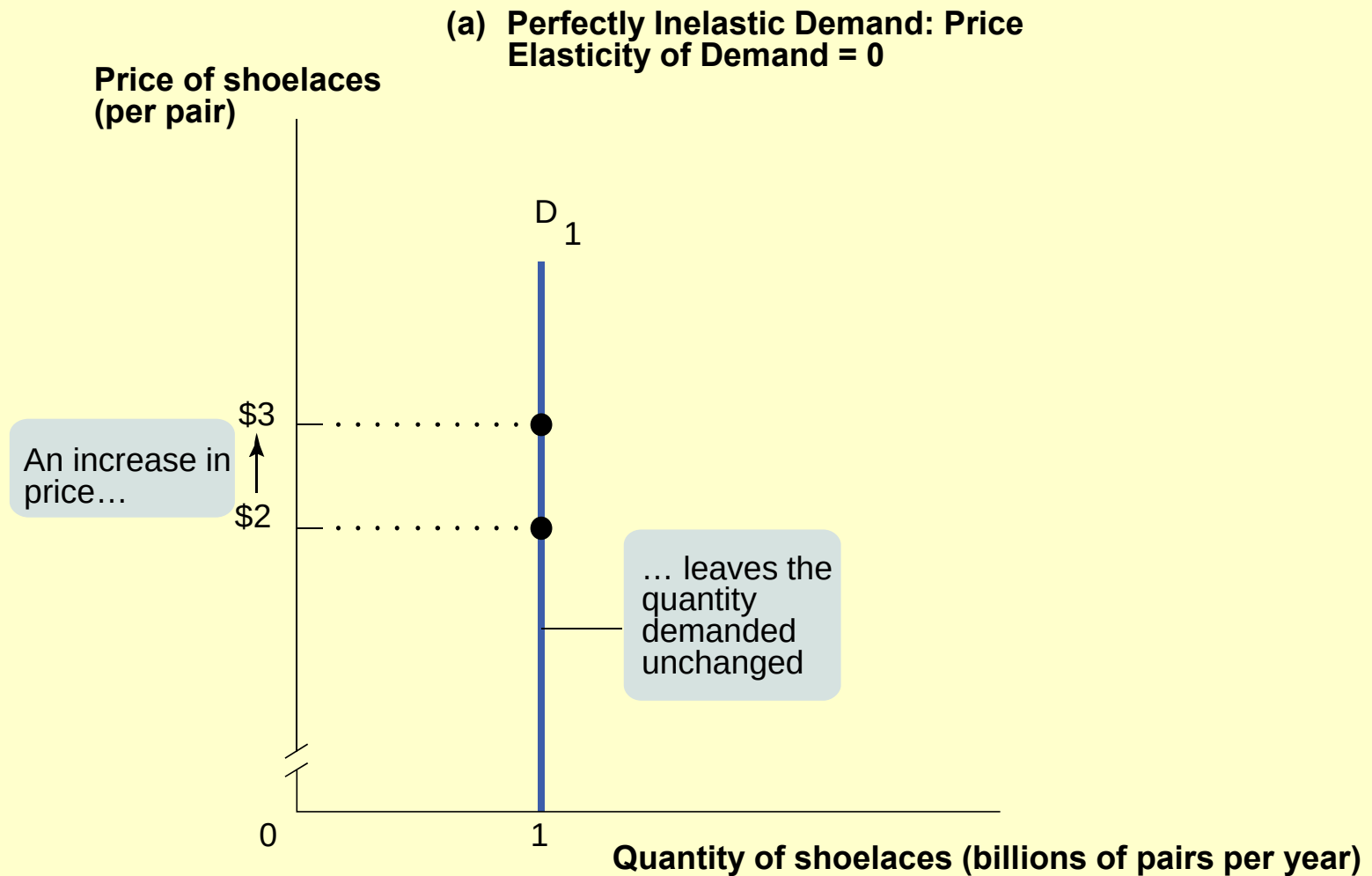
Price elasticity of demand > 1

Interpreting the Price Elasticity of Demand

Two Extreme Cases of Price Elasticity of Demand

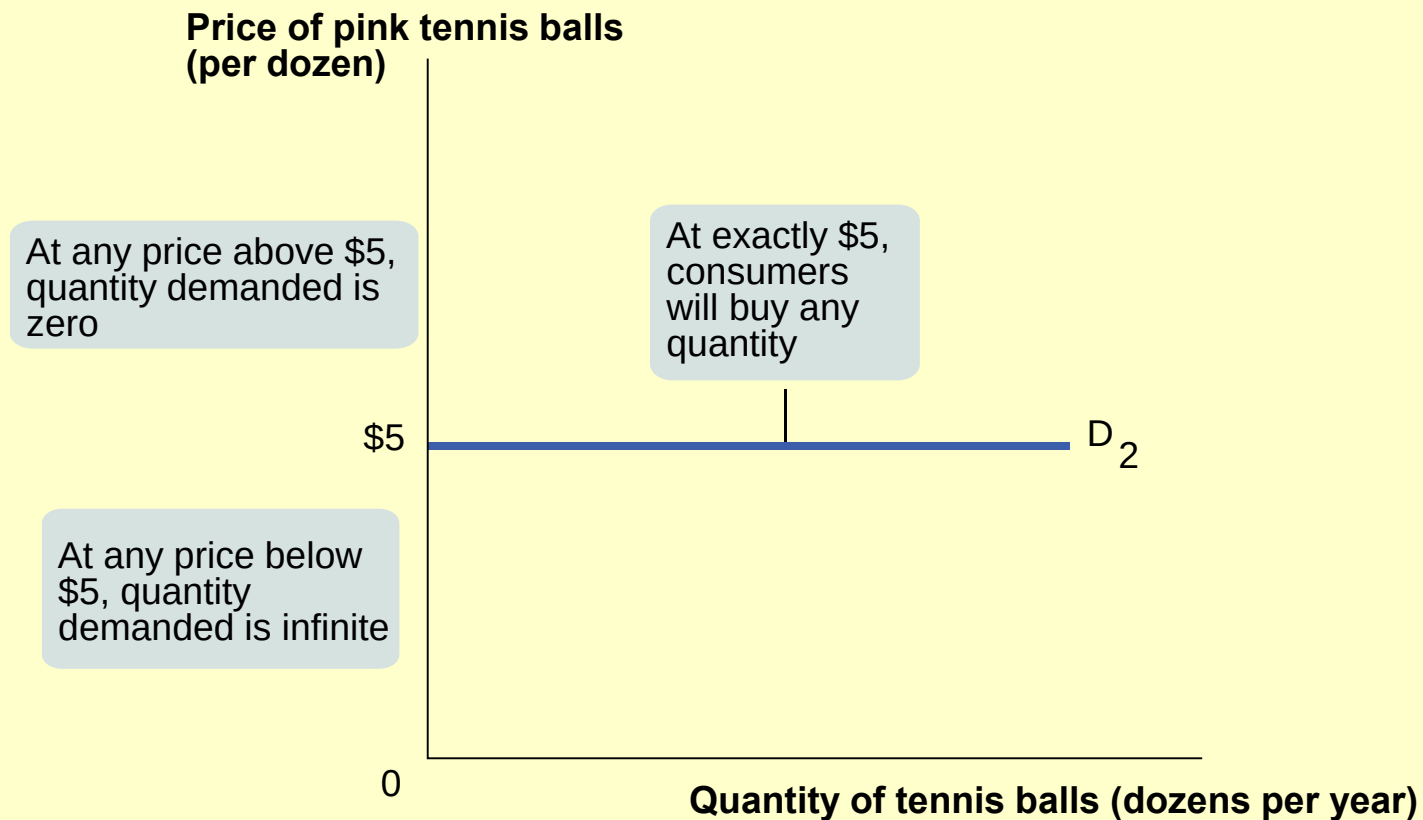
- Demand is **perfectly inelastic** when the quantity demanded does not respond at all to changes in the price. When demand is perfectly inelastic, the demand curve is a vertical line.
- Demand is **perfectly elastic** when any price increase will cause the quantity demanded to drop to zero. When demand is perfectly elastic, the demand curve is a horizontal line.

