Demand and Supply

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Market
Equilibrium

Elasticity

Consumer and
Producer
Surplus

Overview

Demand and supply function

- Factors influencing the position of the demand and supply functions
- Shifts in demand and supply

Market equilibrium

- Intersection of demand and supply
- Market equilibrium changes from shifts in demand and supply

Elasticities

- Increases or decreases in the quantity demanded from percentage changes in price or income

Consumer and producer surplus

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Consumer Demand Overview

Demand function derived from consumer theory

- Aggregation across all consumers leads to market demand: Total units potentially purchased by consumers in a given time period
- Market equilibrium determines actual units purchased

Substitutes and complements

- Substitutes: Goods that can serve as a replacement (to a certain degree), e.g., beef vs. chicken
- Complements: Goods that are usually purchased in combination, e.g., milk and breakfast oats

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Variables Influencing Demand

Variables influencing shape and position of the demand function

- From consumer theory: Own-price, price of other good, and income
- In general: Own-price (P), price of substitutes (P_S), price of complements (P_C), income (I), and other factors (e.g., advertising, taxes, subsidies, weather)

General representation of the demand function:

$$Q^D = f(P, P_S, P_C, I, \dots)$$

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Three Representations of the Demand Function

❶ Functional form (e.g., demand for natural gas):

$$Q = 200 - 4 \cdot P - \frac{T}{2}$$

❷ Table representation (e.g., demand for ice cream):[1]

Price	0.50	1.00	1.50	2.00	2.50
Quantity	3.00	1.50	1.00	0.75	0.50

❸ Graphical representation

- Draw the demand for natural gas (above) for $T = 80$ and $T = 20$.

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[1] Careful with estimating of the demand curve based on price and quantity data only. Serious identification issues.

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Law of Demand

The law of demand states that when the price of a good increases and everything else remains the same, the quantity demanded decreases.

- Movement along the demand curve represents a change in the quantity demanded
- "everthing else remaining the same" is called *ceteris paribus* in economics

Shift in demand

- A change in any variable that affects demand, except for the good's price, results in a change in demand

There is a difference between *change in quantity demanded* (movement along the curve) and *change in demand* (shift of the curve).

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Shifting the Demand Curve

Factor	Right shift	Left Shift
Income or wealth	↑	↓
Price of substitute	↑	↓
Price of complement	↓	↑
Population	↑	↓
Expected price	↑	↓

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Firm Supply Overview

Supply function derived from producer and cost theory

- Aggregation across all firms leads to the market supply: Total units potentially sold by firms in a given time period
- Like for demand: Market equilibrium determines actual units sold
- Quantity supplied that maximizes profits

Variables influencing shape and position of the supply function

- From producer theory: Input prices, i.e., w and r
- In general: Input prices and other factors such as taxes, subsidies, weather, etc.

General representation of the supply function:

$$Q^S = f(P, w, r, t, s, \dots)$$

Quantity supplied depends on output price (P), wages (w), capital cost (r), taxes (t), subsidies (s), etc.

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Supply Curve

Similar to the demand function, there is a difference between *change in the quanity supplied* and *change in supply*

- If the output price changes ⇒ Change in the quantity supplied (movement along the curve)
- If anything else changes ⇒ Change in supply (shift of the curve)

Factor	Right shift	Left Shift
Price of input	↓	↑
Price of alternatives	↓	↑
Number of firms	↑	↓
Expected price	↓	↑

Market Equilibrium

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Overview

Equilibrium price

- The equilibrium price is determined by the intersection of demand and supply. At the equilibrium price, demand equals supply.

Market imbalances:

- Excess supply: Price is above the equilibrium price
- Excess demand: Price is below the equilibrium price

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Market Equilibrium: Numerical Example I

Demand as a function of income:

$$Q^D = 300 - 2 \cdot P + 4 \cdot I$$

Supply as a function of the price

$$Q^S = 3 \cdot P - 50$$

What is the market equilibrium if the income level is $I = 25$? What if $I = 50$?

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Market Equilibrium: Numerical Example II

Consider the demand for masks based on the number of infections (C) from a communicable disease:

$$Q^D = 7 + C - P$$

And the supply of masks is written as

$$Q^S = 1 + 2 \cdot P$$

Initially, $C = 0$ and thus, the equilibrium price and quantity are $P = 2$ and $Q = 5$. What are the equilibrium price and quantity if $C = 6$?

