Additional Note about Demand

Can reverse process to get WTP_M:

Demand: $Q_M^D = 30 - \frac{3}{2}P$
Decision rule for last Q: $WTP_M = P$

Substituting and rearranging:

$$Q_M^D = 30 - \frac{3}{2}P$$

$$Q_M^D = 30 - \frac{3}{2}WTP_M$$

$$\frac{Q_M^D - 30}{-\frac{3}{2}} = WTP_M$$

$$-\frac{2}{3}\, Q_M^D + \frac{2}{3}30 = WTP_M$$

$$WTP_M = 20 - \frac{2}{3}Q_M^D$$

Gives the WTP that goes with any particular unit:

Example: WTP for unit 15?

$$WTP_M = 20 - \frac{2}{3} * 15 = \$10$$

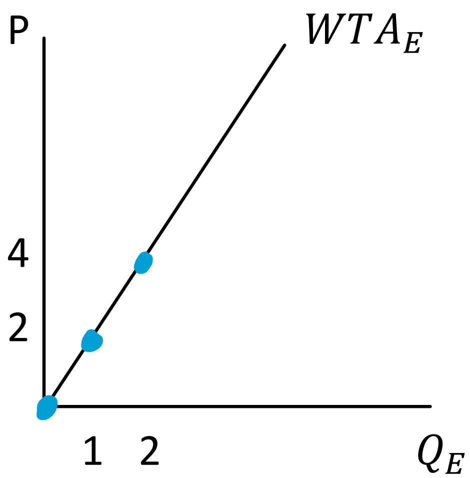
Adding Supply

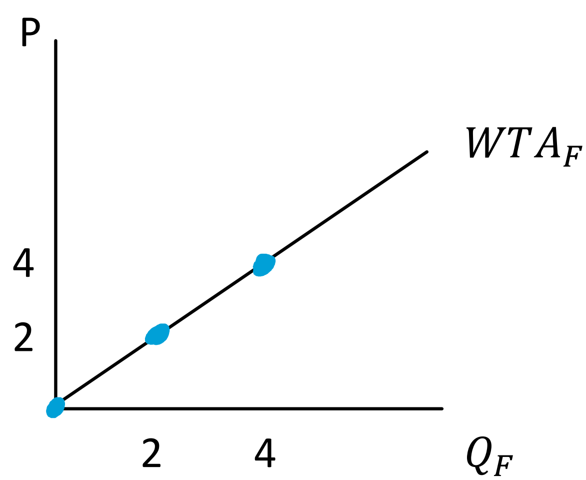
Two sellers:

E $WTA_E = 2Q_E^S$

F $WTA_F = Q_F^S$

Graphing:





For each P, how much will seller E offer, Q_E^S?

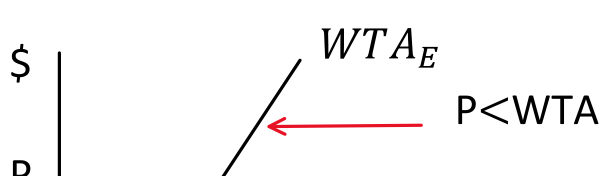
Decision rules:

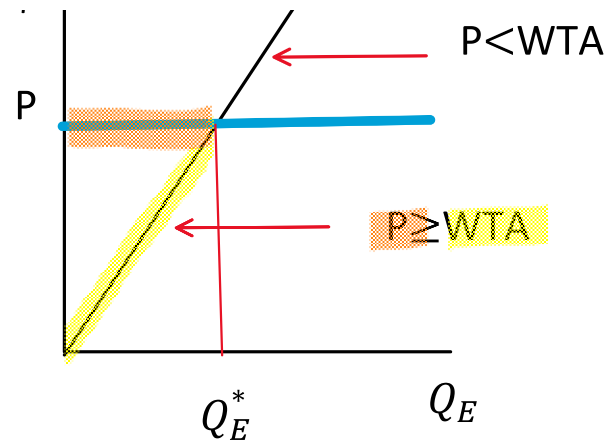
Sell if $P \geq WTA_E$

Don't sell if $P < WTA_E$

Result: Q_E^* is where WTA crosses P:

$WTA_E(Q_E^*) = P$





Use to derive E's supply equation $Q_E^S(P)$

WTA equation: $WTA_E = 2Q_E^S$
Decision rule: $WTA_E = P$

Eliminating WTA_E:

$$P = 2Q_E^S$$

$$Q_E^S = \frac{1}{2}P$$

Seller F's supply:

$$WTA_F = Q_F^S$$
$$WTA_F = P$$

Solving:

$$P = Q_F^S$$

$$Q_F^S = P$$

$$Q_F^S = P$$

Finding the market supply:

