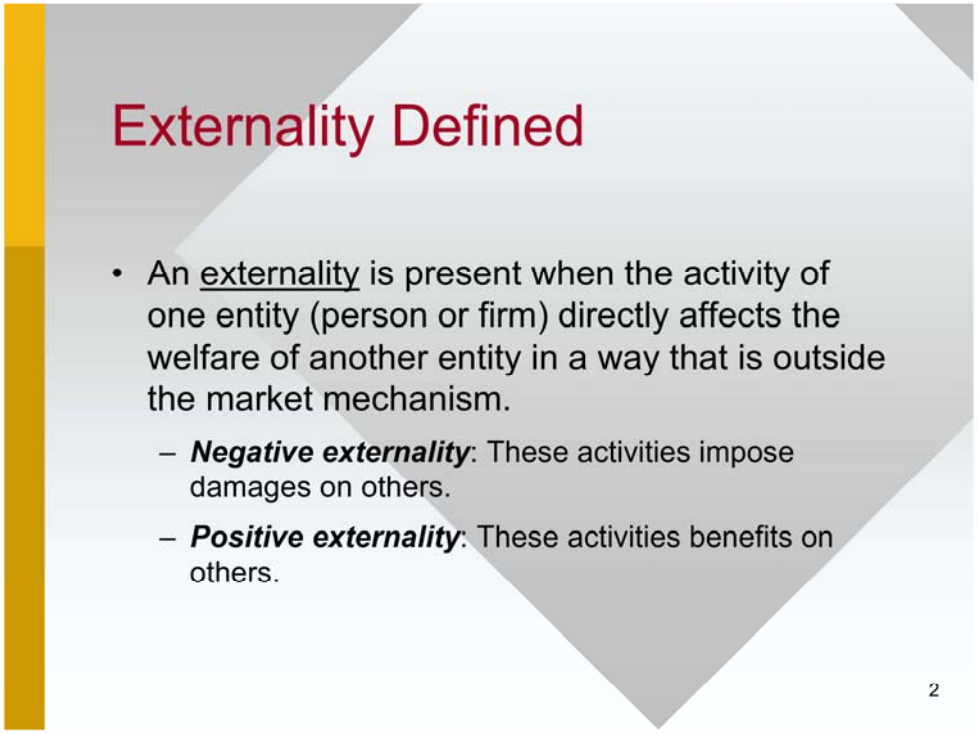
Externalities*

*We thank Harvey Rosen for the useful material.

YOU WILL SEE MORE IF YOU ENROLL EE 475 EE 476

WED 8 MAY (NORMAL CLASS)
FRI 10 MAY (NORMAL CLASS + A MAKEUP (4 PM – 6.30 PM)

FOR "GE"



4 SOURCES OF MKT FAILURE

1. MONOPOLY
2. PUBLIC GOOD
   - NON RIVAL IN CONSUMPTION
   - NON EXCLUDABLE
3. ASYMMETRIC INFORMATION
4. EXTERNALITIES

Examples of Externalities

- Negative Externalities
  - Pollution
  - Cell phones in a movie theater
  - Congestion on the internet
  - Drinking and driving
  - Student cheating that changes the grade curve
  - The “Club” anti-theft device for automobiles
- Positive Externalities
  - Research & development
  - Vaccinations
  - A neighbor’s nice landscape
  - Students asking good questions in class
  - The “LoJack” anti-theft device for automobiles
- *Not* Considered Externalities
  - Land prices rising in urban area
  - Known as “pecuniary” externalities

– Known as "pecuniary externalities

Nature of Externalities

- Arise because there is no market price attached to the activity
- Can be produced by people or firms
- Can be positive or negative
- Public goods are special case
  - Positive externality's full effects are felt by everyone in the economy

(via consumption activities
via production activities

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Graphical Analysis: Negative Externalities

- For simplicity, assume that a steel firm dumps pollution into a river that harms a fishery downstream.
- Competitive markets, firms maximize profits
  - Note that steel firm only cares about its own profits, not the fishery's profits.
  - Fishery only cares about its profits, not the steel firm's profits.

