

3.3 figure it out

Consider the demand and supply for cola in a market represented by the following equations:

$$Q^D = 15 - 10P$$

$$Q^S = 40P - 50$$

where Q is millions of bottles per year and P measures dollars per bottle. The equilibrium price of cola is \$1.30 per bottle, and 2 million bottles are sold each year.

- Calculate the price elasticity of demand and the price elasticity of supply at the equilibrium price and quantity.
- Calculate the share of a tax that would be borne by consumers and the share borne by producers.
- If a tax of \$0.15 per bottle is created, what would be the expected price buyers will have to pay? What price will sellers receive after the tax?
- Redo part (a) using calculus and confirm that your answers are the same. (*Hint:* You learned how to do this in the online appendix to Chapter 2.)

Solution:

- The formula for price elasticity of demand is

$$E^D = \frac{\Delta Q^D}{\Delta P} \times \frac{P}{Q^D}$$

From the demand curve, we can calculate $\frac{\Delta Q^D}{\Delta P}$. Each time P changes by one unit, Q^D falls by 10. Therefore,

$$\frac{\Delta Q^D}{\Delta P} = -10$$

Substituting into the formula for elasticity, we get

$$E^D = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = -10 \times \frac{1.3}{2} = \frac{-13}{2} = -6.5$$

The formula for price elasticity of supply is

$$E^S = \frac{\Delta Q^S}{\Delta P} \times \frac{P}{Q^S}$$

From the supply curve, we can see that $\frac{\Delta Q^S}{\Delta P} = 40$. Note that each time P increases by one unit, Q^S rises by 40.

Thus, the price elasticity of supply is

$$E^S = \frac{\Delta Q^S}{\Delta P} \times \frac{P}{Q^S} = 40 \times \frac{1.3}{2} = \frac{52}{2} = 26$$

- The proportion of the tax borne by buyers will be

$$\frac{E^S}{E^S + |E^D|} = \frac{26}{26 + |-6.5|} = \frac{26}{32.5} = 0.8$$

The proportion of the tax borne by sellers will be

$$\frac{|E^D|}{E^S + |E^D|} = \frac{|-6.5|}{26 + |-6.5|} = \frac{6.5}{32.5} = 0.2$$

So buyers will bear 80% of the tax and sellers will bear only 20% of the tax.

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c. If there is a tax of \$0.15 per bottle, buyers will bear 80% of the tax:

$$\text{Increase in } P_b = (0.80)(\$0.15) = \$0.12$$

The price buyers pay will rise from \$1.30 per bottle (the original equilibrium price) to \$1.42.

Sellers will bear the other 20% of the tax:

$$\text{Decrease in } P_s = (0.2)(\$0.15) = \$0.03$$

The price sellers receive will fall from \$1.30 per bottle to \$1.27.

d. Using derivatives, the price elasticity of demand is $E^D = \frac{\partial Q^D}{\partial P} \frac{P}{Q^D} = -10 \frac{1.3}{2} = -6.5$.

Using derivatives, the price elasticity of supply is $E^S = \frac{\partial Q^S}{\partial P} \frac{P}{Q^S} = 40 \frac{1.3}{2} = 26$.