Elasticity and its Applications

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Elasticity

- **Elasticity:** A measure of the responsiveness of quantity demanded or quantity supplied to a change in one of its determinants.

Price Elasticity of Demand

- **Price Elasticity of Demand:** A measure of how much the quantity demanded of a good responds to a change in the price of that good.
- The price elasticity of demand is measured as the percentage change in quantity demanded divided by the percentage change in price:

$$\mathcal{E}_d^P = \frac{\%\Delta Q_d}{\%\Delta P}$$

- Importantly, when computing **any** elasticities, it must be done keeping **all** other determinants of quantity demanded constant.

Price Elasticity of Demand

Example

If a 10% increase in the price of oil leads to a 5% decrease in the quantity demanded of oil, what is the price elasticity of demand for oil (in absolute terms)?

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$\mathcal{E} = |-5\%/10\%| = 0.5$. This says that the change in Q_D is proportionately half as large as the change in price.

- The common convention is to report price elasticities of demand as absolute values. Thus, a larger price elasticity implies a greater responsiveness of quantity demanded to changes in price.

The Midpoint Method

- The midpoint method is a way to calculate percentage changes such that the percentage change from A to B is the same as the percentage change from B to A. It is calculated as follows:

$$\%\Delta X = \frac{X_1 - X_0}{\left(\frac{X_0 + X_1}{2}\right)} \times 100\%$$

The Midpoint Method

Example

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$$\%\Delta P = \frac{2-4}{(2+4)/2} \times 100\% = -66.7\%$$

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$$\Rightarrow |\mathcal{E}_d^p| = 40/66.7 = .60$$

Factors that Influence $\mathcal{E}_d^p$:

- Availability of substitutes
  - More close substitutes allows individuals to switch to other goods, so quantity demanded is more responsive to changes in prices. More close substitutes $\Rightarrow$ more elastic demand.
- Necessities vs. Luxuries
  - Necessities have more inelastic demand. Luxuries have more elastic demand.
- Definition of the market
  - Broadly defined markets have less elastic demand (e.g., easier to move from Wonka chocolate to other brands vs moving from chocolate to another type of candy.)
- Time Horizon
  - Demand becomes more elastic over a longer time horizon as consumers are more able to adjust their purchasing habits.

Characterizing Demand Elasticity

- **Inelastic Demand:** $\mathcal{E} < 1$.
  - Demand is not very responsive to changes in price.
  - Price effect is greater than the quantity effect.
- **Elastic Demand:** $\mathcal{E} > 1$.
  - Demand is very responsive to changes in price.
  - Quantity effect is greater than the price effect.
- **Unit Elastic Demand:** $\mathcal{E} = 1$.
  - The change in Q_D is proportional to the change in P.

Characterizing Demand Elasticity

Example

Which of the following products would tend to have inelastic demand? Why?

(a) *Luxury sedans*

(b) *Candy*

(c) *Crude oil*

(d) *Black Angus T-bone steak*

Characterizing Demand Elasticity

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Option (c).

Characterizing Demand Elasticity

- Even though the slope of a linear demand curve is constant, the elasticity is not.
- Linear demand curves have the characteristic that at points with a low price and high quantity, the demand curve is inelastic.
- At points with a high price and low quantity, the demand curve is elastic.