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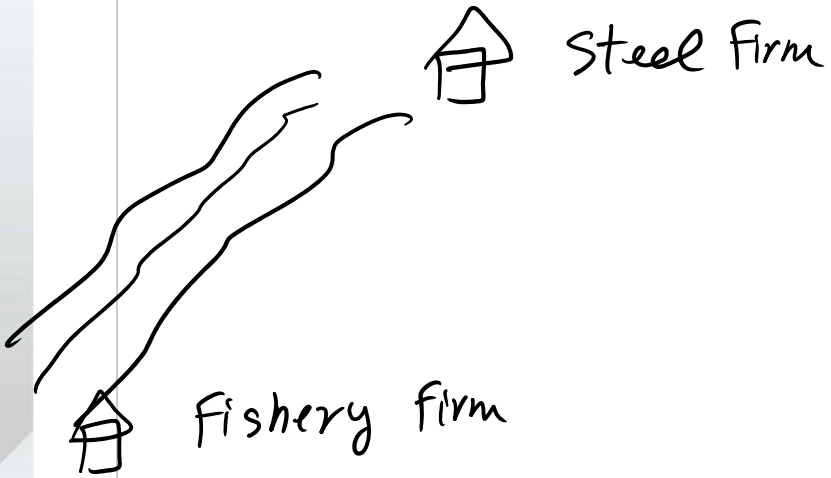

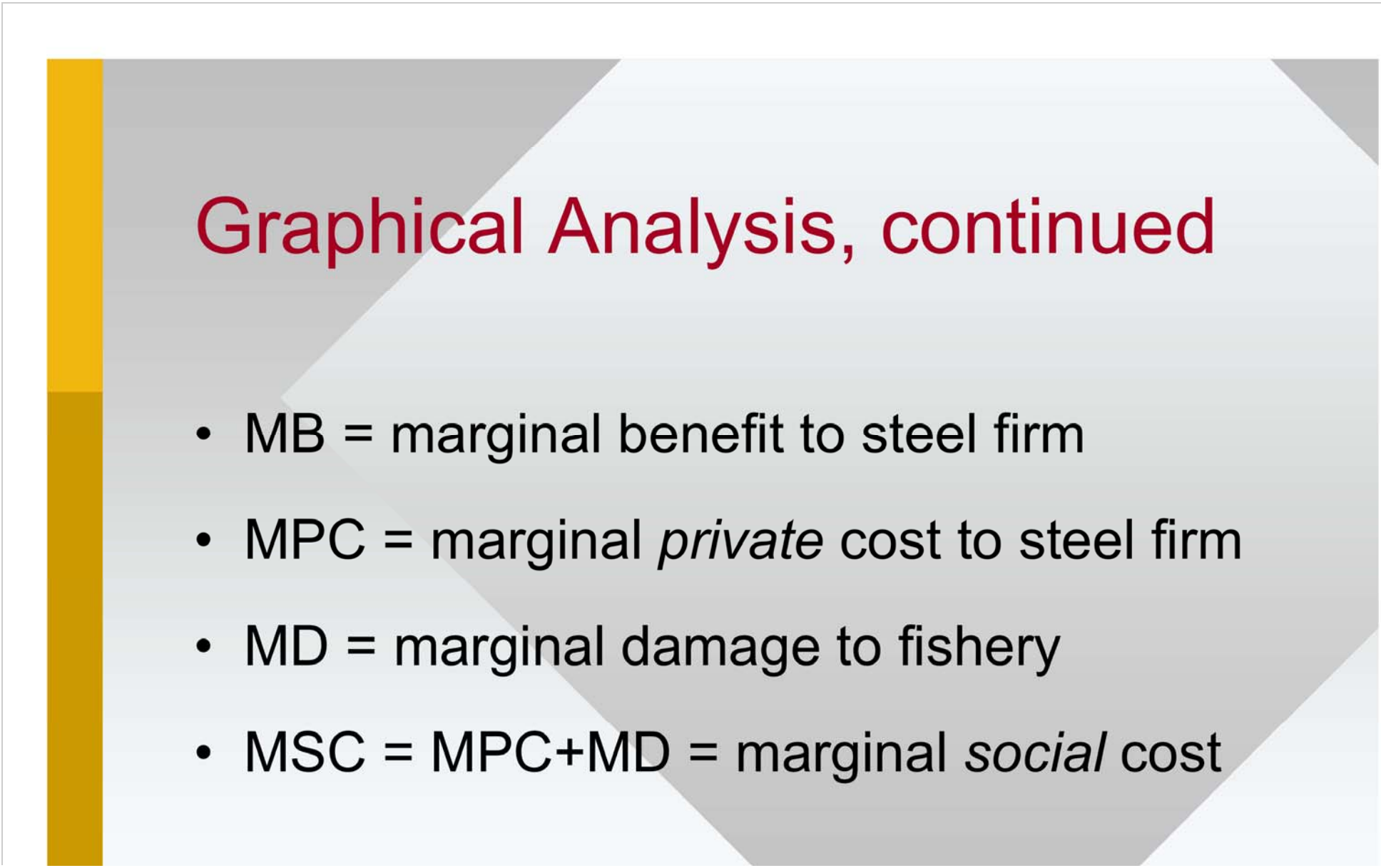
Graphical Analysis, continued
• MB = marginal benefit to steel firm
• MPC = marginal *private* cost to steel firm
• MD = marginal damage to fishery
• MSC = MPC+MD = marginal *social* cost


