# 1 Equilibrium with Taxes

$Q_d(p) = 200 - 40p, Q_s(p) = 10p$

A price where quantity demanded is equal to quantity supplied.

$$200 - 40p = 10p$$

Equilibrium price and quanity:

$$p^* = 4, Q^* = 40$$

Inverse Demand

$$p = 5 - \frac{1}{40}Q$$

Inverse Supply

$$p = \frac{1}{10}Q$$

*A market in equilibrium with no taxes or other distortions will produce the most surplus possible.*

## 1.1 Adding a Tax

Suppose we implement a quantity tax of size $t$ on a market.

When a tax of t.

Consumers pay $p + t$.

Firm gets $p$.

$Q_d(p + t) > Q_s(p)$ not an equilibrium. $p$ will tend to rise.

$Q_d(p + t) < Q_s(p)$ not an equilibrium. $p$ will tend to fall.

$Q_d(p + t) = Q_s(p)$ this is our new equilibrium condition.

## 1.2 Back to Example

$Q_d(p) = 200 - 40p, Q_s(p) = 10p$

Impose a quantity tax of $t = \frac{5}{2}$

$$Q_d\left(p + \frac{5}{2}\right) = Q_s(p)$$

$$200 - 40\left(p + \frac{5}{2}\right) = 10p$$

$$200 - 40p - 40\frac{5}{2} = 10p$$

$$200 - 40p - 100 = 10p$$

$$100 = 50p$$

$$p^* = 2$$

The price that firms receive per unit in equibrlium with the tax $t = \frac{5}{2}$ is $p^* = 2$

The price that consumes pay $p^* + t = 2 + \frac{5}{2} = 4.5$

*When a tax is imposed, relative to the old equilibrium price, consumers will pay more and suppliers will receive less.*

What is the new equilibrium quanity?

$$200 - 40\left(p + \frac{5}{2}\right) = 10p$$

$$200 - 40\,(4.5) = 10\,(2)$$

$$200 - 180 = 20$$

$$20 = 20$$

$$Q^* = 20$$

When a tax is imposed, the equilibrium quantity will decrease.

## 1.3 Graphically

Note that the price consumers pay is $p + t$ and the price tht producers get is $p$. The difference is $t$.

I did a bunch of stuff on the board (see course notes).

## 1.4 Example

$Q_d(p) = 300 - 2p$

$Q_s(p) = p$

a) What is the equilibrium price and quantity?

$$300 - 2p = p$$

$$300 = 3p$$

$$p^* = 100$$

$$Q_d(100) = 300 - 2 * 100 = 100$$

$$Q_s(100) = 100$$

$$Q^* = 100$$

Find the inverse demand and supply.

$$Q = 300 - 2p$$

$$2p = 300 - Q$$

$$p == 150 - \frac{1}{2}Q$$

Inverse Supply

$$Q = p$$

$$p = Q$$

b) What are the consumer and producer surplus in equibrlium?

$$CS = \frac{1}{2} * 100 * 50 = 2500$$

$$PS = \frac{1}{2} * 100 * 100 = 5000$$

$$TS = 7500$$

c) What is the equilium price and quanity with a tax $t = 75$

$$Q_d\left(p + 75\right) = Q_s\left(p\right)$$

$$300 - 2\left(p + 75\right) = p$$

$$300 - 2p - 2 * 75 = p$$

$$300 - 2p - 150 = p$$

$$150 - 2p = p$$

$$150 = 3p$$

$$50 = p^*$$

$$Q_d\left(50 + 75\right) = 300 - 2\left(50 + 75\right) = 300 - 2\left(125\right) = 300 - 250 = 50$$

$$Q_s\left(50\right) = 50$$

d) What is the consumer, prducer surplus, the government revenue, and the deadweight loss under this tax.

$$CS = \frac{1}{2} * 25 * 50 = 625$$

$$PS = \frac{1}{2} * 50 * 50 = 1250$$

$$G = 50 * 75 = 3750$$

$$TS = 625 + 1250 + 3750 = 5625$$

Without a tax, the total surplus was $TS = 7500$

$$DWL = 7500 - 5625 = 1875$$

e) How much more do consumers pay after the tax is imposed?

$$125 - 100 = 25$$

f) How much less do firms get per unit after the tax is imposed:

$$100 - 50 = 50$$

### 1.4.1 Incidence of a Tax

In the previous problem, consumers pay 25 of the 75 tax.

Producers pay 50 of the 75 tax.

**The incidence of the tax**.

The more elastic demand is relative to supply, the less of the burden will be on consumers.

The more elasticy supply is reltive to demand, the less of the burder will be on producers.

When demand is inelastic and supply is elastic (smoking). Most of the burder of the tax will be on consumers.

When demand is elastic and supply is inelastic (concert tickets). Most of the burder of the tax will be on producers.