Characterizing Demand Elasticity

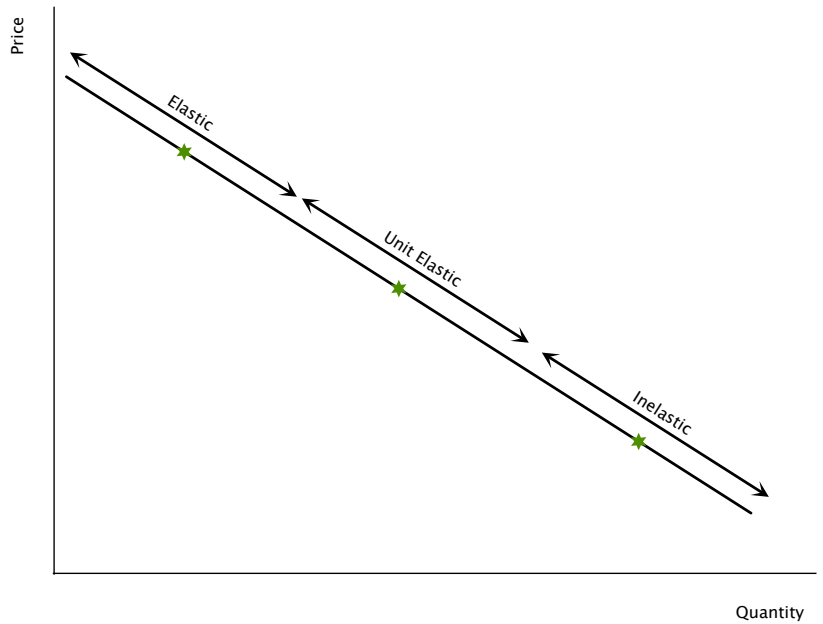


Figure: Points along a Demand Curve

Relative Elasticity

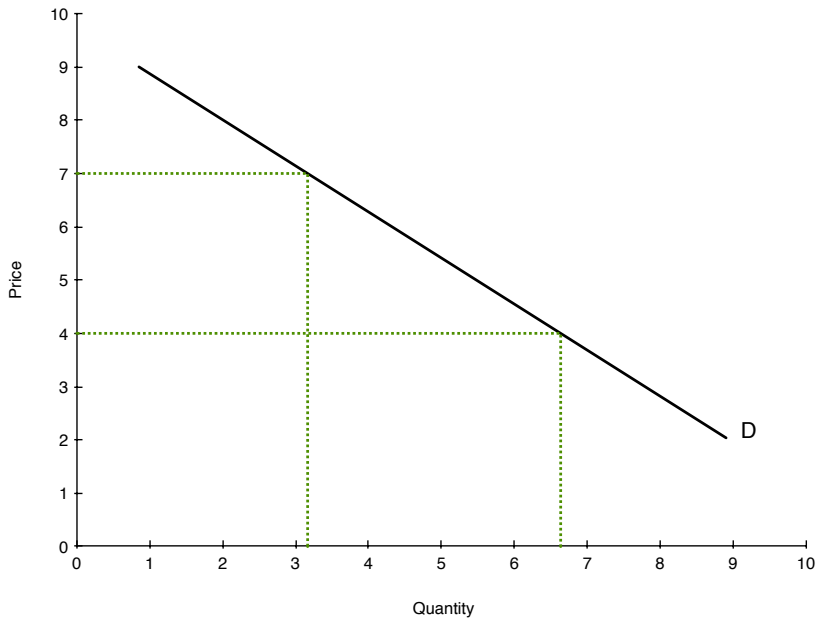
- Because the price elasticity of demand measures how much quantity demanded responds to changes in price, it is closely related to the slope of the demand curve.
- Rearranging the equation for the price elasticity of demand, we have that

$$|\mathcal{E}_d^p| = \left(\frac{P_0 + P_1}{Q_0 + Q_1}\right) \times \left|\frac{1}{m}\right|.$$