Two Extreme Cases of Price Elasticity of Demand



Two Extreme Cases of Price Elasticity of Demand

(b) Price Elastic Demand: Price Elasticity of Demand = ∞



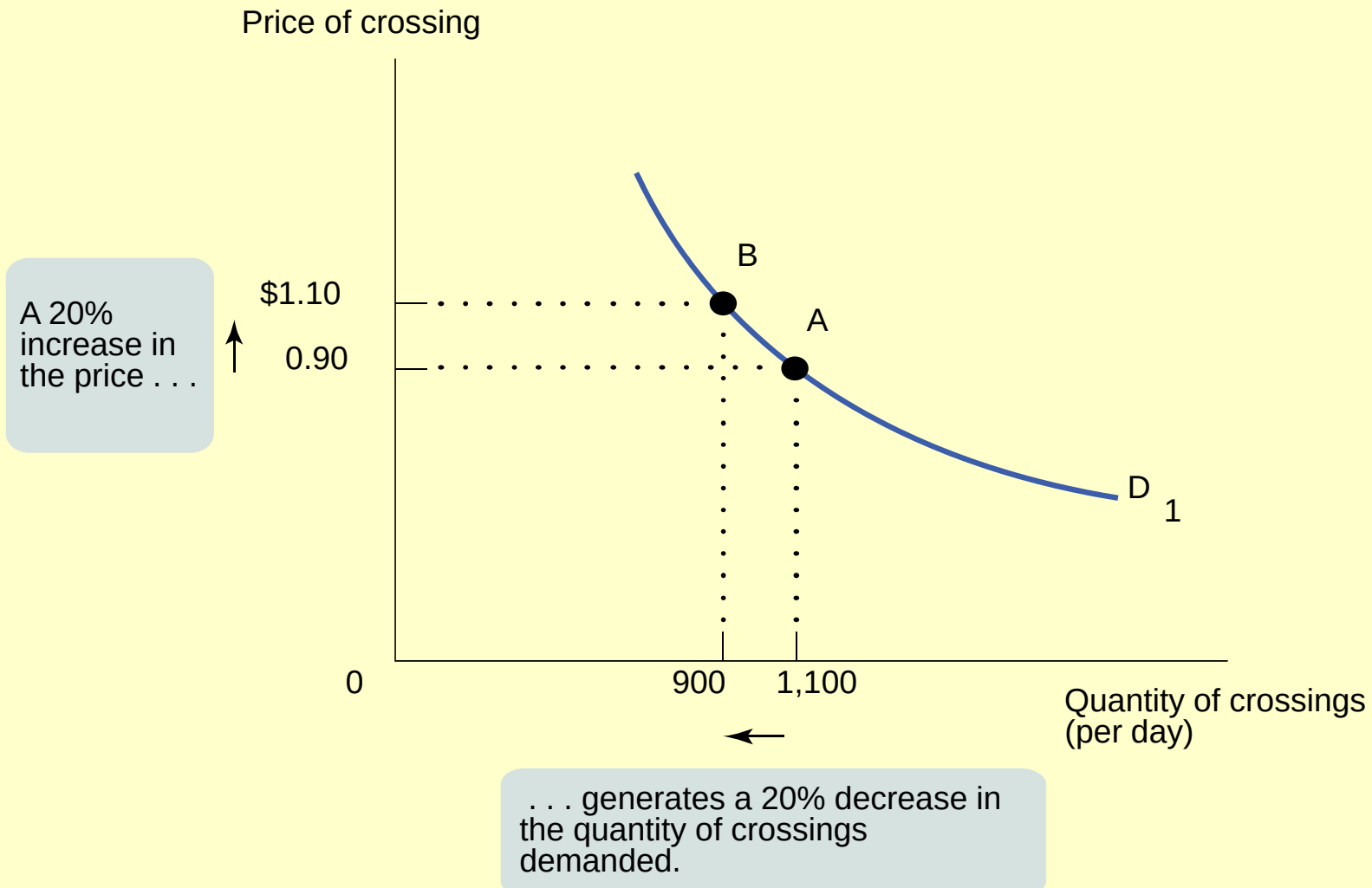
Interpreting the Price Elasticity of Demand

Unit-Elastic Demand, Inelastic Demand, and Elastic Demand

- Demand is **elastic** if the price elasticity of demand is greater than 1, **inelastic** if the price elasticity of demand is less than 1, and **unit-elastic** if the price elasticity of demand is exactly 1.

