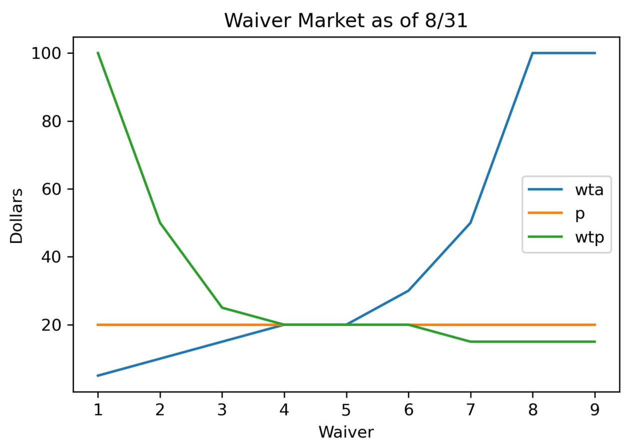
Waiver Market Results

Market diagram:



P^*=$20
Q^*=5

Detailed data:

Waiver	WTP	P	WTA	Trades?	CS	PS
1	100	20	5	yes	80	15
2	50	20	10	yes	30	10
3	25	20	15	yes	5	5
4	20	20	20	yes	0	0
5	20	20	20	yes	0	0
6	20	20	30	no	--	--
7	15	20	50	no	--	--
8	15	20	100	no	--	--
9	15	20	100	no	--	--

Computing the total CS and PS:

CS: 80+30+5+0+0 $115
PS: 15+10+5+0+0 $30

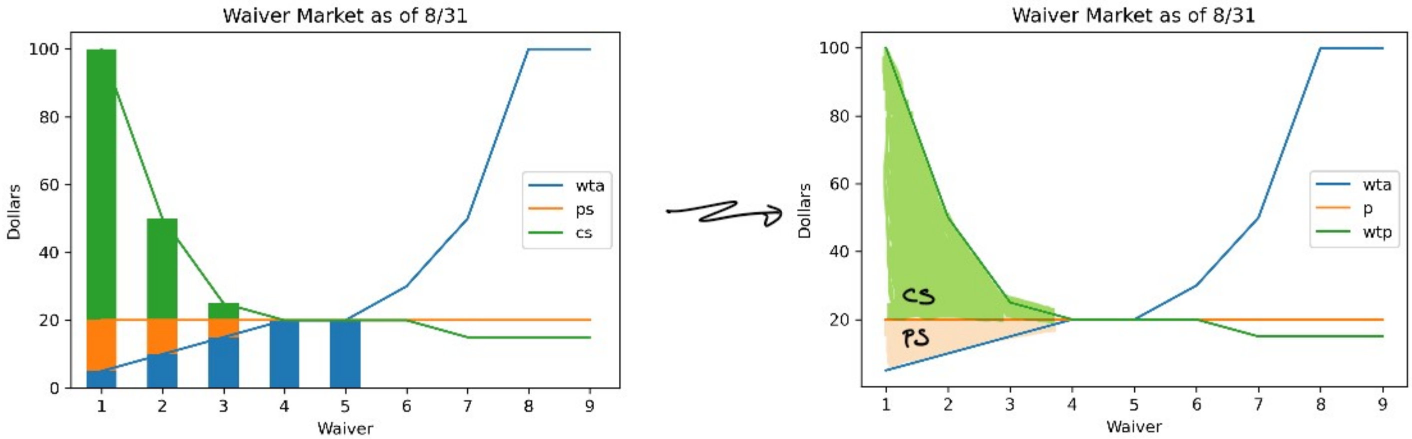
Social surplus, SS, is CS + PS:

SS = 115+30 = $145

SS is the overall *gain from trade*:

Net benefits produced by trading

Showing total CS and PS in the graph:



Exploring gains from trade a bit more:

Total value of waivers to owners?

Before trading:

Sum of WTAs = $350

After trading:

Sum of WTPs for buyers:	$215
Sum of WTAs for non-sellers:	$280
Total	**$495**

Net gain:

$495 - $350 = $145

Economic value is **not** P*Q:

P*Q = $20*9 $180

Value to owners after trades: $495

Why the big difference?