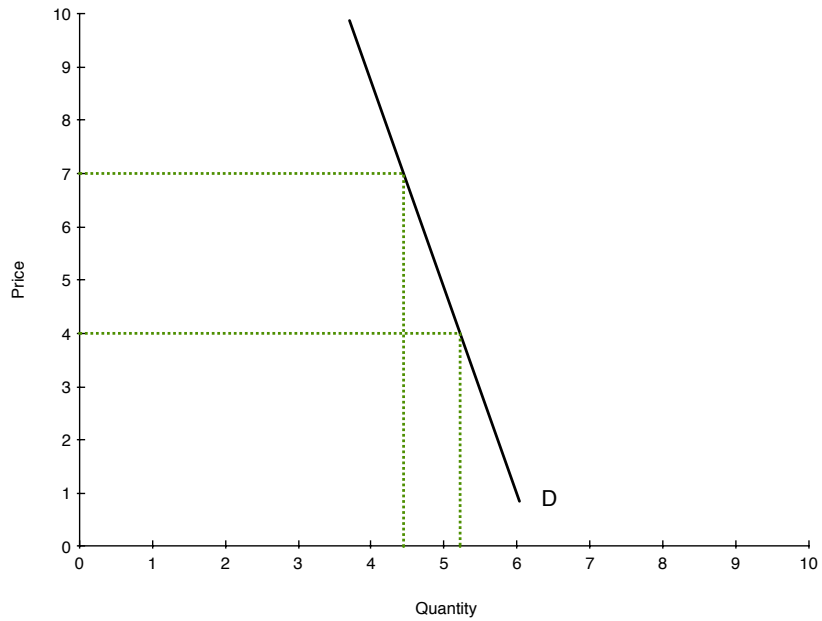
- Thus, a flatter demand curve is relatively elastic compared to a steeper curve.
- Conversely, a steeper demand curve is relatively inelastic compared to a flatter curve.

Relative Elasticity

Figure: Comparing Demand Elasticities



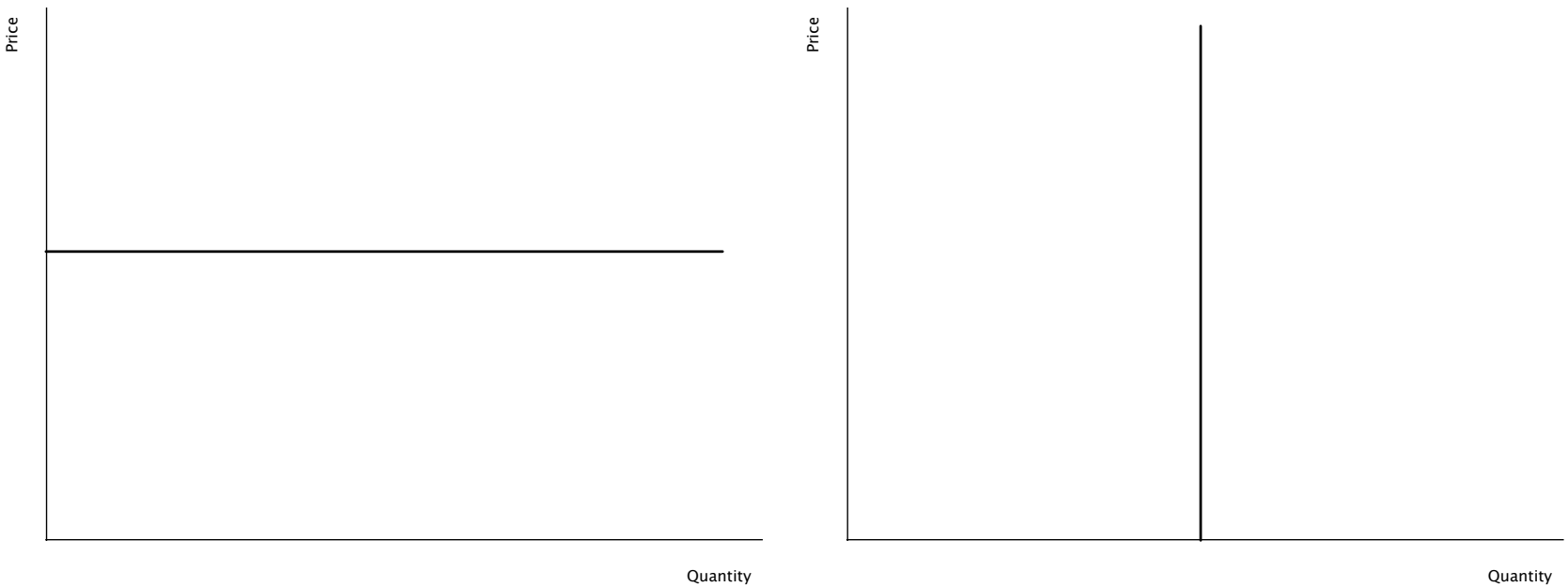
(a) Relatively Elastic Demand Curve



(b) Relatively Inelastic Demand Curve

Relative Elasticity

Figure: Extreme Cases



(a) Perfectly Elastic Demand

(b) Perfectly Inelastic Demand

Relative Elasticity

Example

Megan goes to her favorite coffee shop every morning and always buys one large black coffee, not matter whether there is a special or not. What is her price elasticity of demand?