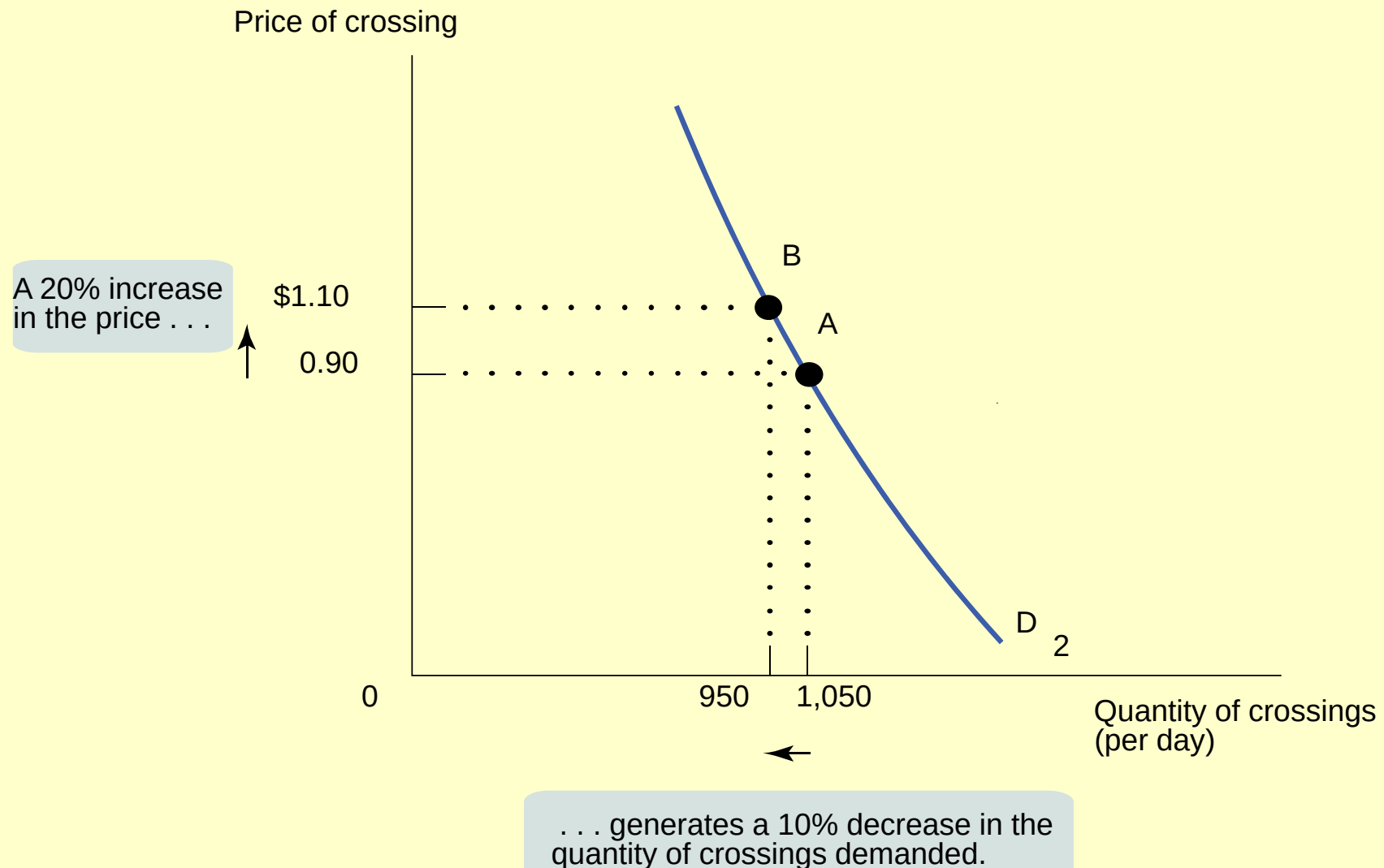
Unit Elasticity of Demand

(a) Unit-Elastic Demand: Price Elasticity of Demand = 1



Inelastic Demand

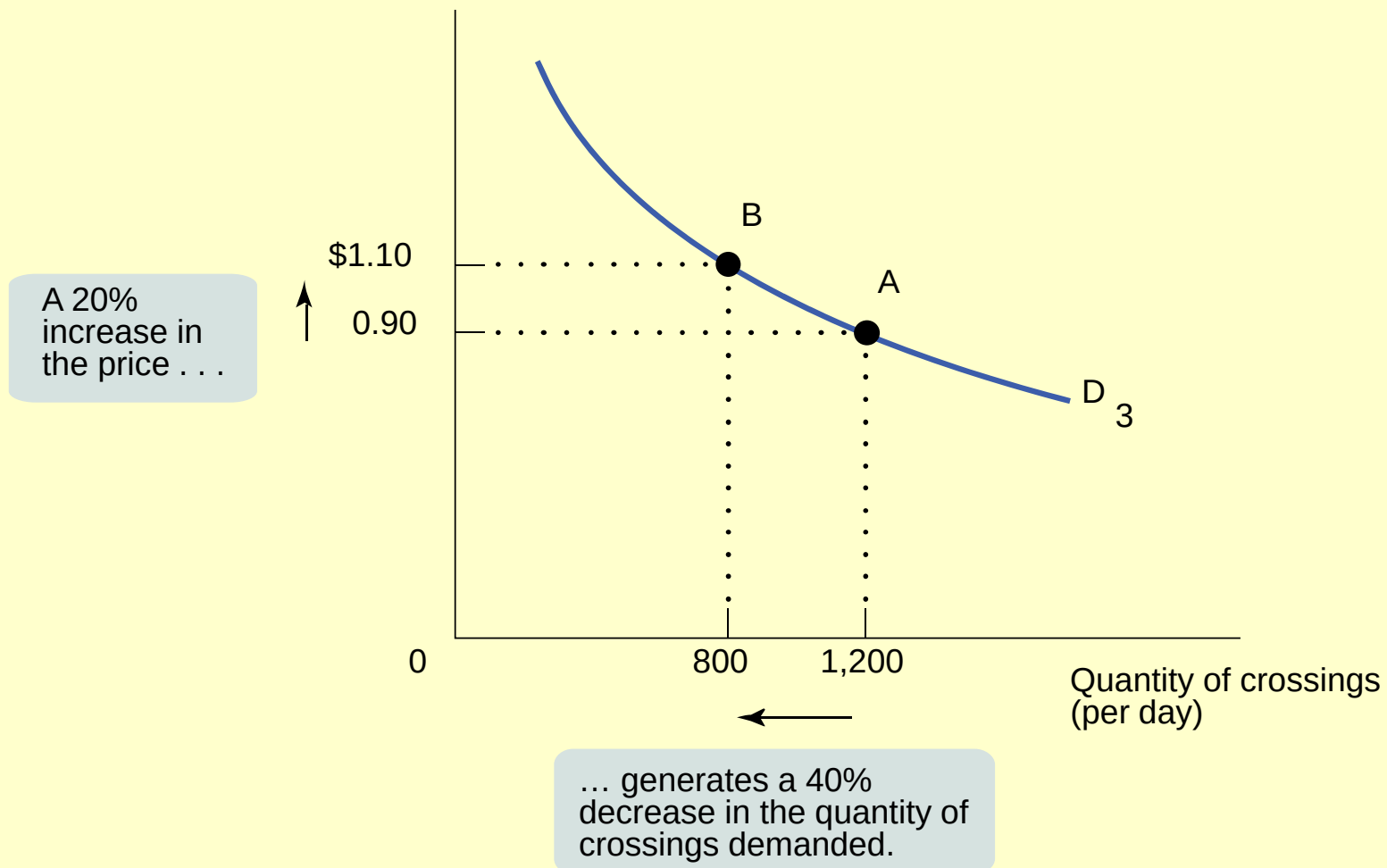
(b) Inelastic Demand: Price Elasticity of Demand = 0.5



