An Introduction to Economics

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Market Equilibrium

Consider the following example:

- The demand curve for smoothies in a suburb of Boston is given by:

$$Q_d = 20 - 4P$$

- The supply curve is given by:

$$Q_s = 6P - 20$$

Compute the equilibrium price and quantity.
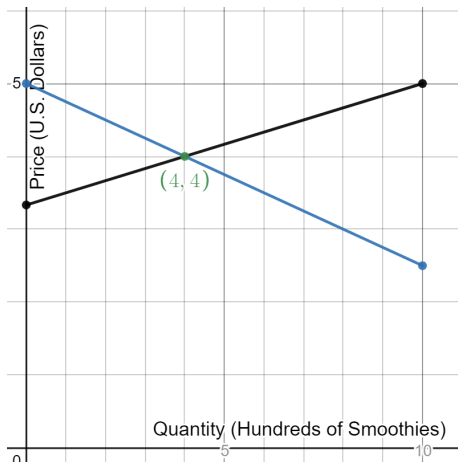
Market Equilibrium (2)

Figure 1: The market for smoothies

Efficiency

- Under perfect competition, alongside some additional assumptions, the market equilibrium exists and is *Pareto Efficient*.
- This is part of a broader concept known as the *First Welfare Theorem*.
- These additional assumptions boil down to:
    - Prices are well defined (i.e. no arbitrage)
    - No positive or negative externalities generated by transactions and consumption.

- Suppose now that all smoothie shops in the area collude and set a price above 4.
- What would this result in?
- Would the outcome be efficient? Why or why not?

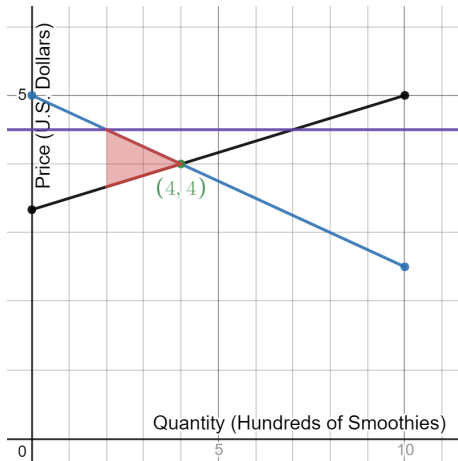# Inefficiencies: Surplus and Excess Supply

Figure 2: Loss in transactions due to a high price

- Suppose instead that, in order to keep smoothie prices low, a price ceiling below 4 dollars is imposed.
- What would this result in?
- Would the outcome be efficient? Why or why not?

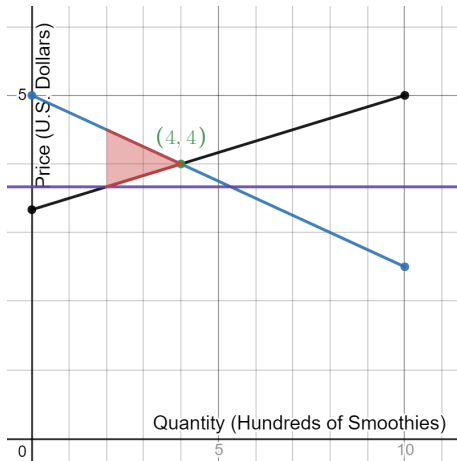# Inefficiencies: Shortage and Excess Demand

Figure 3: Loss in transactions due to the price ceiling.

Markets Equilibrium: Remarks

- Under perfect competition, we see that equilibria exist and typically have nice properties.
- Perfect competition is quite fragile, and many modern markets fail to satisfy all of the conditions.
- Nevertheless, large-scale shortages or surpluses typically occur only in extreme circumstances.
- Markets serve as excellent sources of aggregate information about the value of goods and services to both consumers and producers.

Elasticity: Motivating Example

- Suppose that you are a policy-maker considering whether or not to impose a consumption tax on cigarettes.
- You have information about how consumers have reacted to changes in the price of cigarettes in the past.
- In particular, you have data which demonstrates the market demand for cigarettes at several different prices in the past.
- How should you use this information when considering your policy?

Price Elasticity of Demand

- A measure of the responsiveness of demand to changes in price.
- Given by:

$$\epsilon_{p,d} = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}} \tag{1}$$

- Percentage used to avoid dependency on units.
- Should be negative in the majority of cases. (why?)

- Availability of close substitutes.
- Whether agents are physically or chemically dependent on the good.
- Information about the present value of the good.
- Persistence of the change in price.
- Percentage of income spent on the good.

Calculation: Midpoint Method

- Suppose that you observed the price of a pack of cigarettes rise from $4.50 to $6.00 over the course of a year.

- Over the same period, you observe a decrease in sales of cigarettes from 200 million packs to 190 million packs per year.

- The price elasticity of demand in this case is given by:

$$\frac{\frac{Q_2-Q_1}{\frac{Q_1+Q_2}{2}}}{\frac{P_2-P_1}{\frac{P_1+P_2}{2}}} = \frac{\frac{190-200}{195}}{\frac{6-4.50}{5.25}} = \frac{-\frac{2}{39}}{\frac{6}{21}} = -\frac{7}{39} \tag{2}$$

- Midpoint used to avoid misleading calculations that depend on the initial price or quantity.