Relative Elasticity

Example

Megan goes to her favorite coffee shop every morning and always buys one large black coffee, not matter whether there is a special or not. What is her price elasticity of demand?

No matter what the price is, quantity demanded does not change. Her price elasticity of demand is zero and she has a perfectly inelastic demand curve.

Total Revenue and Price Elasticity of Demand

- **Total Revenue:** The total amount paid by buyers & received by sellers of a good. $TR = P \times Q$.
- As prices change, the change in total revenue depends on the elasticity of demand.
- We can write the percentage change in total revenue as

$$\%\Delta TR \approx \%\Delta P + \%\Delta Q_D$$

Total Revenue and Price Elasticity of Demand

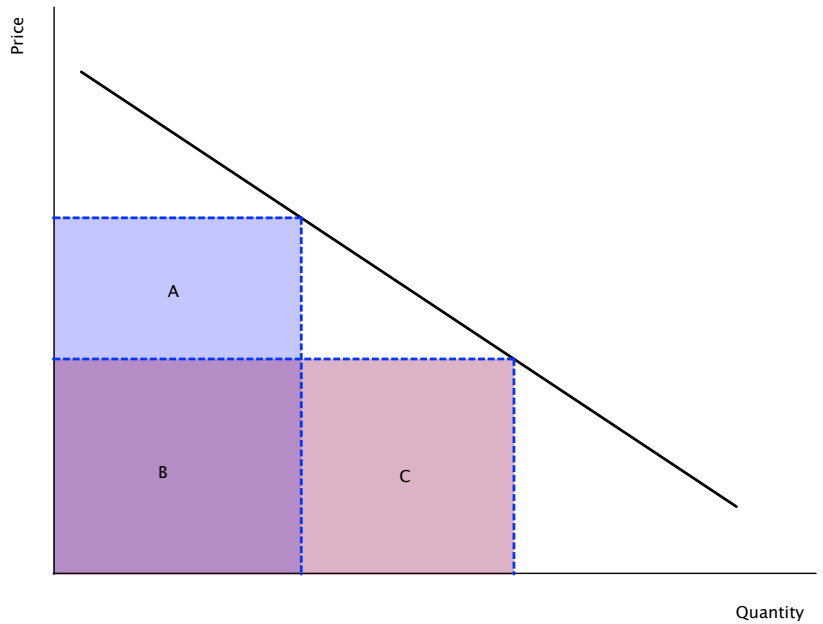


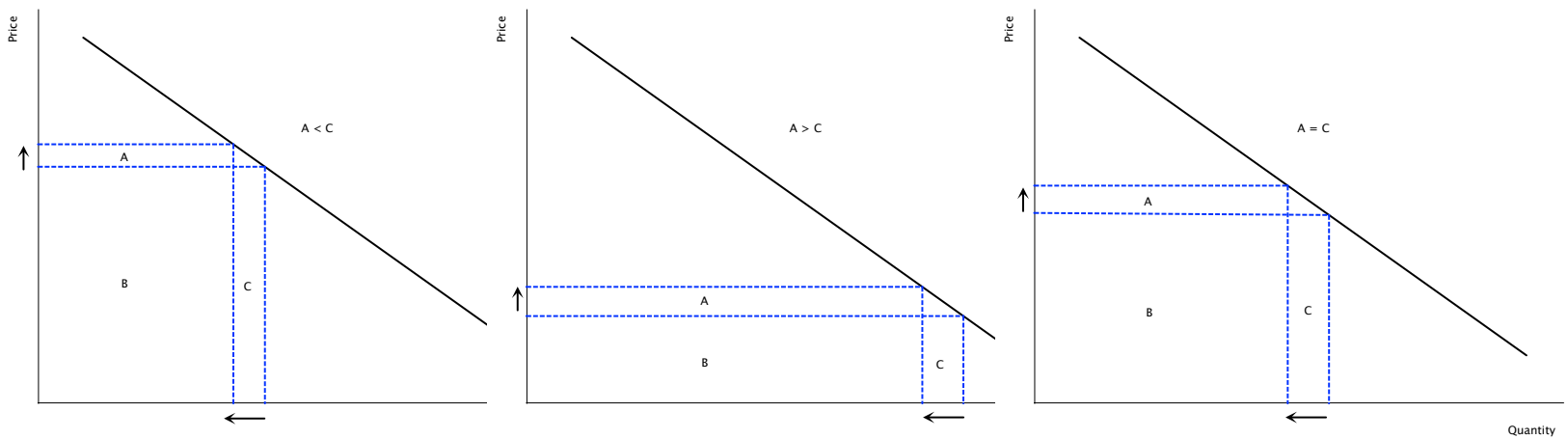
Figure: Total Revenue

Total Revenue and Price Elasticity of Demand

- If demand is inelastic, $|\%\Delta P| > |\%\Delta Q_D|$. Thus, if prices rise then total revenue will increase.
- If demand is elastic, $|\%\Delta P| < |\%\Delta Q_D|$. Thus, if prices rise then total revenue will decrease.
- If demand is unit elastic, $|\%\Delta P| = |\%\Delta Q_D|$. Thus, total revenue will not change when the price changes.

Total Revenue and Price Elasticity of Demand

Figure: Comparing Demand Elasticities and Total Revenue



(a) Elastic Point (b) Inelastic Point (c) Unit Elastic Point

Total Revenue and Price Elasticity

Example

The local pizza restaurant makes such great bread sticks that consumers do not respond much at all to a change in the price. If the owner is only interested in increasing revenue, he should

(a) *lower the price of bread sticks*

(b) *leave the price of bread sticks alone*

(c) *raise the price of bread sticks*

(d) *reduce costs*

Total Revenue and Price Elasticity

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Consumers aren't responsive to price changes, so demand is inelastic. He should increase the price of breadsticks (c).

Total Revenue and Price Elasticity

Example

Assume drug addicts pay for their addictions by stealing so that the higher the total revenue of the illegal drug industry, the higher the amount of theft.

1. *Suppose the government cracks down on drug suppliers by imposing stiff penalties for those caught dealing drugs. How will this affect the price of illegal drugs?*
2. *What happens to the amount of stealing if the demand for drugs is elastic? Inelastic?*
3. *If instead the government pursued a policy of drug education that reduced the demand for drugs, what would be the effect on stealing?*