Finally, WTP vs WTA bids:

Mean of WTP bid 1's:	$9
Mean WTA:	$39

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

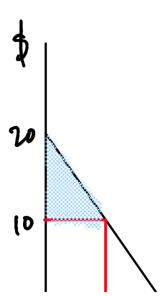
Note: it's a coincidence that $Q_A^D = Q_E^S$ and $Q_B^D = Q_F^S$

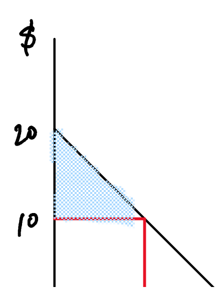
Now compute welfare impacts: CS and PS

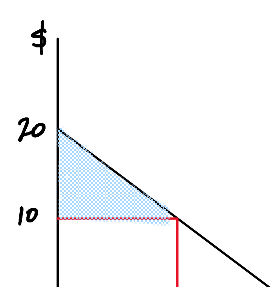
With algebraic equations CS and PS are computed using areas:

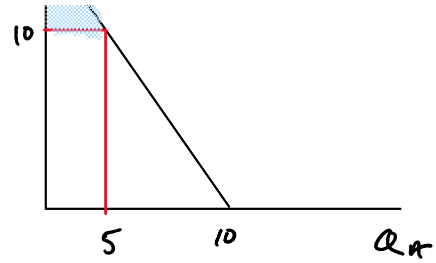
- CS is the area *below* WTP and *above* P (adds up WTP - P)
- PS is the area *below* P and *above* WTA (adds up P - WTA)

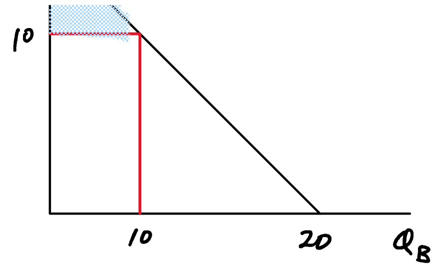
Implementing here:

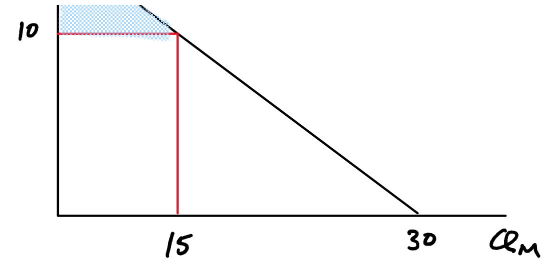








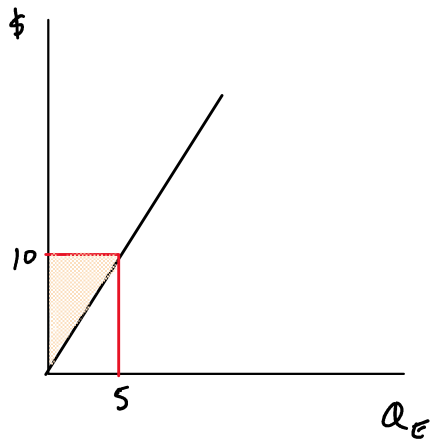


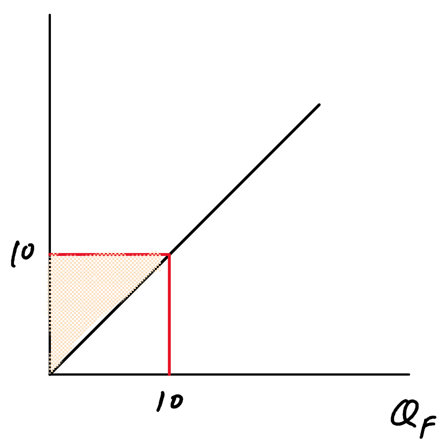


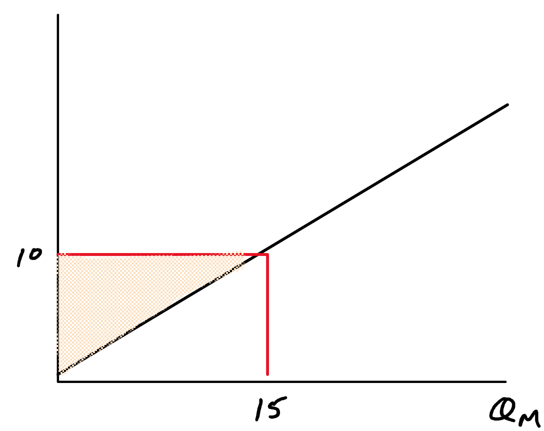
$$CS_A = \frac{1}{2}(5)(20-10)$$
$$CS_A = \$25$$