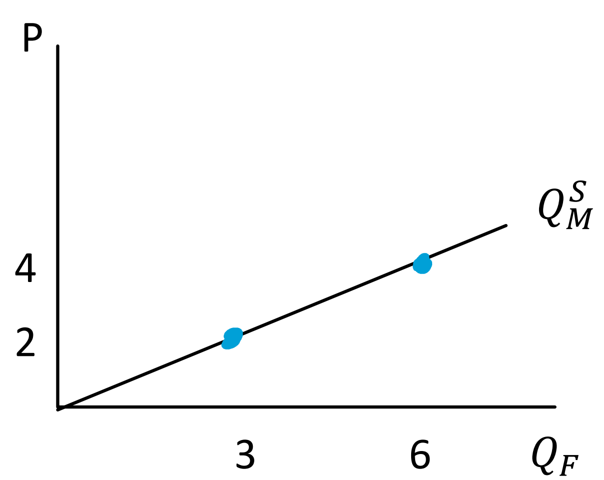
$$Q_M^S = \sum_i^N Q_i^S$$

$$Q_M^S = Q_E^S + Q_F^S$$

$$Q_M^S = \left(\frac{1}{2}P\right) + (P)$$

$$Q_M^S = \frac{3}{2}P$$

Graphing:



Reversing to find WTA_M:

$$Q_M^S = \frac{3}{2}P$$

$$WTA_M = P$$

$$Q_S^M = \frac{3}{2}WTA_M$$

$$WTA_M = \frac{2}{3}Q_M^S$$

Gives the WTA for any given Q:

Example: WTA for unit 15?

$$\text{WT}A_M = \frac{2}{3} * 15 = \$10$$

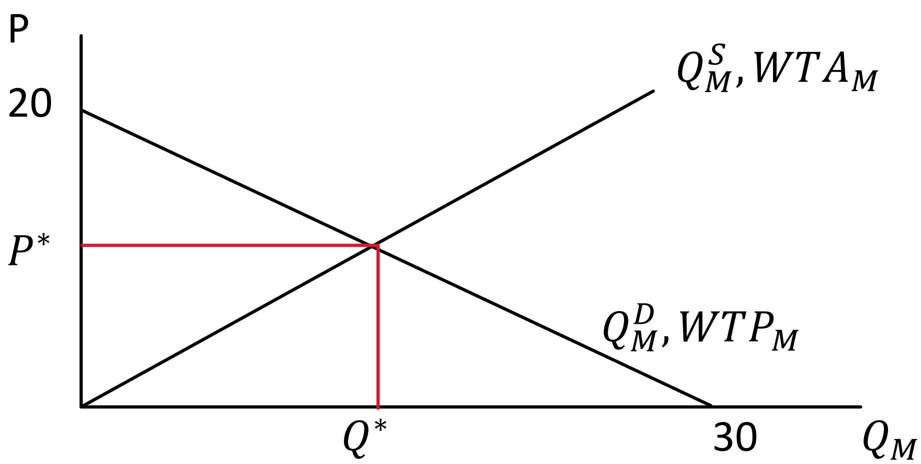
Finding the Equilibrium

Market demand and supply equations:

$$Q_M^D = 30 - \frac{3}{2}P$$

$$Q_M^S = \frac{3}{2}P$$

Graphing:



Finding P^* and Q^*:

Two possible approaches:

1. $Q_M^D(P^*) = Q_M^S(P^*)$ Demand equals supply
2. $WTP_M(Q^*) = WTA_M(Q^*)$ WTP equals WTA

Here, first is easiest since we have Q_M^D and Q_M^S.

Three equations and three unknowns:

$$Q_M^D = Q_M^S$$
$$Q_M^D = 30 - \frac{3}{2}P$$
$$Q_M^S = \frac{3}{2}P$$

Substituting and simplifying:

$$30 - \frac{3}{2}P = \frac{3}{2}P$$

$$30 = 3P$$

$P = 10$ (equilibrium price)

Finding Q:

$$Q_M^D = 30 - \frac{3}{2}P = 30 - \frac{3}{2} * 10 = 15$$

Checking:

$Q_M^S = \frac{3}{2} * P = \frac{3}{2} * 10 = 15$ (same as Q_M^D, passes check)

Equilibrium:

$$P^* = \$10, Q^* = 15$$

Impacts on Agents

Determine Q's using individual demands and supplies

Evaluate each at $P = P^* = 10$

Buyers:

A	$Q_A^D = 10 - 0.5P$	$Q_A^D = 5$
B	$Q_B^D = 20 - P$	$Q_B^D = 10$
Total		15

Sellers:

E	$Q_E^S = 0.5P$	$Q_E^S = 5$
F	$Q_F^S = P$	$Q_F^S = 10$
Total		15

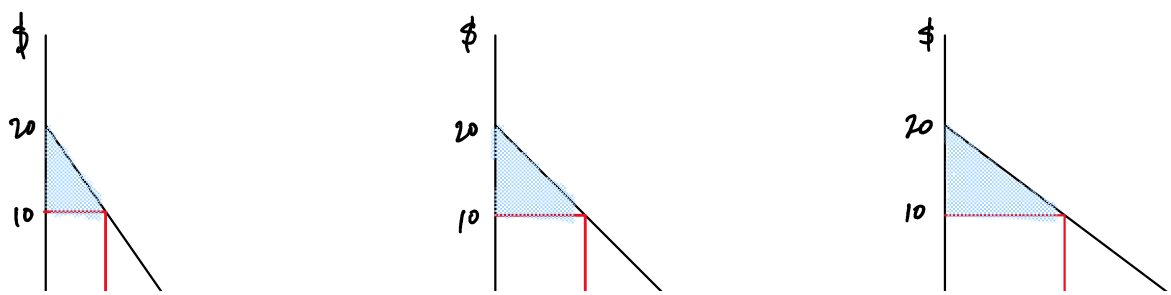
Note: it's a coincidence that $Q_A^D = Q_E^S$ and $Q_B^D = Q_F^S$