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Changes in the Market Equilibrium

1. Shift in demand for heat pumps due to high natural gas prices
2. Shift in supply for heat pumps due to government subsidies to firms
3. Shift in demand and supply for heat pumps due to high natural gas prices and government subsidies to firms

Simultaneous shift of demand and supply $\Rightarrow$ Ambiguous effect on price and quantity

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Summary Table

If both curves shift, the effect of quantity and price is ambiguous.

	Demand ↑	Demand ○	Demand ↓
Supply ↑	P?,Q ↑	P↓,Q ↑	P↓,Q ?
Supply ○	P↑,Q ↑	P ○,Q ○	P↓,Q ↓
Supply ↓	P↑,Q ?	P↑,Q ↓	P?,Q ↓

To determine the exact effect, we need mathematics.

Elasticity

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Introduction

Elasticity measures the percentage change in one variable (y) divided by the percentage change in some other variable (x). Examples for a good with a own-price elasticity of -0.6:

- Price increase of 1% $\Rightarrow$ Change in quantity demanded by $-0.6 \cdot 1\% = -0.6\%$
- Price decrease of 3% $\Rightarrow$ Change in quantity demanded by $-0.6 \cdot -3\% = 1.8\%$

Other elasticities of interest besides own-price elasticity:

- Income elasticity: Impact of economic growth on market demand
- Cross-price elasticities: Substitutes or complements

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Calculating Elasticities

Own-price elasticity: Change in quantity demanded of good i with respect to price of good i:

$$\epsilon_P = \frac{\%\Delta Q_i}{\%\Delta P_i} = \frac{P_i}{Q_i} \cdot \frac{\Delta Q_i}{\Delta P_i}$$

Income elasticity: Change in quantity demanded of good i with respect to income:

$$\epsilon_I = \frac{\%\Delta Q_i}{\%\Delta I} = \frac{I}{Q} \cdot \frac{\Delta Q}{\Delta I}$$

Cross-price elasticity: Change in quantity demanded of good i with respect to price of good j:

$$\epsilon_P = \frac{\%\Delta Q_i}{\%\Delta P_j} = \frac{P_j}{Q_i} \cdot \frac{\Delta Q_i}{\Delta P_j}$$

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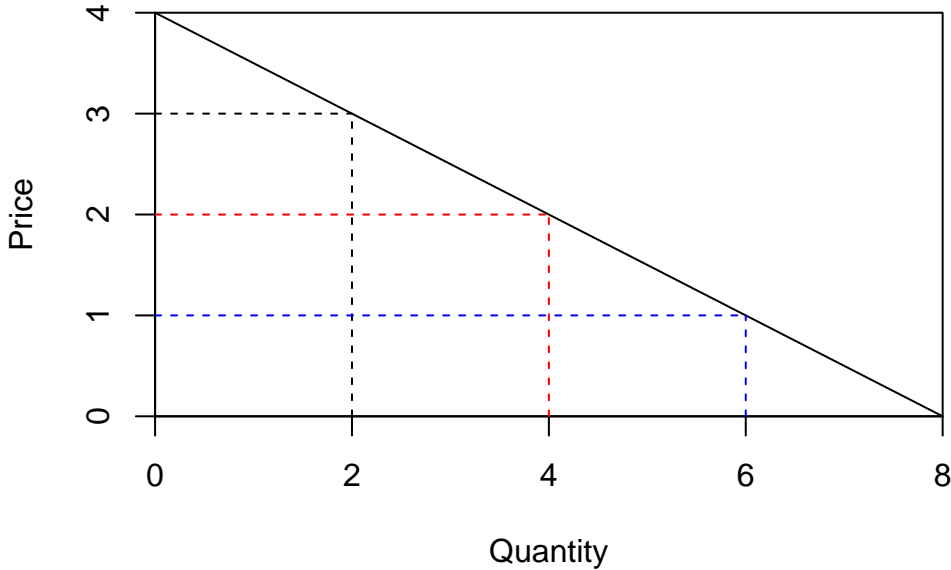# Elasticity in the Case of Linear Demand I

Linear demand function:

$$Q = 8 - 2P$$

In this case:

$$\text{constant} = \frac{\Delta Q_i}{\Delta P_i}$$

What is the elasticity at $p = 4$? $p = 3$? $p = 2$? $p = 1$? $p = 0$?