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

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







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

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

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

Total gain:

SS = CS + PS

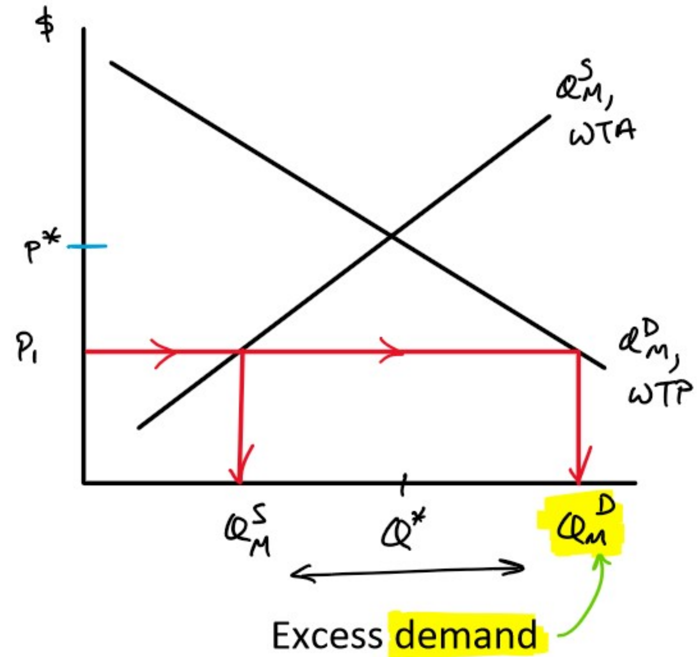
SS = \$75 + \$75 = \$150

Properties of the Market Equilibrium

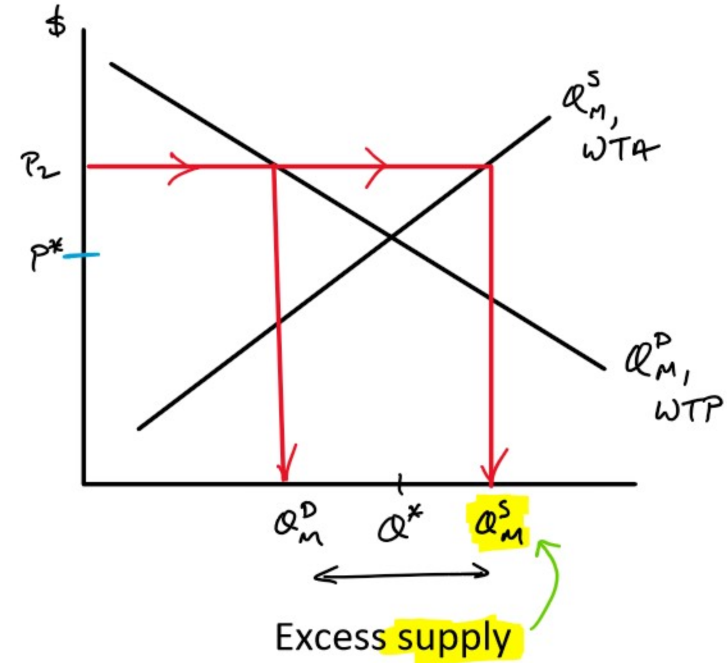
(1) At price P^* where $Q_M^D = Q_M^S$