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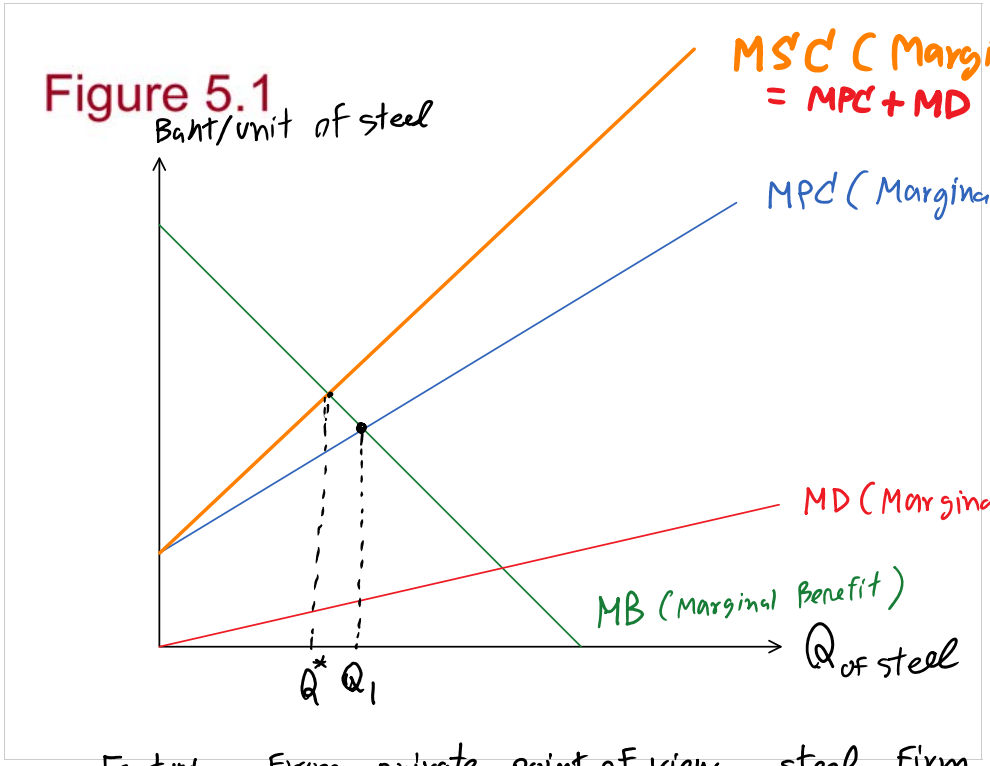

Fact#1 From private point of view, steel firm maximizes its profit by choosing Q where MB = MPC.
So he produces $Q = Q_1$.

Fact#2 From society view point, socially optimal amount of steel occurs where MB = MSC.
So $Q = Q^*$ ⇒ it implies that zero pollution is not the goal of society.

Fact#3 From Fishery's viewpoint, it would be nice if steel

Firm produces no steel ($Q = 0$)

Fact#4 Q^* is the best compromise between steel firm and fishery firm.

Fact #5 From society's viewpoint, steel firm produces too much as $Q_1 > Q^*$.

Graphical Analysis, continued

- From Figure 5.1, as usual, the steel firm maximizes profits at ***MB=MPC***. This quantity is denoted as Q_1 in the figure.
- Social welfare is maximized at ***MB=MSC***, which is denoted as Q^* in the figure.