Point Elasticities

- If you were given a great deal of data, say an entire demand curve, it's also possible to compute the price elasticity of demand at any point along the curve.
- In order to do this, one need only modify the midpoint formula above, so that $\Delta Q = Q_2 - Q_1$ and $\Delta P = P_2 - P_1$ tend toward zero.
- The ratio,

$$\frac{\Delta Q}{\Delta P} \tag{3}$$

is the multiplicative inverse of the slope of the demand curve at a point.[1]

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[1]That is to say, $\frac{\Delta P}{\Delta Q}$ is the slope of the demand curve.

Point Elasticity (2)

- The price elasticity of demand at a point (Q, P) along the demand curve is then given by:

$$\frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} \tag{4}$$

where $\frac{\Delta Q}{\Delta P}$ is the inverse slope of the demand curve at the point (Q, P).

- To determine the slope of the demand curve at a given point:
  - Use the slope of the curve at any point for a linear demand curve
  - Use the derivative at a point for nonlinear demand curves

An example: Linear Demand

- Consider the following demand curve:

$$Q_d = 25 - \frac{P}{4}$$

- What happens to the point elasticity along the curve as one raises the price?
- Is there a point where the price elasticity of demand is -1?

Figure 4: Elasticity and Demand

Types of Goods

- A good with a price elasticity less than 1 (in absolute value) is said to be *inelastic*.
- Demand responds very little to changes in price when the elasticity is close to 0.
- A good with a price elasticity greater than 1 (in absolute value) is said to be *elastic*.
- Demand is increasingly responsive as elasticity increases.

Extreme Elasticities

- Demand for a good is said to be perfectly inelastic when the price elasticity of demand is equal to 0.
- Some goods have extremely low elasticities, but in practice never perfectly 0.
- Demand is said to be perfectly elastic if the price elasticity of demand is unbounded.
- If demand is perfectly elastic, then any change in price will result in a drastic change in quantity demanded.

Cross-Price Elasticity

- Recall our discussion of the factors that may shift the demand curve.
- Among them were the prices of related goods, complements and substitutes.
- The cross price elasticity of demand can be used to determine how the demand for good A responds to changes in the price of good B.
- This is given, by a midpoint formula, as:

$$\epsilon_{A,B} = \frac{\% \text{ change in quantity of A demanded}}{\% \text{ change in price of B}} = \frac{\frac{Q_2^A - Q_1^A}{\frac{Q_1^A + Q_2^A}{2}}}{\frac{P_2^B - P_1^B}{\frac{P_1^B + P_2^B}{2}}}$$

$$= \frac{Q_2^A - Q_1^A}{P_2^B - P_1^B} \cdot \frac{P_1^B + P_2^B}{Q_1^A + Q_2^A}$$

Substitutes and Complements: Cross-Price Elasticity of Demand

- Recall the definition of substitutes and complements.
- Good A is a substitute for good B is the cross price elasticity of A with respect to B is positive.
- Good A is a complement for good B is the cross price elasticity of A with respect to B is negative.

Income Elasticity of Demand

- Rather than considering responsiveness of demand to prices, one can also measure how demand changes with income.
- The income elasticity of demand is given by:

$$\epsilon_{I,d} = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}}$$

Normal Goods and Inferior Goods: Income Elasticity of Demand

- Recall the definitions of normal and inferior goods.
- Good A is a normal good if the income elasticity of demand is positive.
  - If the income elasticity of demand is between 0 and 1, then the good is sometimes called a necessity.
  - If the income elasticity of demand is greater than 1, the good is sometimes referred to as a luxury.
- Good A is an inferior good if the income elasticity of demand is negative.

Price Elasticity of Supply

- Analogous definition of the price elasticity of demand applied to suppliers.
- Measures the responsiveness of suppliers to changes in the market price for the goods they produce.
- Given as:

$$\epsilon_{p,s} = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}} \tag{5}$$

- $\epsilon_{p,s}$ is positive in general. (why?)

Factors affecting Price Elasticity of Supply

- Time required and cost of altering inputs to increase supply (factor mobility).
- Length of the production process vs. time to respond to changes in price.
- The number of producers.
- Scarcity of inputs.

Elasticity at Equilibrium

- Consider the following market demand and supply curve for headphones.

$$Q_d = 60 - 2P$$
$$Q_s = 5P - 80$$

1. Sketch the demand and supply curves.
2. What is the equilibrium price and quantity?
3. What are the price elasticities of supply and demand at equilibrium?
4. Suppose now that the price of stereo sound systems increases. Following this, you observe an increase in the price and quantity at equilibrium in the market for headphones. What can you conclude about the cross-price elasticity of headphones with respect to the price of stereos.
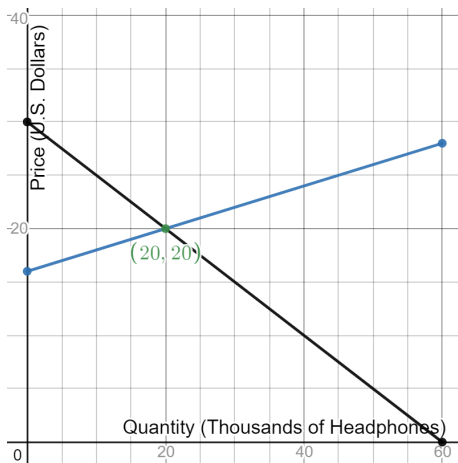
Figure 5: Equilibrium for Headphones