Elastic Demand

(c) Elastic Demand: Price Elasticity of Demand = 2

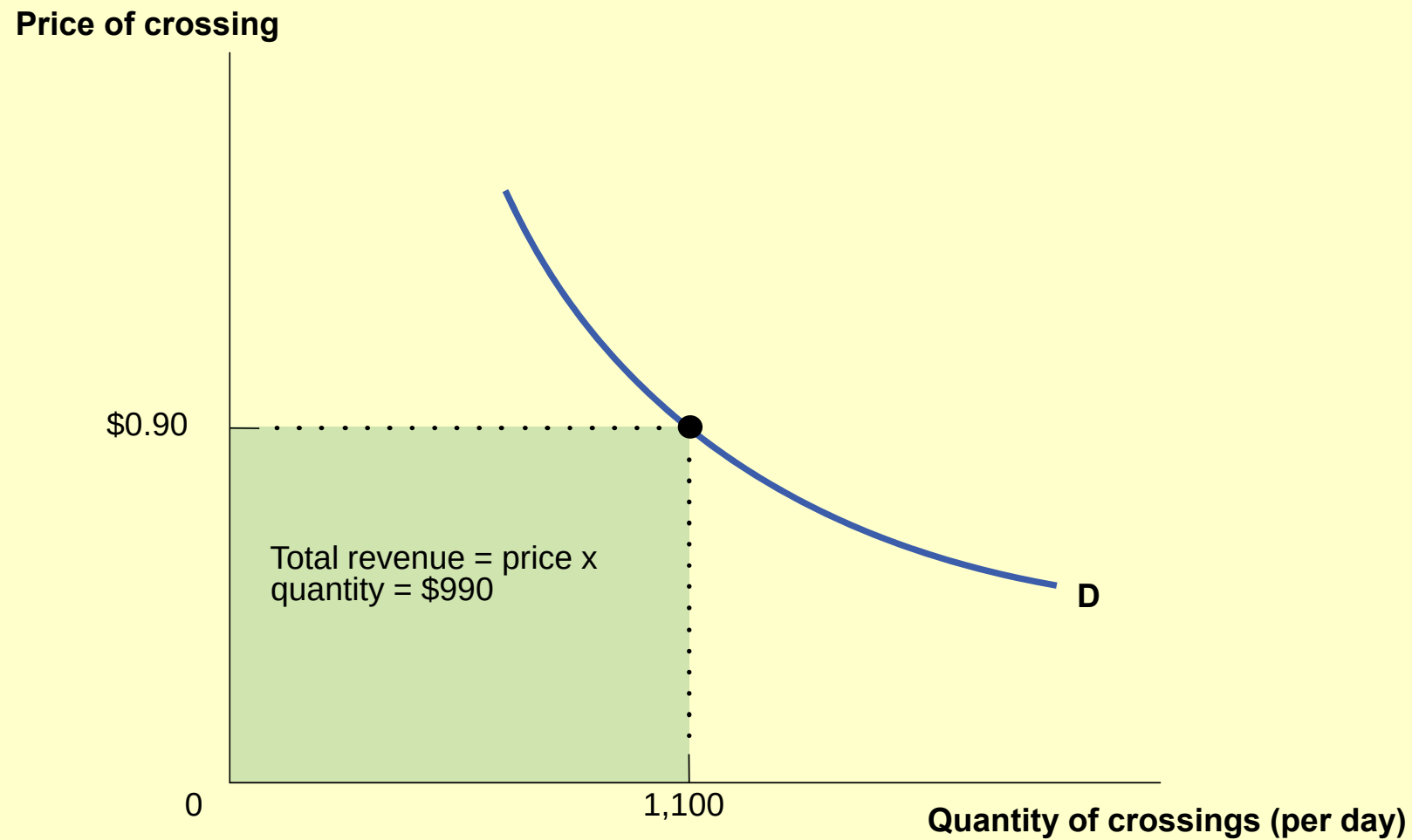
Price of crossing



Why does it matter whether demand is unit-elastic, inelastic, or elastic?

- Because this classification predicts how changes in the price of a good will affect the *total revenue* earned by producers from the sale of that good.
- The **total revenue** is defined as the total value of sales of a good or service, i.e.
- Total Revenue = Price × Quantity Sold