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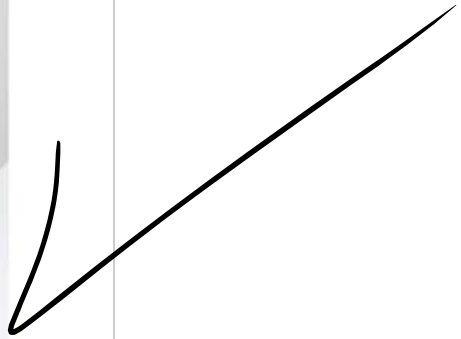
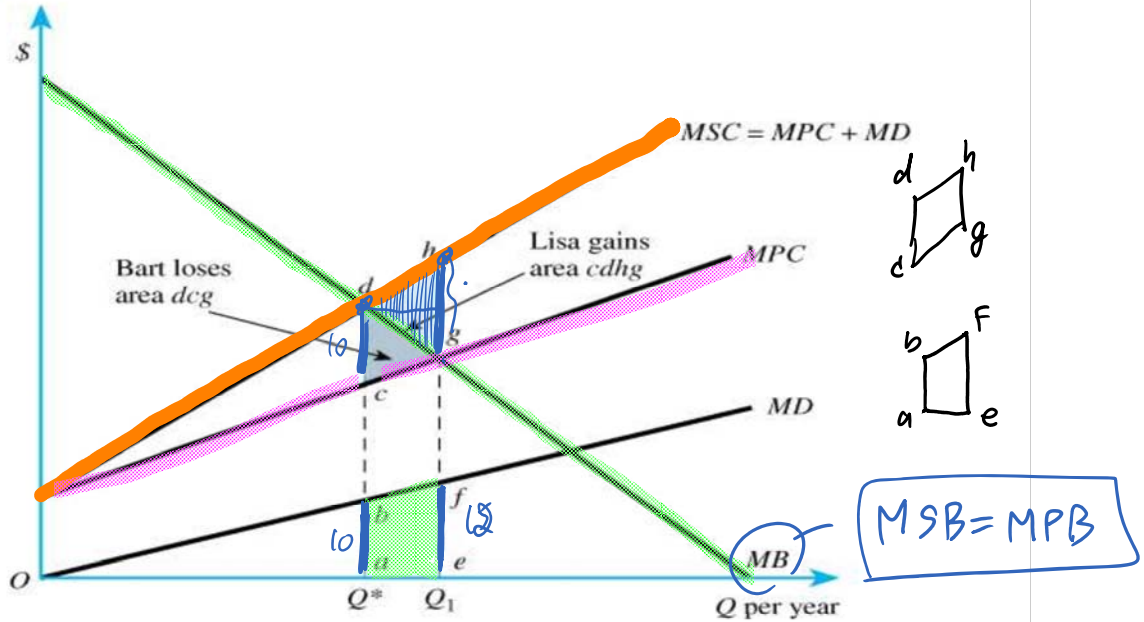
Graphical Analysis, Implications

- ***Result 1***: $Q_1 > Q^*$
  - Steel firm privately produces "*too much*" steel, because it does not account for the damages to the fishery.
- ***Result 2***: Fishery's preferred amount is 0.
  - Fishery's damages are minimized at MD=0.
- ***Result 3***: Q^* is not the preferred quantity for either party, but is the best compromise between fishery and steel firm.
- ***Result 4***: Socially efficient level entails some pollution.
  - Zero pollution is not socially desirable.



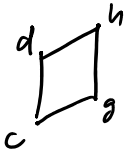
Bart ⇒ steel firm
Lisa ⇒ fishery firm

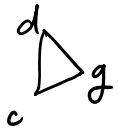
Figure 5.2



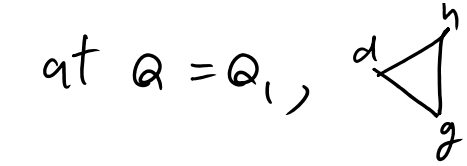
MSB = MPB

Fact#6 If Q moves from Q_1 to Q^*, Lisa's gain > Bart's loss





And then society would gain 

But if Bart still produces at $Q = Q_1$, 

would be called
"Deadweight loss"
(DWL)
due to overproduction
compared with socially
desirable level of steel.

Graphical Analysis, Intuition

- In Figure 5.2, loss to steel firm of moving to Q^* is shaded triangle ***dcg***.
  - This is the area between the MB and MPC curve going from Q_1 to Q^*.
- Fishery gains by an amount ***abfe***.
  - This is the area under the MD curve going from Q_1 to Q^*. By construction, this equals area ***cdhg***.
- Difference between fishery's gain and steel firm's loss is the efficiency loss from producing Q_1 instead

- Difference between fishery's gain and steel firm's loss is the efficiency loss from producing Q_1 instead of Q^*.