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Elasticity in the Case of Linear Demand II

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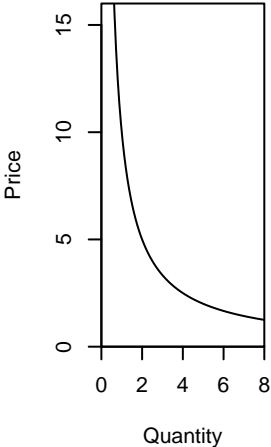Consumer and
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Interpretation

Elasticity:

- Demand is elastic if the percentage change in quantity is greater than the percentage change in price.
- Demand is inelastic if the percentage change in quantity is less than the percentage change in price.
- Demand is unitary elastic if the percentage change in quantity is equal to the percentage change in price.
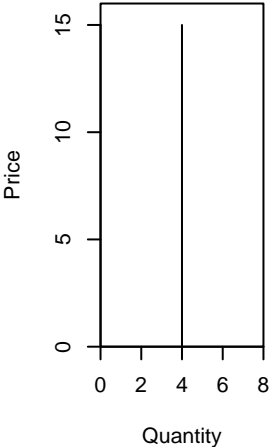
Complements or substitutes

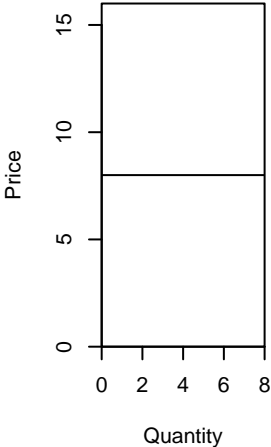$\epsilon_p < 0 \Rightarrow$ complements $\epsilon_p > 0 \Rightarrow$ substitutes

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Special Cases

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Connection between Revenue and Elasticities I

Demand function:

$$Q = 5 - 0.5 \cdot P$$
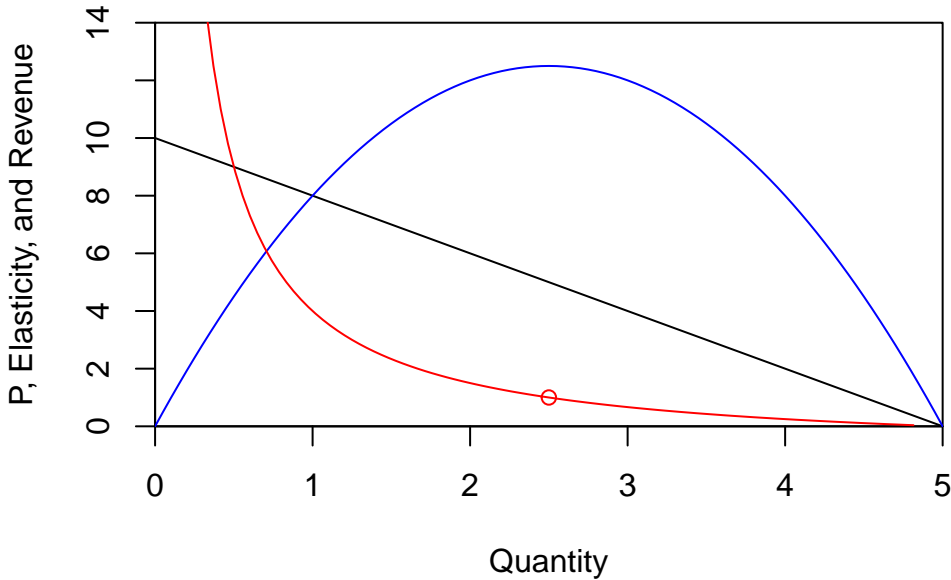
Revenue function:

$$R = Q \cdot (10 - 2 \cdot Q)$$

Elasticity:

$$\epsilon^D = \frac{0.5 \cdot (10 - 2 \cdot Q)}{Q}$$

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Connection between Revenue and Elasticities II

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Policy Applications of Elasticities

Public transportation and U.S. Postal Service

- Small marginal cost, i.e., costs are not very sensitive to the number of riders.
- Are current prices in the elastic or inelastic section of the demand?

Private and public investment decision

- How does the demand evolve in the future given a new investment?