Total Revenue by Area

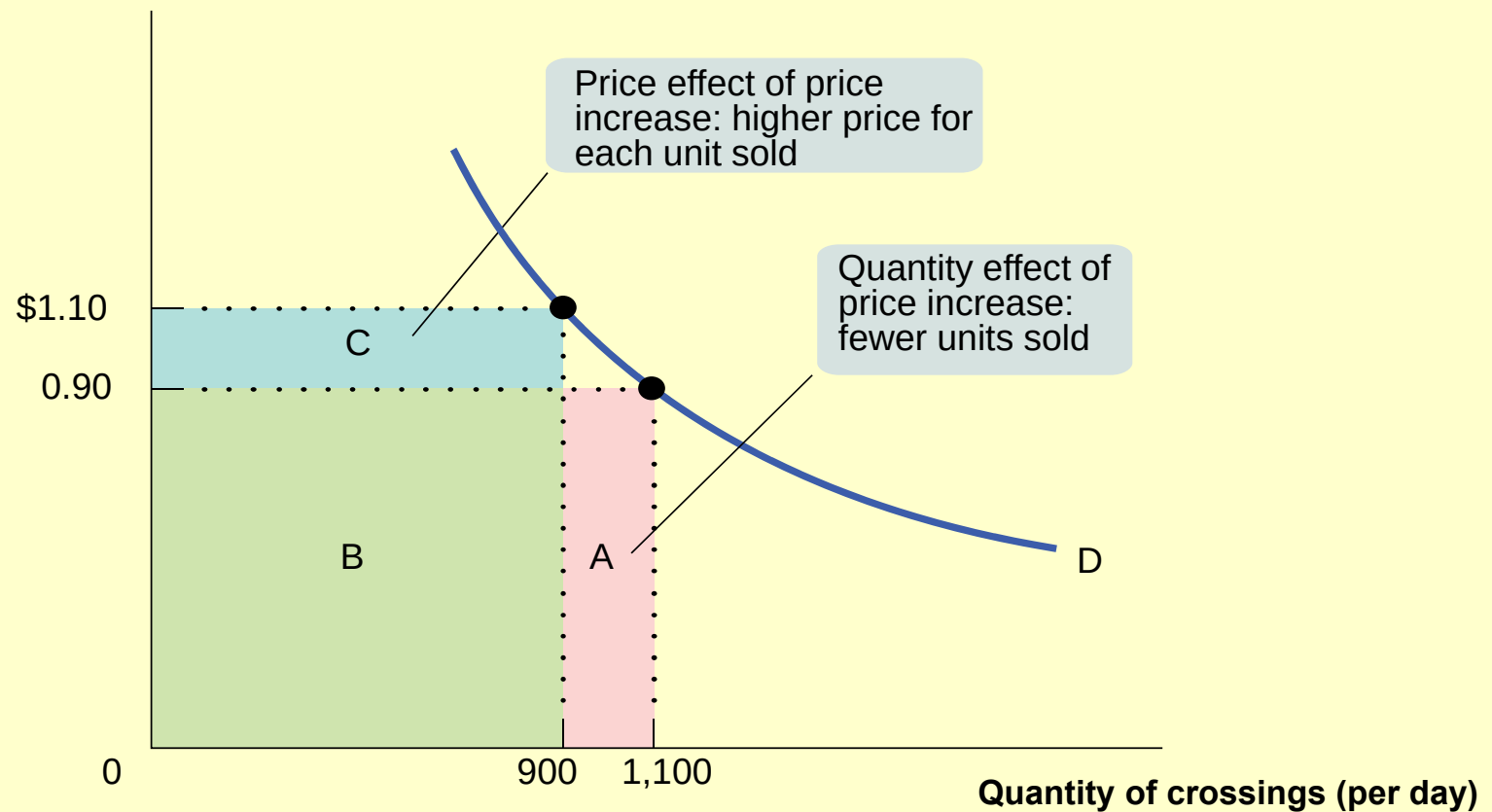


Elasticity and Total Revenue

- When a seller raises the price of a good, there are two countervailing effects in action (except in the rare case of a good with perfectly elastic or perfectly inelastic demand):
 - ***A price effect:*** After a price increase, each unit sold sells at a higher price, which tends to raise revenue.
 - ***A quantity effect:*** After a price increase, fewer units are sold, which tends to lower revenue.

Effect of a Price Increase on Total Revenue

Price of crossing



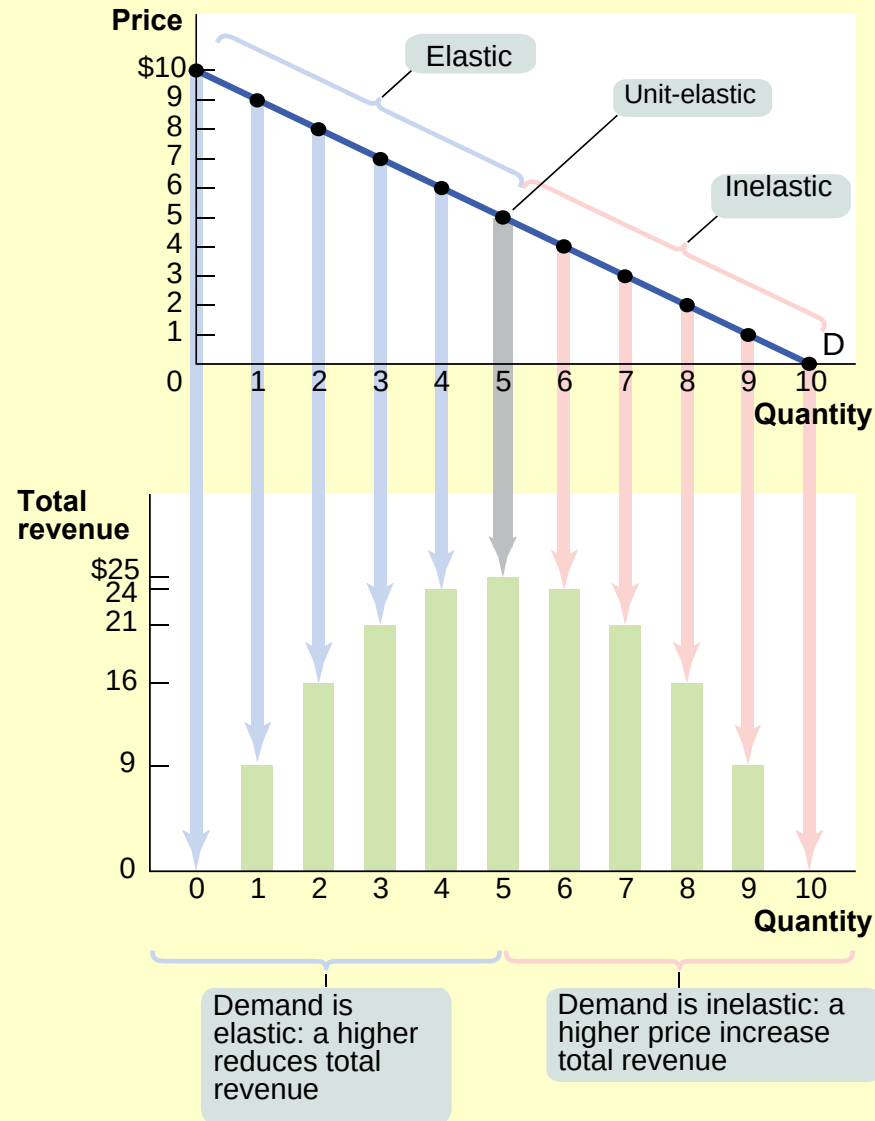
Elasticity and Total Revenue

- If demand for a good is ***elastic*** (the price elasticity of demand is greater than 1), an increase in price reduces total revenue. In this case, the quantity effect is stronger than the price effect.
- If demand for a good is ***inelastic*** (the price elasticity of demand is less than 1), a higher price increases total revenue. In this case, the price effect is stronger than the quantity effect.
- If demand for a good is ***unit-elastic*** (the price elasticity of demand is 1), an increase in price does not change total revenue. In this case, the sales effect and the price effect exactly offset each other.

Price Elasticity of Demand and Total Revenue

	Price of crossing = \$0.90	Price of crossing = \$1.10
Unit-elastic demand (price elasticity of demand = 1)		
Quantity demanded	1,100	900
Total revenue	\$990	\$990
Inelastic demand (price elasticity of demand = 0.5)		
Quantity demanded	1,050	950
Total revenue	\$945	\$1,045
Elastic demand (price elasticity of demand = 2)		
Quantity demanded	1,200	800
Total revenue	\$1,080	\$880