At all other prices $Q_M^D \neq Q_M^S$

$P_1 < P^*$



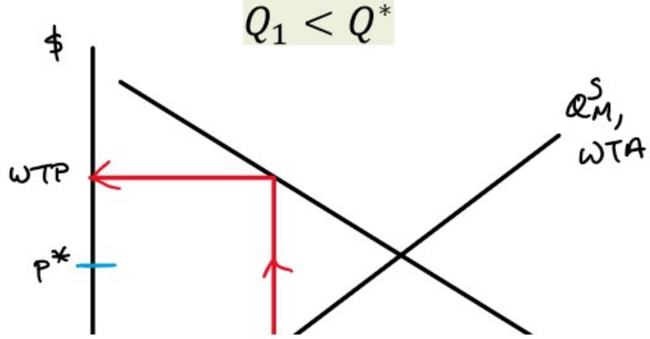
$P_2 > P^*$



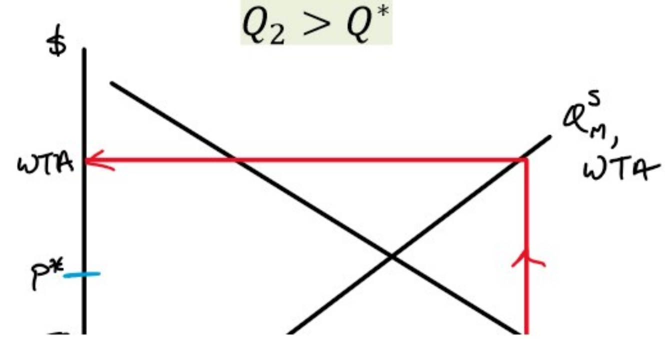
(2) At quantity Q^* where $WTP_M = WTA_M$

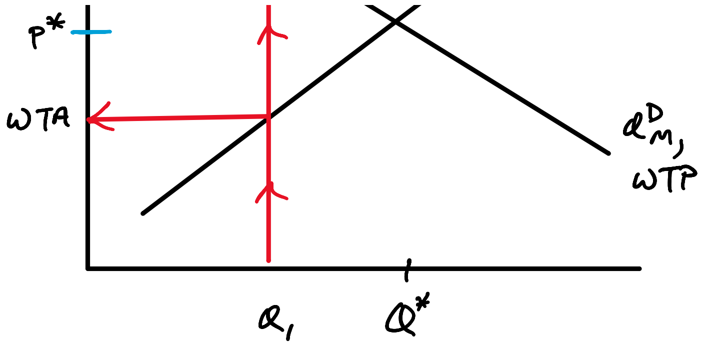
All other Q's have $WTP_M \neq WTA_M$

$Q_1 < Q^*$

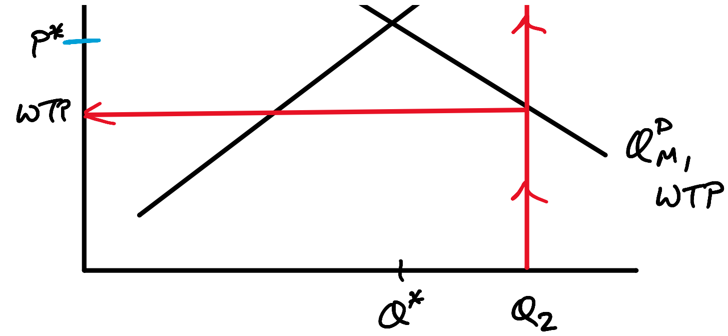


$Q_2 > Q^*$





$WTP > WTA$



$WTA > WTP$

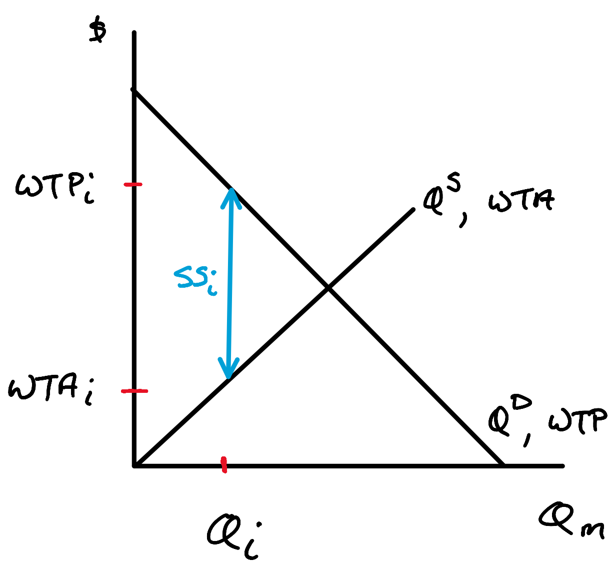
(3) Generates maximum possible gains from trade