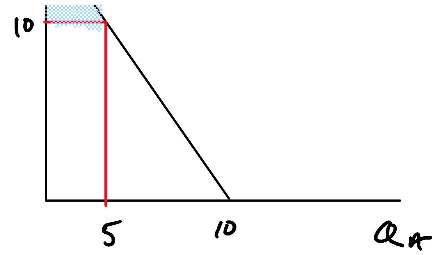
Now compute welfare impacts: CS and PS

With algebraic equations CS and PS are computed using areas:

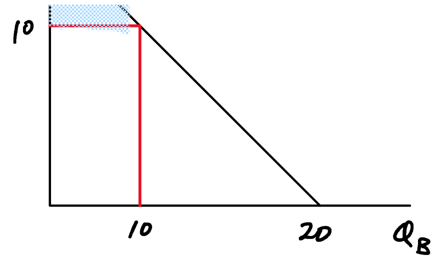
- CS is the area *below* WTP and *above* P (adds up WTP - P)
- PS is the area *below* P and *above* WTA (adds up P - WTA)

Implementing here:

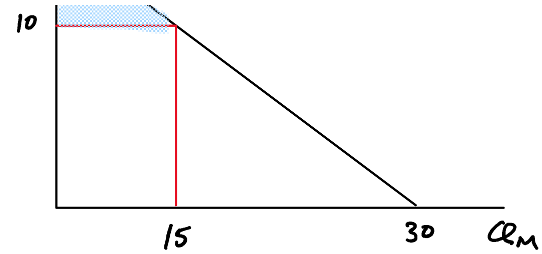




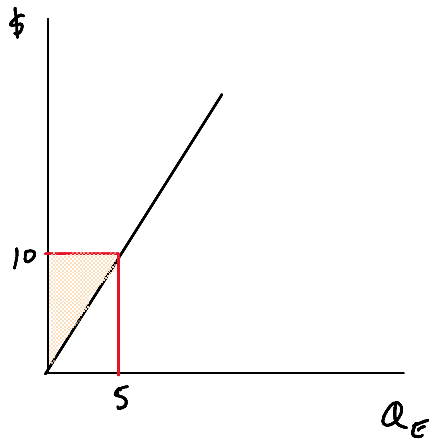
$$CS_A = \frac{1}{2}(5)(20-10)$$
$$CS_A = \$25$$



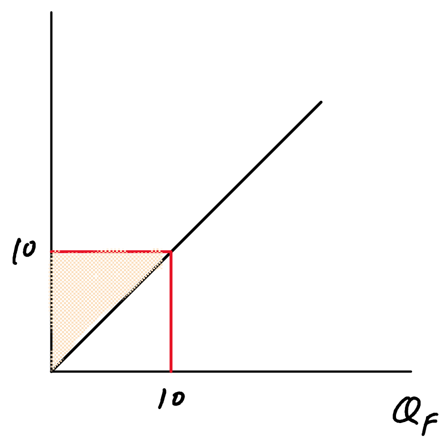
$$CS_B = \frac{1}{2}(10)(20-10)$$
$$CS_B = \$50$$



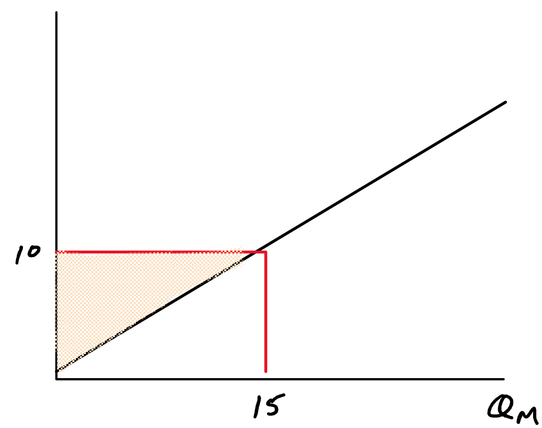
$$CS_M = \frac{1}{2}(15)(20-10)$$
$$CS_M = \$75$$



$$PS_E = \frac{1}{2}(5)(10-0)$$
$$PS_E = \$25$$



$$PS_F = \frac{1}{2}(10)(10-0)$$
$$PS_F = \$50$$



$$PS_M = \frac{1}{2}(15)(10-0)$$
$$PS_M = \$75$$

Total gain:

SS = CS + PS
SS = \$75 + \$75 = \$150