Total Revenue and Price Elasticity

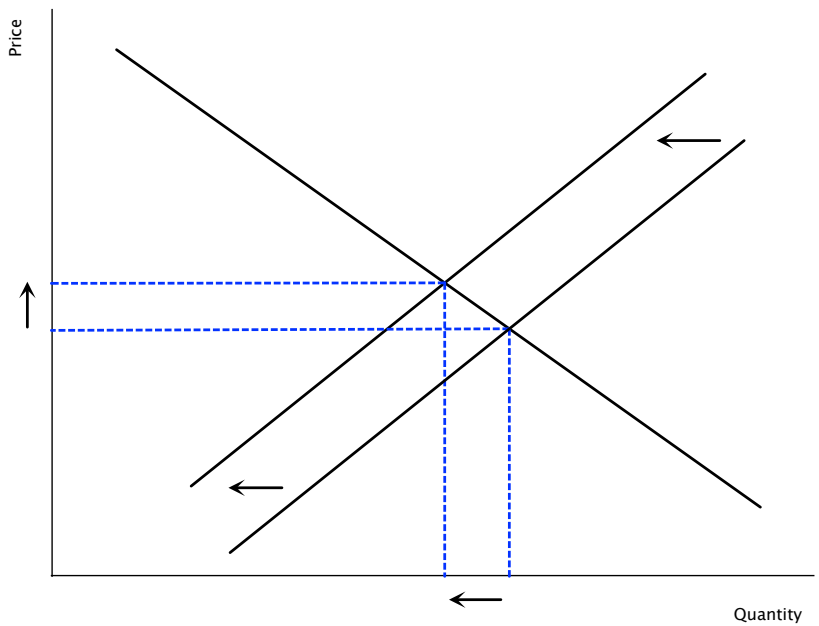
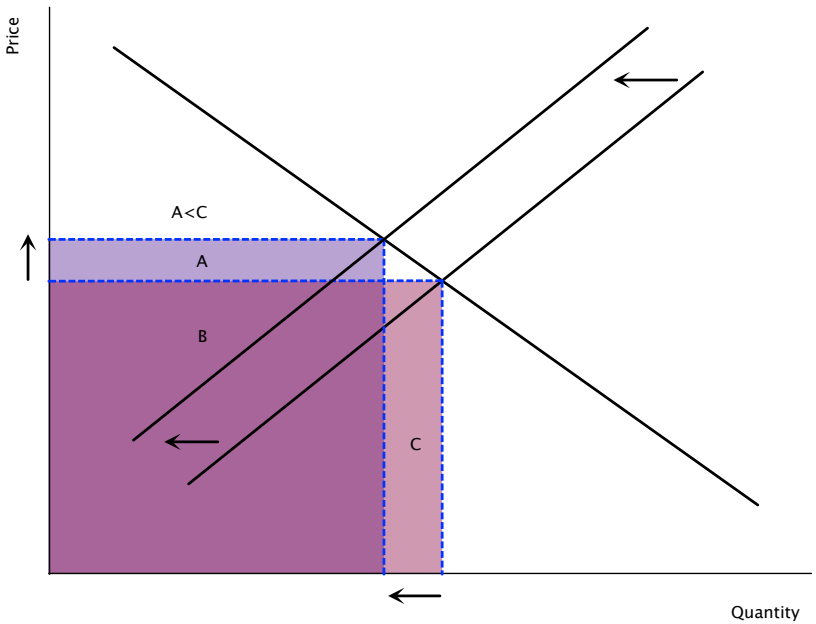


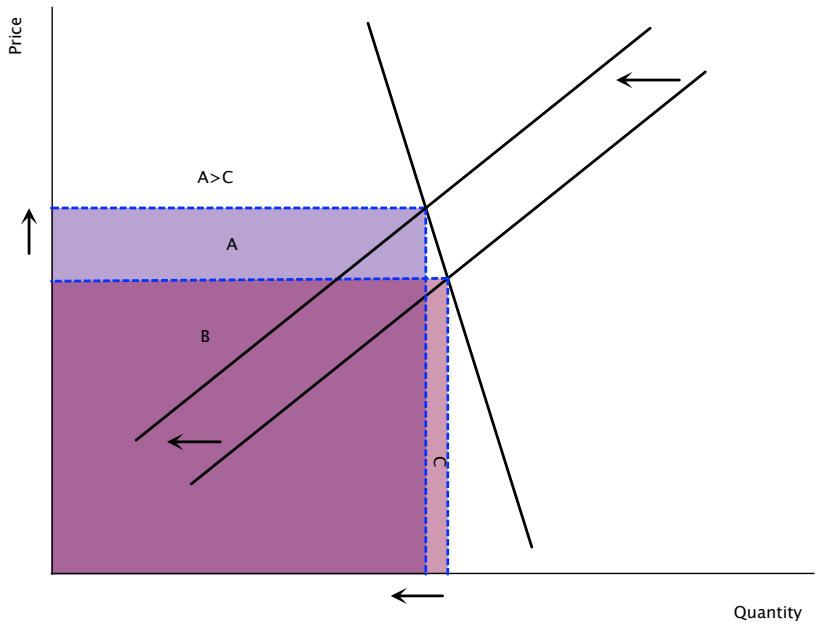
Figure: Drug Crack Down

The price of drugs will increase since supply decreases. The change in total revenue depends on the elasticity of demand.