Numerical Example: Negative Externalities

- Assume the steel firm faces the following MB and MPC curves:

$$MB = 300 - Q$$

$$MPC = 20 + Q$$

- Assume the fishery faces the following MD curve:

$$MD = 40 + 2Q$$

$$MD = 40 + 2Q$$

Numerical Example, continued

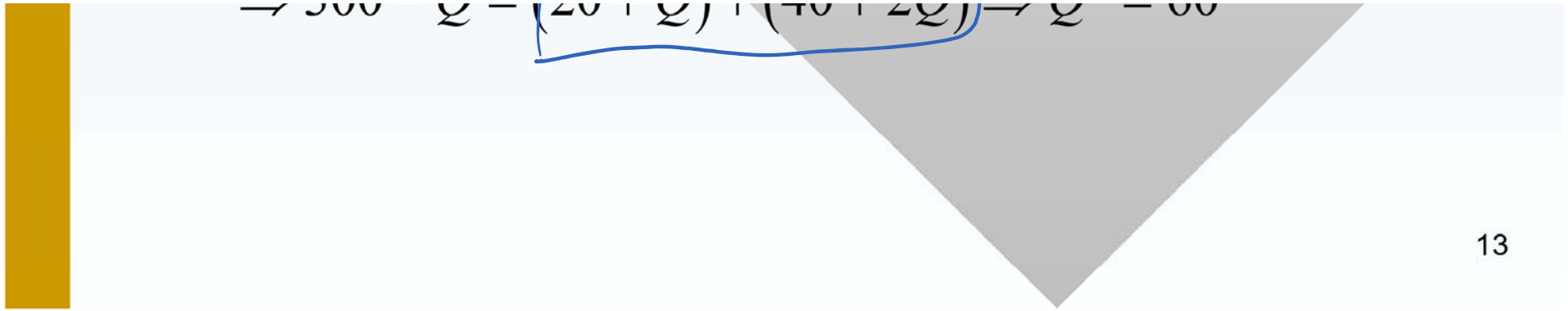
- The steel firm therefore chooses Q_1:

$$MB = MPC \Rightarrow 300 - Q = 20 + Q \Rightarrow Q_1 = 140$$

- The socially efficient amount is instead Q^*:

$$MB = MSC = MPC + MD$$

$$\Rightarrow 300 - Q = (20 + Q) + (40 + 2Q) \Rightarrow Q^* = 60$$



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Numerical Example, continued

- The deadweight loss of steel firm choosing Q_1=140 is calculated as the triangle between the MB and MSC curves from Q_1 to Q^*.

$$DWL = \frac{1}{2}\left(Q_1 - Q^*\right)\left(MSC\big|_{Q_1} - MB\big|_{Q_1}\right)$$

$$DWL = \frac{1}{2}(140 - 60)(480 - 160) = \$12800$$

- In Figure 5.2, this corresponds to area ***dhg***.

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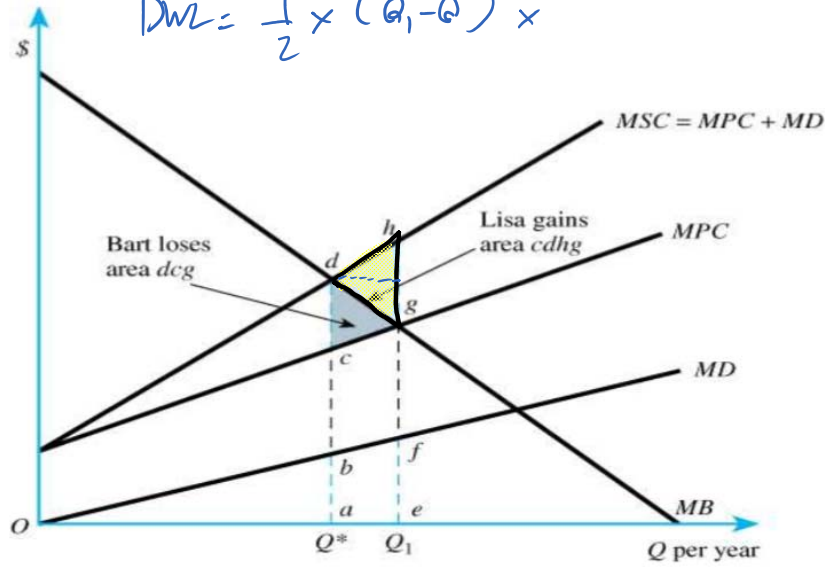
height base = hg