Gain on trade of unit Q_i:

$$SS_i = CS_i + PS_i$$

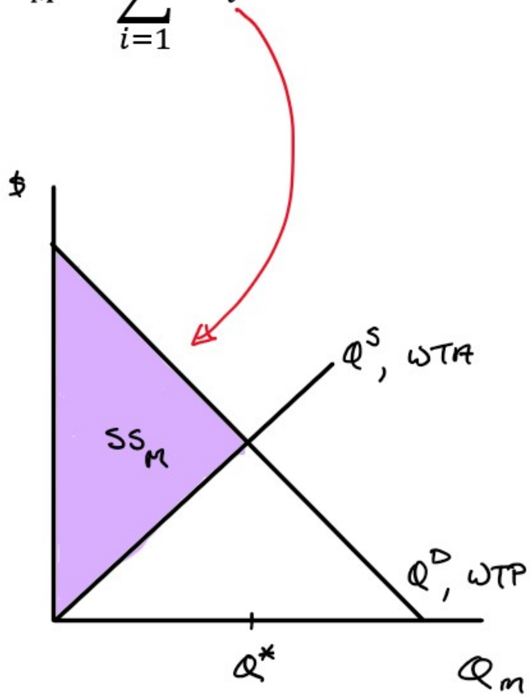
$$SS_i = (WTP_i - P) + (P - WTA_i)$$

$$SS_i = WTP_i - WTA_i$$

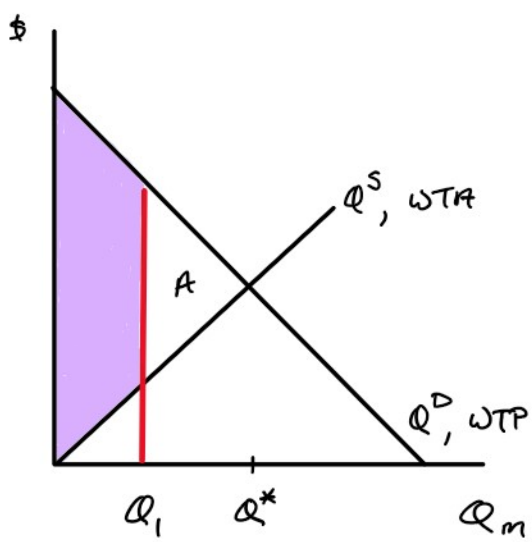


Total gain on Q* units:

$$SS_M = \sum_{i=1}^{Q^*} SS_i$$



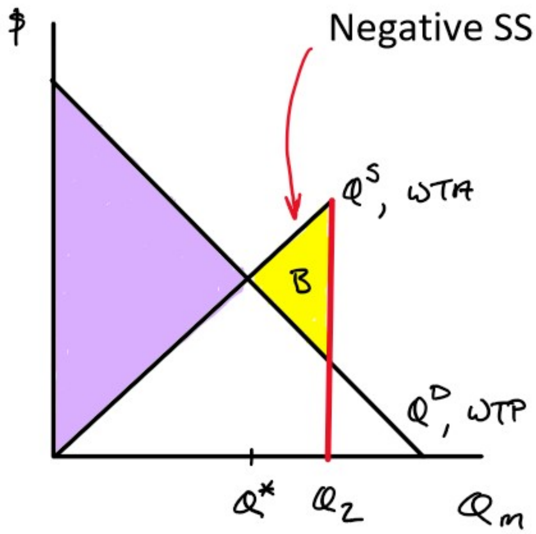
SS_M smaller if stop at $Q_1 < Q^*$



A = gains foregone by stopping at Q_1

Missed SS is called *deadweight loss* (DWL)

SS_M also smaller if $Q_2 > Q^*$



B = loss from going beyond Q^*

Also missed SS, so also DWL

Maximum possible gains at Q^*:

- *All* trades occur where $WTP > WTA$
- *No* trades occur where $WTP < WTA$
- No DWL

(4) Is Pareto efficient

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Pareto Efficiency

Definition: efficiency

An outcome is **Pareto efficient** when no one can be made better off without making someone else worse off.