Total Revenue and Price Elasticity



(a) Drug Crack Down: Elastic



(b) Drug Crack Down: Inelastic

In the elastic case, the amount of stealing will decrease because the decrease in quantity will outweigh the increase in price. In the inelastic case, stealing will increase since the price effect will dominate.

Total Revenue and Price Elasticity

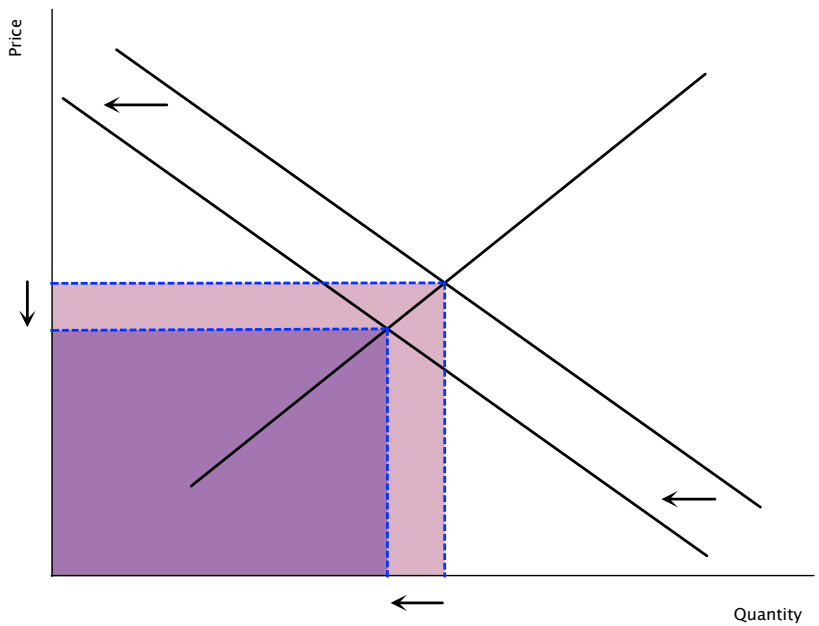


Figure: Drug Education Policy

The drug education policy will result in both a lower equilibrium price and quantity, which will reduce the amount of stealing.

Income Elasticity of Demand

- **Income elasticity of demand:** A measure of how much quantity demanded responds to a change in consumers' income.

$$\mathcal{E}_d^I = \frac{\%\Delta Q_D}{\%\Delta I}$$

Income Elasticity of Demand

- If a good is **normal**, a higher (lower) income will increase (decrease) quantity demanded. Thus, $\mathcal{E}_d^I$ is positive for these goods because if $\%\Delta I \gtrless 0$, then $\%\Delta Q_D \gtrless 0$.
- If a good is **inferior**, a higher (lower) income will decrease (increase) quantity demanded. Thus, $\mathcal{E}_d^I$ is negative for these goods because if $\%\Delta I \gtrless 0$, then $\%\Delta Q_D \lessgtr 0$.

Cross-Price Elasticity of Demand

- **Cross-price elasticity of demand:** A measure of how much the quantity demanded of one good responds to a change in the price of another good.

$$\mathcal{E}_{d_x}^{p_y} = \frac{\%\Delta Q_{D_x}}{\%\Delta P_y}$$

Cross-Price Elasticity of Demand

- If the goods are **substitutes**, an increase (decrease) in the price of one good increases (decreases) the quantity demanded of the other. Thus, $\mathcal{E}_{d_x}^{p_y}$ is positive because if $\%\Delta P_y \geqslant 0$, then $\%\Delta Q_{D_x} \geqslant 0$.
- If the goods are **complements**, an increase (decrease) in the price of one good decreases (increases) the quantity demanded of the other. Thus, $\mathcal{E}_{d_x}^{p_y}$ is negative because if $\%\Delta P_y \geqslant 0$, then $\%\Delta Q_{D_x} \leqslant 0$.

Example

Figure 12 shows that the demand for Converse shoes has increased because average consumer incomes have increased from $2,000 to $4,000. What is the income elasticity of demand for Converse shoes?