Demand Schedule and Total Revenue



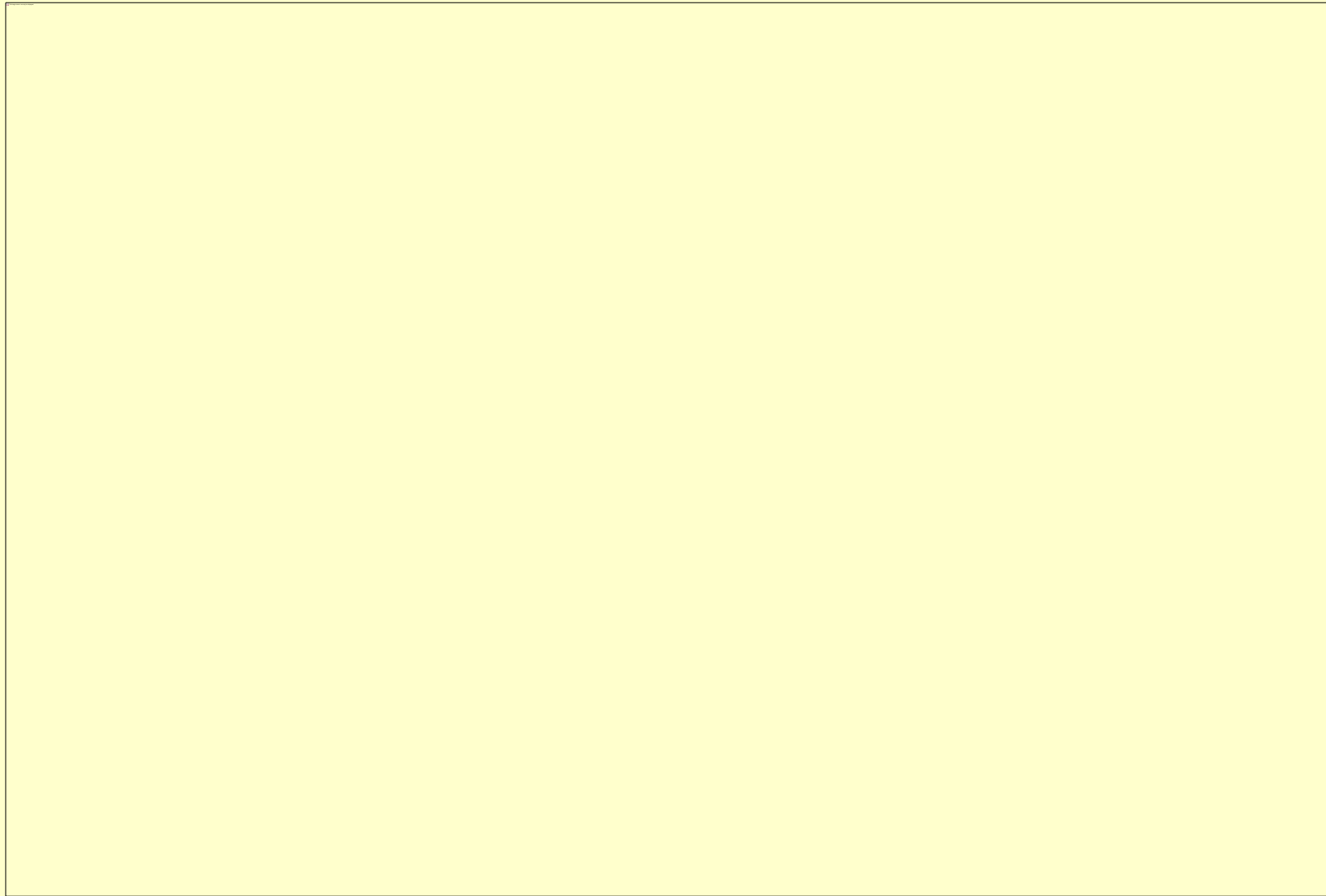
Demand Schedule and Total Revenue for a Linear Demand Curve		
Price	Quantity demanded	Total Revenue
\$0	10	\$0
1	9	9
2	8	16
3	7	21
4	6	24
5	5	25
6	4	24
7	3	21
8	2	16
9	1	9
10	0	0

The price elasticity of demand changes along the demand curve

What Factors Determine the Price Elasticity of Demand?

- Whether Close Substitutes Are Available
- Whether the Good Is a Necessity or a Luxury
- Share of Income spent on the Good
- Time

How Mad?



► **ECONOMICS IN ACTION**

- Responding to your tuition bill:
 - Tuition has been rising faster than the overall cost of living for years. But does rising tuition keep people from going to college?
 - A 1988 study found that a 3% increase in tuition led to an approximately 2% fall in the number of students enrolled at four-year institutions, giving a price elasticity of demand of 0.67 ($2\%/3\%$) and 0.9 for two-year institutions.
 - Enrollment decision for students at two-year colleges was significantly more responsive to price than for students at four-year colleges. The result: students at two-year colleges are more likely to forgo getting a degree because of tuition costs than students at four year colleges.
 - A 1999 study confirmed this pattern.

Other Demand Elasticities: Cross-Price Elasticity

- The **cross-price elasticity of demand** between two goods measures the effect of the change in one good's price on the quantity demanded of the other good. It is equal to the percent change in the quantity demanded of one good divided by the percent change in the other good's price.

The Cross-Price Elasticity of Demand Between Goods A and B:

$$= \frac{\% \text{ change in quantity of A demanded}}{\% \text{ change in price of B}}$$

Cross-Price Elasticity

- Goods are **substitutes** when the *cross-price elasticity of demand* is positive.
- Goods are **complements** when the cross-price elasticity of demand is negative.

The Income Elasticity of Demand

- The **income elasticity of demand** is the percent change in the quantity of a good demanded when a consumer's income changes divided by the percent change in the consumer's income.

$$\text{Income elasticity of demand} = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}}$$