Cross-price elasticity:

- Negative $\Rightarrow$ Complement
- Positive $\Rightarrow$ Substitute

Antitrust laws

- Office Depot and Staples, Alcoa (aluminum market), DuPont (cellophane), Continental Can acquiring a glass manufacturer

Consumer and Producer Surplus

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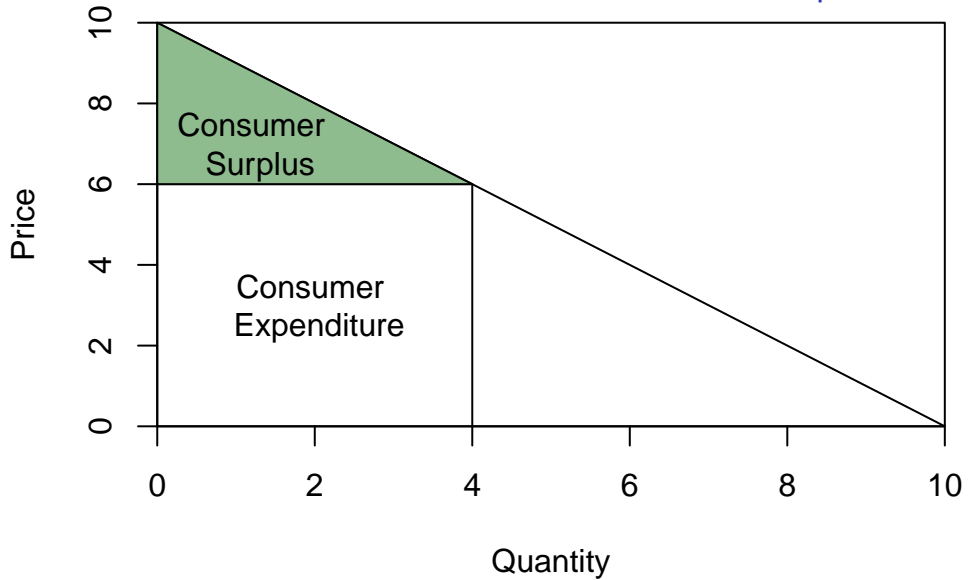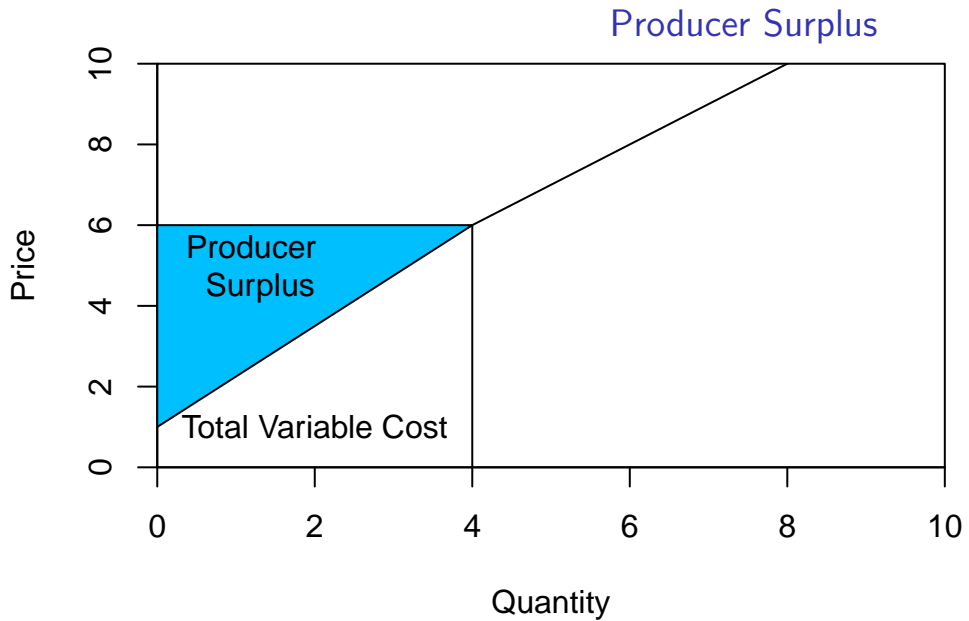Consider a demand and supply functions of the following form:

$$Q^D = 10 - P$$

$$Q^S = P - 2$$

Market equilibrium: $P = 6$ and $Q = 4$

- Some consumers are willing to pay more than $4 since the choke price is at $10.
- Some producers would supply the good even if the price was below $4.
- Those consumers and producers realize a surplus when the market price is $4.

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Social Welfare