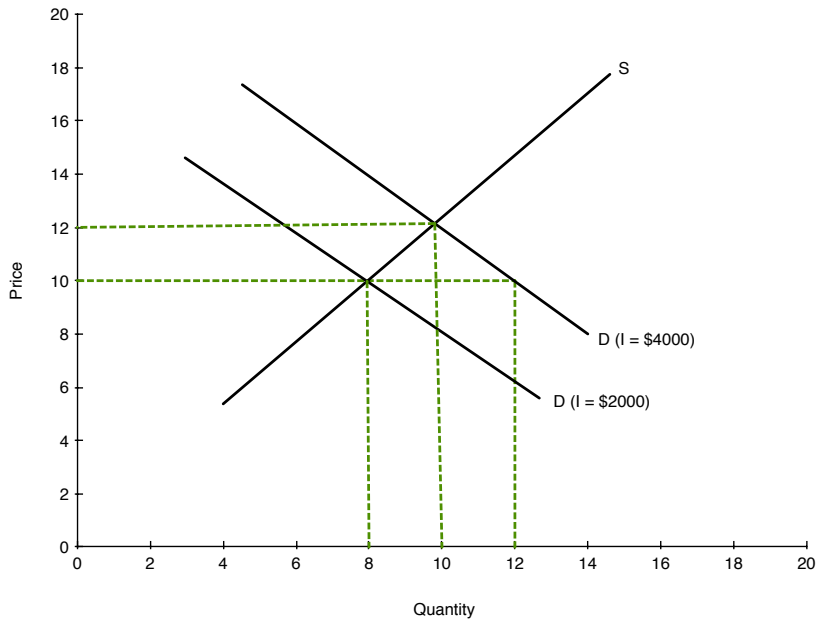


Figure: Market for Converse Shoes

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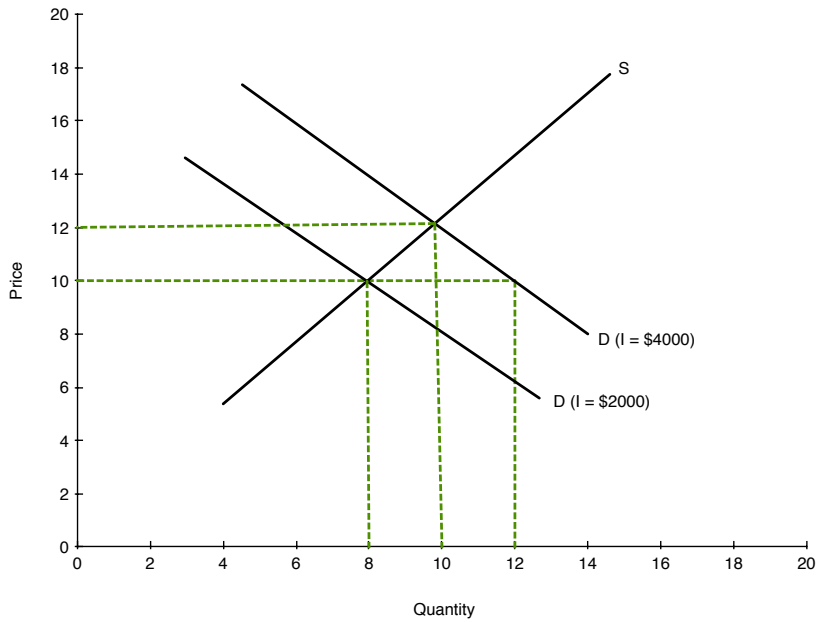

Figure: Market for Converse Shoes

Hold the price constant at $P = \$10$
$\%\Delta Q_D = 12 - 8/10 = 40\%$ $\%\Delta I = 4000 - 2000/3000 = 67\%$

$\mathcal{E}_d^I = .4/.67 = .60$. This is a normal good

Price Elasticity of Supply

- **Price Elasticity of Supply:** A measure of how much quantity supplied responds to changes in prices of a good.
- The major determinant of price elasticity of supply we will examine is the time horizon. In the long run, supply is more elastic.

Readings and Assignments

- Today: Mankiw Ch. 5
- Next time: Mankiw Ch. 6
- Problem Set 2, section 1