Normal Goods and Inferior Goods

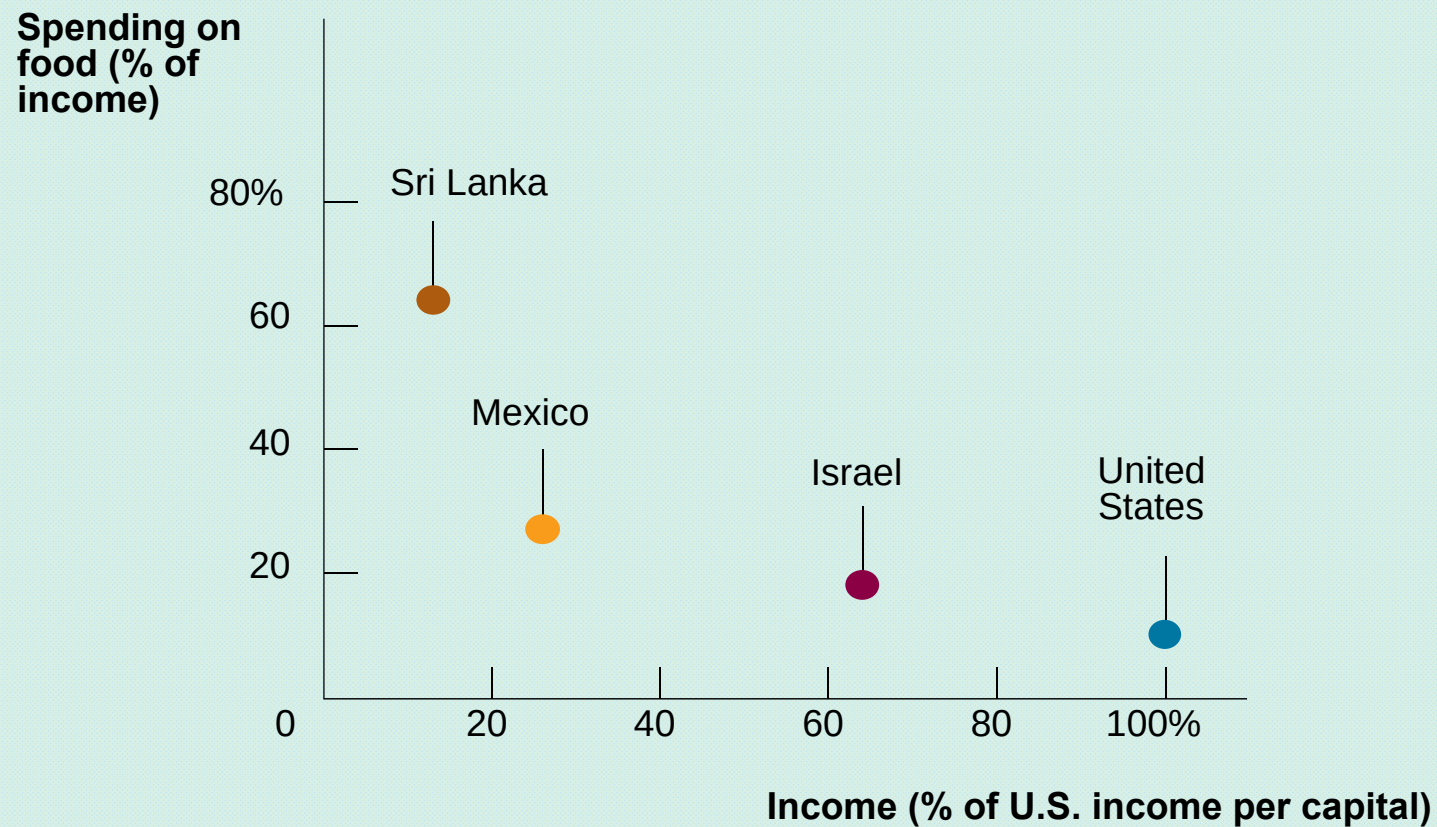
- When the income elasticity of demand is positive, the good is a ***normal good*** - that is, the quantity demanded at any given price increases as income increases.
- When the income elasticity of demand is negative, the good is an ***inferior good*** - that is, the quantity demanded at any given price decreases as income increases.

Where Have All the Farmers Gone?

- Why do so few people now live and work on farms in the United States?
- The income elasticity of demand for food is much less than 1—it is income inelastic. As consumers grow richer, other things equal, spending on food rises less than income → as the U.S. economy has grown, the share of income it spends on food—and therefore the share of total U.S. income earned by farmers—has fallen.
- Agriculture has been a technologically progressive sector for approximately 150 years in the U.S., with steadily increasing yields over time. Competition among farmers means that technological progress leads to lower food prices. Meanwhile, the demand for food is price-inelastic, so falling prices of agricultural goods, other things equal, reduce the total revenue of farmers → progress in farming has been good for consumers but bad for farmers.

GLOBAL COMPARISON

FOOD'S BITE IN WORLD BUDGETS



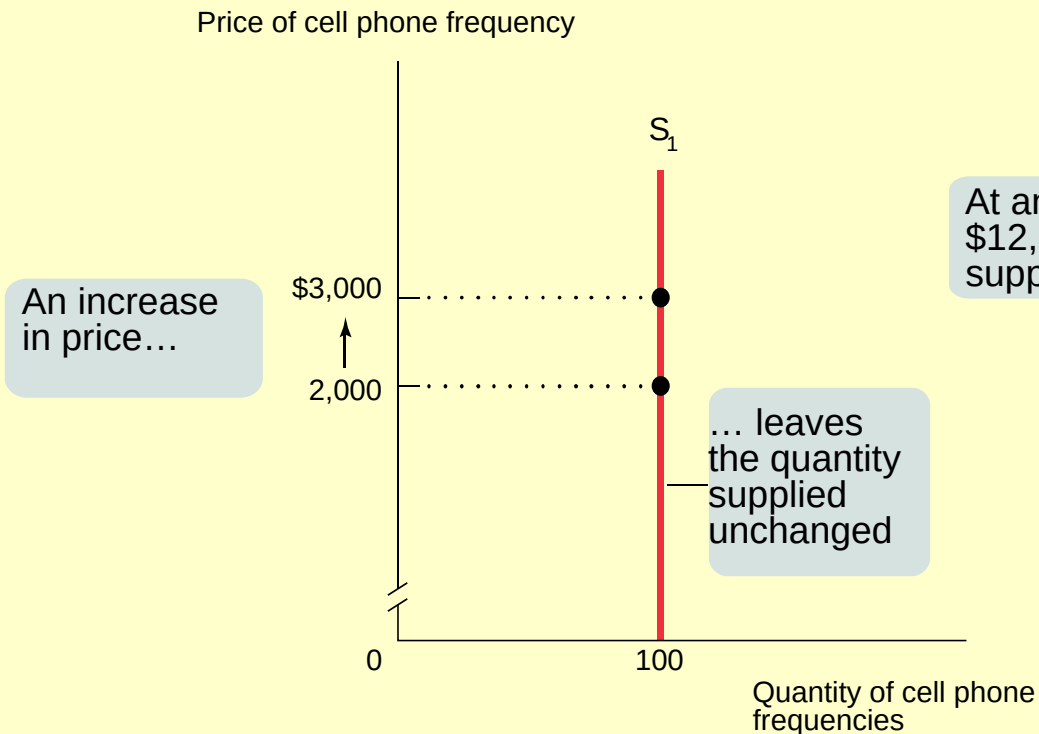
Measuring the Price Elasticity of Supply

- The **price elasticity of supply** is a measure of the responsiveness of the quantity of a good supplied to the price of that good. It is the ratio of the percent change in the quantity supplied to the percent change in the price as we move along the supply curve.