$DWL = \frac{1}{2} \times (Q_1 - Q^*) \times$



$hg = eh - eg$

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Numerical Example, continued

- By moving to Q^* the fishery reduces its damages by an amount equal to the trapezoid under the MD curve from Q_1 to Q^*.

$$GAIN = \frac{1}{2}\left(Q_1 - Q^*\right)\left(MD\big|_{Q^*} + MD\big|_{Q_1}\right)$$

$$GAIN = \frac{1}{2}(140 - 60)(160 + 320) = 19200$$

- By moving to Q^* the steel firm loses profits equal to the triangle between the MB and MPC curve from Q_1 to Q^*.

$$LOSS = \frac{1}{2}\left(Q_1 - Q^*\right)\left(MB\big|_{Q^*} - MC\big|_{Q^*}\right)$$

$$LOSS = \frac{1}{2}(140 - 60)(240 - 80) = \$6400$$

GAIN − LOSS = 12800 (dhg)

19200 6400

gain to the society

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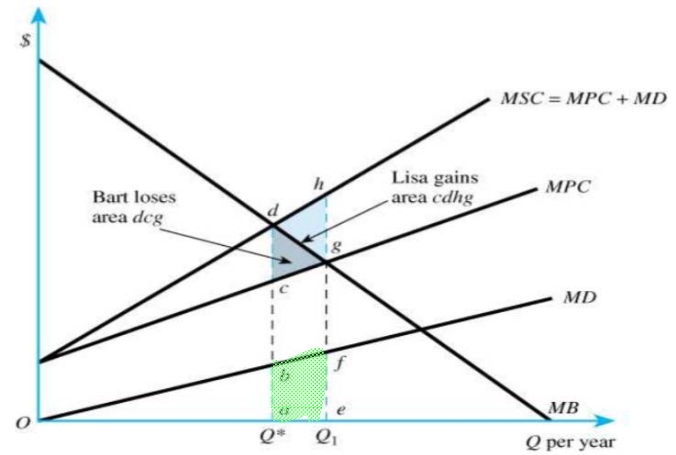


