Elasticity of Demand and Total Revenue

- Consider a firm facing a downward sloping demand curve. The total revenue the firm receives is the price of the good multiplied by the quantity sold. That is:

$$\text{Total revenue} = \text{Price} \times \text{Quantity Sold}$$

  Suppose the firm considers increasing the price its good. There are two effects:

  1. A *price effect.* After a price increase, each unit sold sells for a higher price, which tends to raise revenue.
  2. A *quantity effect.* After a price increase, fewer units are sold, which tends to lower revenue.

- The price elasticity of demand tells us what happens to total revenue when prices: its size determines which effect – the price effect or the quantity effect – is stronger.

A Tollbooth Example

- Suppose the current toll on a bridge is \$1.00, but that the highway department must raise extra money for road repairs. Will raising the toll to \$1.10 increase or decrease total revenue?
- Suppose 1,000 cars cross the bridge each day at the current price. So total revenue is:

$$\text{Total revenue} = \$1.00 \times 1000 = \$1000.00$$

- Let's look at three cases. The Price Elasticity of Demand is
  1. inelastic, $E_p = 0.5$.
  2. elastic, $E_p = 2.0$.
  3. unit-elastic, $E_p = 1.0$.

Case I: Inelastic Demand

- Suppose the price elasticity of demand is 0.5; What effect will the 10 percent increase in the toll have on total revenue?
- We need to solve for quantity sold at \$1.10

$$\begin{aligned} E_p &= \text{Price elasticity of demand} \\ &= \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}} \\ &= \frac{\frac{Q_{\$1.10} - Q_{\$1.00}}{Q_{\$1.00}}}{\frac{\$1.10 - \$1.00}{\$1.00}} \end{aligned}$$

- We know $E_p = 0.5$ and $Q_{\$1.00} = 1000$. So

$$-0.5 = \frac{\frac{Q_{\$1.10} - 1000}{1000}}{0.10}$$

- So $Q_{\$1.10} = 950$ and total revenue at the higher toll is

$$\text{Total revenue} = \$1.10 \times 950 = \$1045.00$$

Case II: Elastic Demand

- Suppose the price elasticity of demand is 2.0; What effect will the 10 percent increase in the toll have on total revenue?

$$\begin{aligned} E_p &= \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}} \\ &= \frac{\frac{Q_{\$1.10} - Q_{\$1.00}}{Q_{\$1.00}}}{\frac{\$1.10 - \$1.00}{\$1.00}} \\ -2.0 &= \frac{\frac{Q_{\$1.10} - 1000}{1000}}{0.10} \end{aligned}$$

- In this case $Q_{\$1.10} = 800$ and total revenue at the higher toll would be

$$\text{Total revenue} = \$1.10 \times 800 = \$880.00$$

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Case III: Unit-Elastic Demand

- Suppose the price elasticity of demand is 1.0; What effect will the 10 percent increase in the toll have on total revenue?
- Enough of the math ... Let's think for a minute. A price elasticity of demand of 1 means that a one-percent increase in the price leads to an one-percent decrease in quantity demanded.
- So if the price increase by 10 percent, quantity sold will decrease by 10 percent.
- So quantity sold at \$1.10 will be 900 and total revenue will be

$$\text{Total revenue} = \$1.10 \times 900 = \$990 \approx \$1000$$

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More generally ...

- 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 price effect is weaker than the quantity effect.
- If demand for a good is *inelastic* (the price elasticity of demand is less than 1), an increase in price increases total revenue. In this case, the price effect is stronger than the quantity effect.
- If the demand for the good is *unit-elastic* (the price elasticity of demand is 1), an increase in price does not change total revenue. In this case the two effects off-set each other.

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Conversely for a decrease in price...

- When demand is *elastic*, the quantity effect dominates the price effect; so a decrease in the price increases total revenue.
- When demand is *inelastic*, the price effect dominates the quantity effect; so a decrease in the price reduces total revenue.
- When demand is *unit-elastic*, the effects exactly balance; so a decrease in the price has no effect on total revenue.