Corollary: inefficiency

An outcome is **inefficient** when someone *can* be made better off *without* making anyone worse off.

Possible to rearrange the outcome to
help someone without hurting anyone.

"Money left on the ground"

Policy implication:

Want to *detect* and *fix* inefficient outcomes

Look for *Pareto improvements*:
Action that makes someone better off without hurting anyone

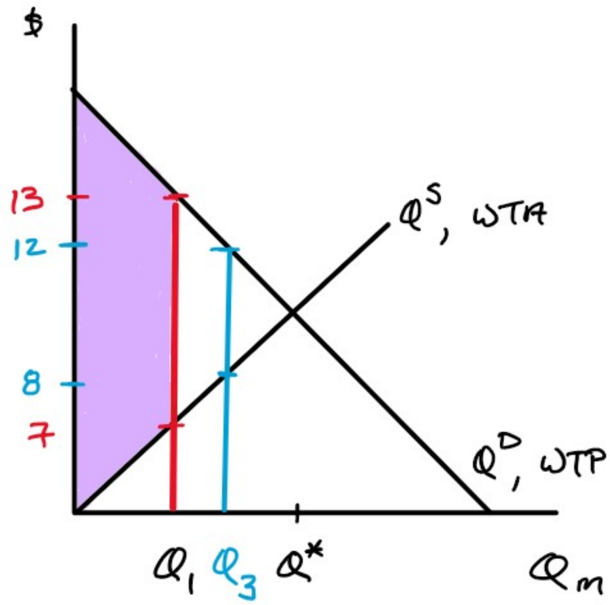
Market Q^* is efficient; other Qs are inefficient

Case 1:

If $Q_1 < Q^*$ a Pareto improvement is possible by increasing Q

Example:

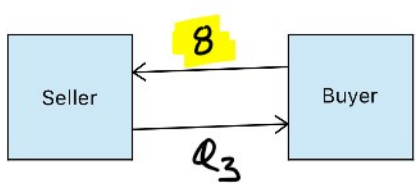
Suppose WTP and WTA have the values below



Potential SS:

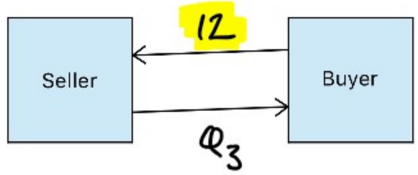
$12 - $8 = $4

Possible Pareto improvement 1:



P = $8	WTP = $12
WTA = $8	P = $8
PS = $0	CS = $4

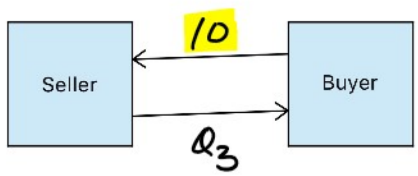
Possible Pareto improvement 2:



P = \$12
WTA = \$8
PS = \$4

WTP = \$12
P = \$12
CS = \$0

Possible Pareto improvement 3:



P = \$10
WTA = \$8
PS = \$2

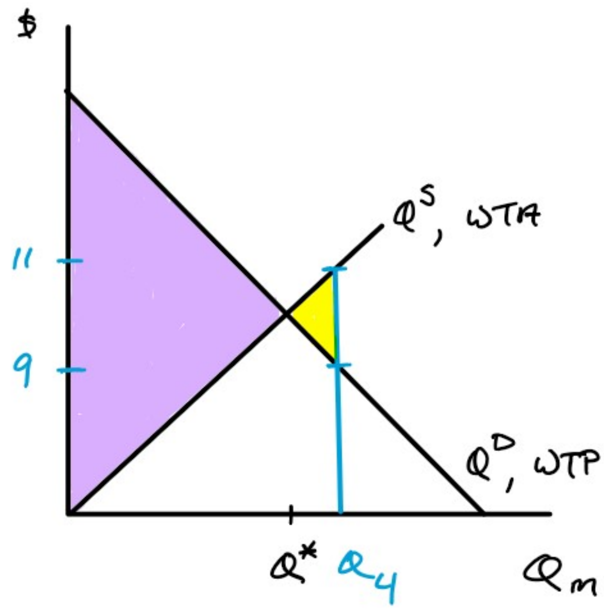
WTP = \$12
P = \$10
CS = \$2

Many possible improvements:

- All produce a gain of \$4
- Stopping at Q_1 is not efficient.