60 140

MD = 40 + 2Q

$MD_{at\ Q^*=60} = 40 + 2(60)$

$= 40 + 120$

$= 160$

gain to the society

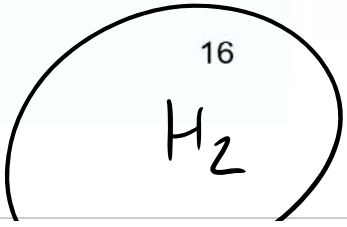
if Q ↓ from Q_1 to Q^*

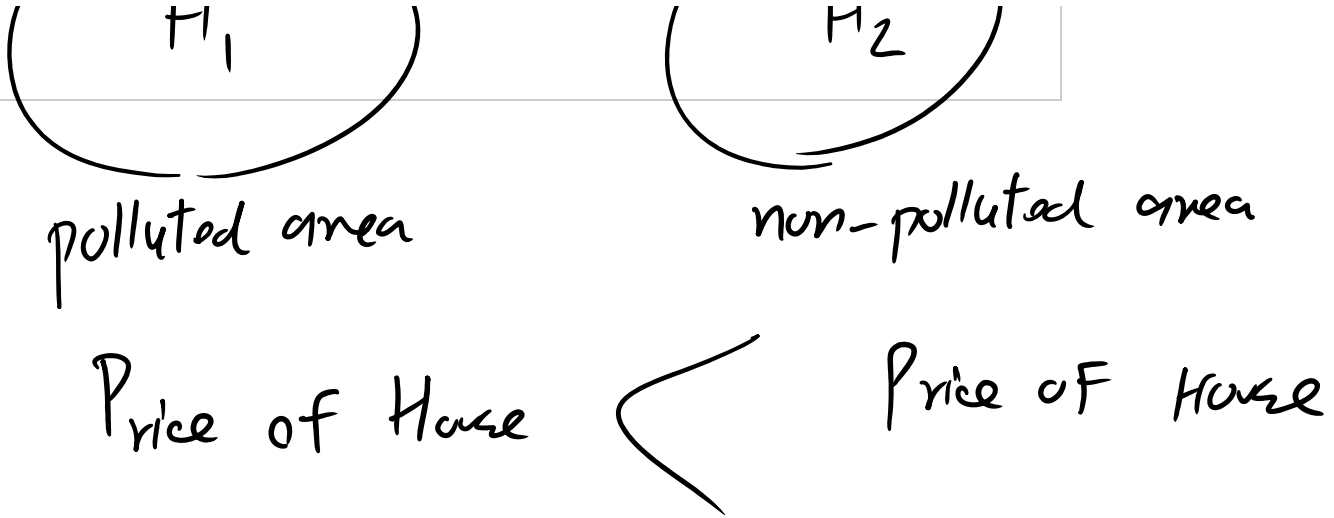
$MD_{at\ Q_1=140} = 40 + 2(140)$

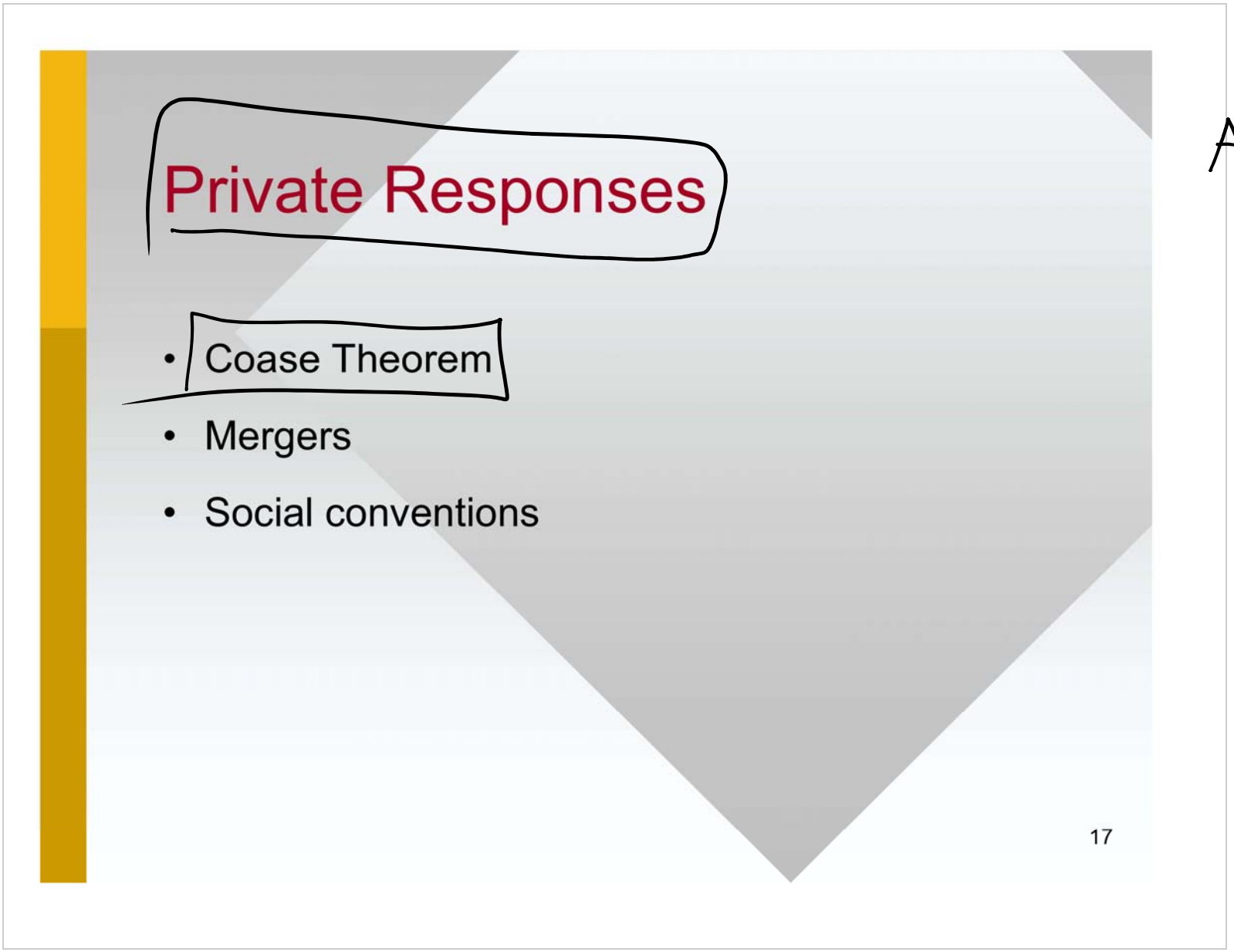
$= 320$

Calculating Gains & Losses Raises Practical Questions

- What activities produce pollutants?
  - With acid rain it is not known how much is associated with factory production versus natural activities like plant decay.
- Which pollutants do harm?
  - Pinpointing a pollutant's effect is difficult. Some studies show very limited damage from acid rain.
- What is the value of the damage done?
  - Difficult to value because pollution not bought/sold in market. Housing values may capitalize in pollution's effect.




