Equilibrium

- Introduce supply
- Equilibrium
- The effect of taxes
- Who really “pays” a tax?
- The deadweight loss of a tax
- Pareto efficiency
Supply

Assume firms, as consumers, take the market price for the good they are selling as given and outside of their control: the market is competitive.

A firm’s supply function measures the quantity of a good that the firm supplies at a given price:

\[ q = S(p) \]
In general, a firm’s supply increases with the good’s price:

\[ \frac{\partial S}{\partial p} > 0 \]

An inverse supply function tells us what the price would have to be to get the producer to supply \( q \) units of the good:

\[ p = P_s(q) \]
Net Producer’s Surplus

$p^*$

$p$

$q^*$

$q$

$Ps(q)$

$NPS$
Changes in Net Producer’s Surplus

\[ P_s(q) \]

Diagram showing changes in price and quantity.
Market Supply Curve

\[
P_S(q)
\]
Equilibrium

Consider the market for a good where
market demand is \( D(p) \) and
market supply is \( S(p) \)

Equilibrium price is a price \( p^* \) such that:

\[
D(p^*) = S(p^*)
\]
Equilibrium: \( D(p^*) = S(p^*) \)
Special Cases

Perfectly inelastic supply

\[ p \quad P_s(q) \quad q^* \]

Perfectly elastic supply

\[ p \quad P_D(q) \quad q^* \]
Solving for Equilibrium: A Linear Example

Suppose that demand and supply functions are linear:

\[ S(p) = c + dp \]
\[ D(p) = a - bp \]

for some:

\[ c > 0, d > 0 \]
\[ a > 0, b > 0 \]
Solving for Equilibrium: A Linear Example

Equilibrium: \[ D(p^*) = S(p^*) \]

Solve this equation for \( p^* : a - bp = c + dp \)

Solution: \[ p^* = \frac{a - c}{d + b} \]

\[ D(p^*) = a - bp^* = \frac{ad + bc}{b + d} = S(p^*) \]
Comparative Statics

Demand Shift

Supply Shift

$P_{S}(q)$

$q^{*}$

$q^{**}$

$p^{*}$

$p^{**}$

$p$

$q$

$P_{D}(q)$

$q^{*}$

$q^{**}$

$p^{*}$

$p^{**}$

$p$

$q$
Let’s consider the gasoline market one more time.

As of today the US government imposes a 15 cents tax per gallon of gasoline.

Thus, there will be two prices on the market:

- $p_s$: price that the supplier gets.
- $p_d = p_s + $0.15$: price that consumer pays.
Equilibrium with Taxes

Quantity demanded depends on $P_D$:

$$D(p_D)$$

Quantity supplied depends on $P_S$:

$$S(p_S)$$
Equilibrium with Taxes

Two equations:

\[ D(p_D) = S(p_S) \]

\[ p_D = p_S + $0.15 \]

in two unknowns: \( p_D^*, p_S^* \)

Combining them:

\[ D(p_S^* + 0.15) = S(p_S^*) \]
Equilibrium with Taxes:

\[ D(p_s^* + 0.15) = S(p_s^*) \]
Inverse Demand and Supply

- Inverse demand function:
  \[ p_D = P_D(q) \]

- Inverse supply function:
  \[ p_S = P_S(q) \]

- Equilibrium:
  \[ P_S(q^*) = P_D(q^*) - 0.15 \]
Equilibrium with Taxes:

\[ P_s(q^*) = P_d(q^*) - 0.15 \]
Equilibrium with Taxes:
\[ P_D(q^*) = P_S(q^*) + \$0.15 \]

[Diagram showing supply and demand curves with tax adjustment]
Passing Along a Tax: Consumers Pay the Tax: $P_s(q^*) + 0.15 = P_D(q^*)$
Passing Along a Tax: Producers Pay the Tax: $P_s(q^*) = P_d(q^*) - 0.15$

\[ P_s(q^*) = P_d(q^*) - 0.15 \]
Passing Along a Tax: Consumers Pay Almost All the Tax

\[ P_s(q) + 0.15 \]

Graph showing supply and demand curves with a tax imposed on suppliers.
Passing Along a Tax: Producers Pay Almost All the Tax

\[ P_D(q) \]

\[ P_S(q) \]

\[ p_D^* \]

\[ p_S^* \]

\[ p_D \]

\[ p_S \]

\[ q^* \]

\[ q \]

\[ P_D(q) - \$0.15 \]
Deadweight Loss of a Tax: B+D

$p$

$q$

$P_s(q)$

$P_D(q)$

$p^*_D$

$p^*_S$

$q^*$

$q'$

$A$

$B$

$C$

$D$
Pareto Efficiency

- An economic situation is **Pareto efficient** when there is no way to make any person better off without hurting anybody else.

- Pareto efficiency and **income distribution**.

- **Is a competitive market Pareto efficient?**
Competitive Market and Pareto Efficiency

\[ P_D(q) \]

\[ P_S(q) \]

\[ p^* \]

\[ q^* \]

\[ q'' \]

\[ q \]
Equilibrium:

\[ D(p_D) = S(p_S) \]

\[ p_D = (1 + t) p_S \]

Inverse demand and supply:

\[ (1 + t) P_S(q^*) = P_D(q^*) \]