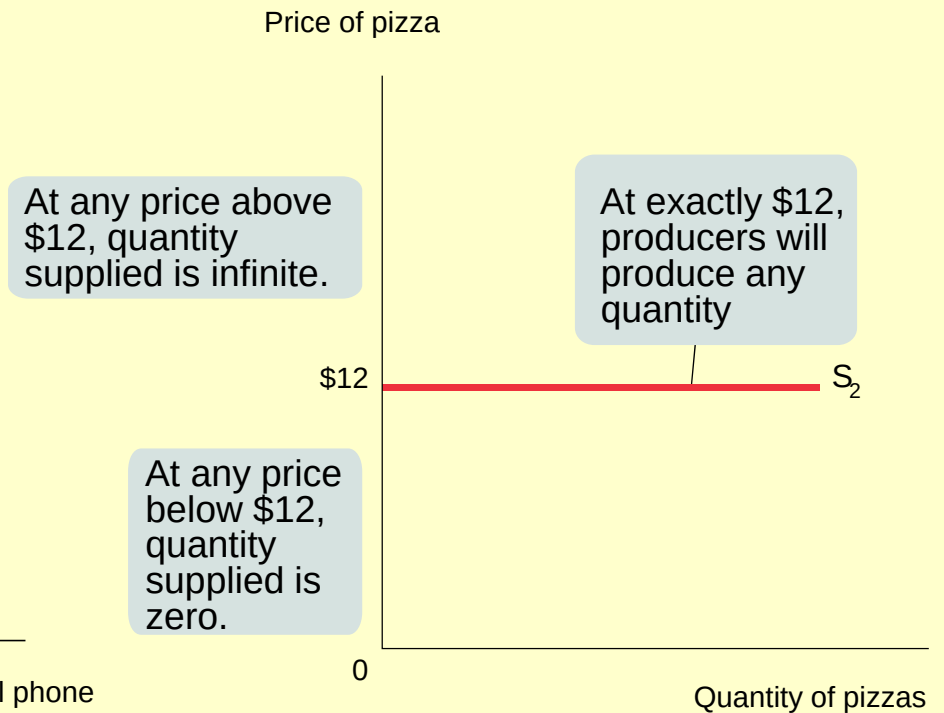
$$\text{Price elasticity of supply} = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}}$$

Two Extreme Cases of Price Elasticity of Supply

(a) Perfectly Inelastic Supply:
Price Elasticity of Supply = 0



(b) Perfectly Elastic Supply:
Price Elasticity of Supply = ∞



Two Extreme Cases of Price Elasticity of Supply

- There is **perfectly inelastic supply** when the price elasticity of supply is zero, so that changes in the price of the good have no effect on the quantity supplied. A perfectly inelastic supply curve is a vertical line.
- There is **perfectly elastic supply** when even a tiny increase or reduction in the price will lead to very large changes in the quantity supplied, so that the price elasticity of supply is infinite. A perfectly elastic supply curve is a horizontal line.

What Factors Determine the Price Elasticity of Supply?

- **The Availability of Inputs:** The price elasticity of supply tends to be large when inputs are readily available and can be shifted into and out of production at a relatively low cost. It tends to be small when inputs are difficult to obtain.
- **Time:** The price elasticity of supply tends to grow larger as producers have more time to respond to a price change. This means that the long-run price elasticity of supply is often higher than the short-run elasticity.

“European Farm Surpluses”

- Imposition of a *price floors* to support the incomes of farmers has created “butter mountains” and “wine lakes” in Europe.
- Were European politicians unaware that their price floors would create huge surpluses?
- They probably knew that surpluses would arise, but underestimated the price elasticity of agricultural supply due to availability of inputs:
- They thought big increases in production were unlikely since there was little new land available in Europe for cultivation. However, farm production could expand by adding other resources, especially fertilizer and pesticides. So although farm acreage didn't increase much, farm production did!

An Elasticity Menagerie

Name	Possible values	Significance
Price elasticity of demand = $\frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}$ (dropping the minus sign)		
Perfectly inelastic demand	0	Price has no effect on quantity demanded (vertical demand curve).
Inelastic demand	Between 0 and 1	A rise in price increases total revenue.
Unit-elastic demand	Exactly 1	Changes in price have no effect on total revenue.
Elastic demand	Greater than 1, less than ∞	A rise in price reduces total revenue.
Perfectly elastic demand	∞	A rise in price causes quantity demanded to fall to 0. A fall in price leads to an infinite quantity demanded (horizontal demand curve).

An Elasticity Menagerie

Cross-price elasticity of demand = $\frac{\% \text{ change in quantity of one good demanded}}{\% \text{ change in price of another good}}$		
Complements	Negative	Quantity demanded of one good falls when the price of another rises.
Substitutes	Positive	Quantity demanded of one good rises when the price of another rises.
Income elasticity of demand = $\frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}}$		
Inferior good	Negative	Quantity demanded falls when income rises.
Normal good, income-inelastic	Positive, less than 1	Quantity demanded rises when income rises, but not as rapidly as income.
Normal good, income-elastic	Greater than 1	Quantity demanded rises when income rises, and more rapidly than income.
Price elasticity of supply = $\frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}}$		
Perfectly inelastic supply	0	Price has no effect on quantity supplied (vertical supply curve).
	Greater than 0, less than ∞	Ordinary upward-sloping supply curve.
Perfectly elastic supply	∞	Any fall in price causes quantity supplied to fall to 0. Any rise in price elicits an infinite quantity supplied (horizontal supply curve).

SUMMARY

1. *Elasticity* is a general measure of **responsiveness** that can be used to answer such questions.
2. The **price elasticity of demand**—the percent change in the quantity demanded divided by the percent change in the price (dropping the minus sign)—is a measure of the responsiveness of the quantity demanded to changes in the price.
3. The responsiveness of the quantity demanded to price can range from **perfectly inelastic demand**, where the quantity demanded is unaffected by the price, to **perfectly elastic demand**, where there is a unique price at which consumers will buy as much or as little as they are offered. When demand is perfectly inelastic, the demand curve is a vertical line; when it is perfectly elastic, the demand curve is a horizontal line.

SUMMARY

4. The price elasticity of demand is classified according to whether it is more or less than 1. If it is greater than 1, demand is **elastic**; if it is less than 1, demand is **inelastic**; if it is exactly 1, demand is **unit-elastic**. This classification determines how **total revenue**, the total value of sales, changes when the price changes.
5. The price elasticity of demand depends on whether there are close substitutes for the good in question, whether the good is a necessity or a luxury, the share of income spent on the good, and the length of time that has elapsed since the price change.

SUMMARY

6. The **cross-price elasticity of demand** measures the effect of a change in one good's price on the quantity of another good demanded. The cross-price elasticity of demand can be positive, in which case the goods are substitutes, or negative, in which case they are complements.
7. The **income elasticity of demand** is the percent change in the quantity of a good demanded when a consumer's income changes divided by the percent change in income. The income elasticity of demand indicates how intensely the demand for a good responds to changes in income. It can be negative; in that case the good is an inferior good. Goods with positive income elasticities of demand are normal goods. If the income elasticity is greater than 1, a good is **income elastic**; if it is positive and less than 1, the good is **income-inelastic**.

SUMMARY

8. The **price elasticity of supply** is the percent change in the quantity of a good supplied divided by the percent change in the price. If the quantity supplied does not change at all, we have an instance of **perfectly inelastic supply**; the supply curve is a vertical line. If the quantity supplied is zero below some price but infinite above that price, we have an instance of **perfectly elastic supply**; the supply curve is a horizontal line.
9. The price elasticity of supply depends on the availability of resources to expand production and on time. It is higher when inputs are available at relatively low cost and the longer the time elapsed since the price change.

The End of Chapter 6

coming attraction:
Chapter 7:
Taxes