Case 2:

If $Q_2 > Q^*$ a Pareto improvement is possible by decreasing Q



Loss of SS:

$9 - $11 = -$2

Possible Pareto improvement:

1. Cancel Q_4
2. Seller gives buyer $9 instead

Seller gain: $11 - $9 = $2

Buyer gain: $9 - $9 = $0

Inefficiency and deadweight loss:

- If there is *DWL* the outcome is *inefficient*
- Could make someone better off

Analyzing Policies

Core approach:

Compute two market outcomes for two cases:
(1) Baseline or "business as usual" (BAU)
(2) Policy scenario with the policy change in place

Compare the results:
Changes in prices, quantities, CS, PS and more

Formally known as *comparative statics*

Example: imposing a new sales tax

Case	Description	Tax
1	BAU: no tax	$T = 0$
2	Policy: tax $T per unit	$T > 0$

Types of sales taxes:

Unit tax:	$ tax per unit	[this example]
Ad valorem tax:	% of price	[more common]

Adds a complication:

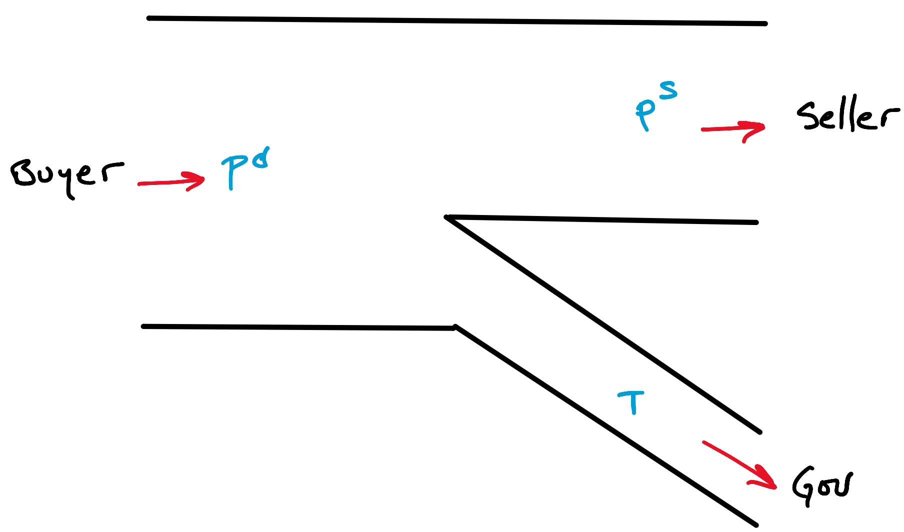
Tax causes buyer and seller prices to differ

Define two prices:

Price paid by buyer: P^d

Price seller keeps: P^s

Visualizing the flow of money through a transaction:



In algebra:

$$P^d = P^s + T$$

What goes into the transaction must equal what comes out.

Technically, an *accounting identity*

Changing the decision rules accordingly:

Buyers buy until Q^* where: $WTP(Q^*) = P^d$

Sellers sell until: $WTA(Q^*) = P^s$

Moves the equilibrium to an inefficient Q

Can see by substituting decision rules into accounting equation:

$$P^d = P^s + T$$

$$WTP(Q^*) = WTA(Q^*) + T$$

Implication:

- If $T > 0$, will end up at Q^* where $WTP(Q^*) > WTA(Q^*)$
- Q^* will be too small

Intuition behind inefficiency?

1. Rewrite equation:
   $$\text{WTP}(Q^*) - WTA(Q^*) = T$$

2. Also know difference is SS:
   $$\text{WTP}(Q^*) - WTA(Q^*) = SS(Q^*)$$

3. Thus, at new Q^*:
   $$\text{SS}(Q^*) = T$$

Last unit has $SS = T$:

Tax eliminates all trades with SS gains less than T