H1
H2
polluted area
non-polluted area
Price of House
<
Price of House



A. C. Pigou
(
Pigouvian Tax

Coase Theorem

- Insight: root of the inefficiencies from externalities is the absence of property rights.
- The ***Coase Theorem*** states that once property rights are established and transaction costs are small, then one of the parties will bribe the other to attain the socially efficient quantity.
- The socially efficient quantity is attained *regardless* of to whom the property rights were

- The socially efficient quantity is attained *regardless* of to whom the property rights were initially assigned.

Illustration of the Coase Theorem

- Recall the steel firm/fishery example. If the steel firm were assigned property rights, it would ***initially produce*** Q_1, which maximizes its profits.
- If the fishery were assigned property rights, it would ***initially mandate zero production***, which minimizes its damages.


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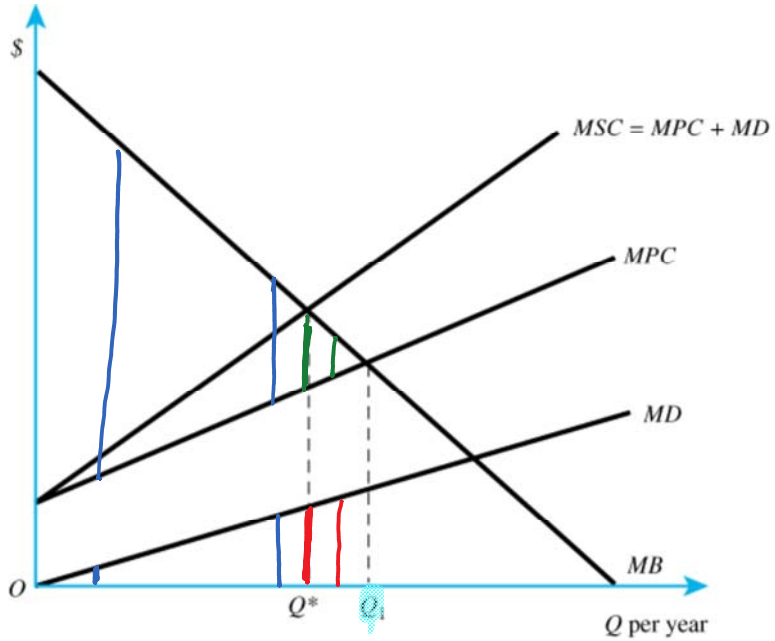
Figure 5.3



CASE 1 : Steel Firm owns river

① Q starts at Q = Q_1. (MB = MPC')

② As long as

MD > MB − MPC', bargain process continues

MD: amount of money that Lisa is willing bribe to Bart.

MB − MPC': amount of money that Bart "would be willing to accept" in order to reduce his Q.

③ Bargaining process stops at Q where MD = MB − MPC' which is at Q^* !!!

Coase Theorem: Assign Property Rights to Steel Firm

- Consider the effects of the steel firm reducing production in the direction of the socially efficient level, Q^*. This entails a cost to the steel firm and a benefit to the fishery:
  - The steel firm (and its customers) would lose surplus between the MB and MPC curves between Q_1 and Q_1-1, while the fishery's damages are reduced by the area under the MD curve between Q_1 and Q_1-1.
  - Note that the marginal loss in profits is extremely small, because the steel firm was profit maximizing, while the reduction in damages to the fishery is substantial.

reduction in damages to the fishery is substantial.

– A bribe from the fishery to the steel firm could therefore make all parties better off.

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Coase Theorem: Assign Property Rights to Steel Firm

- When would the process of bribes (and pollution reduction) stop?
  - When the parties no longer find it beneficial to bribe.
  - The fishery will not offer a bribe larger than its MD for a given quantity, and the steel firm will not accept a bribe smaller than its loss in profits (MB-MPC) for a given quantity.
  - Thus, the quantity where MD=(MB-MPC) will be where the parties stop bribing and reducing output.
  - Rearranging, MC+MPC=MB, or MSC=MB, which is equal

parties stop bribing and reducing output.

– Rearranging, MC+MPC=MB, or MSC=MB, which is equal at Q^*, the socially efficient level.

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Coase Theorem: Assign Property Rights to Fishery

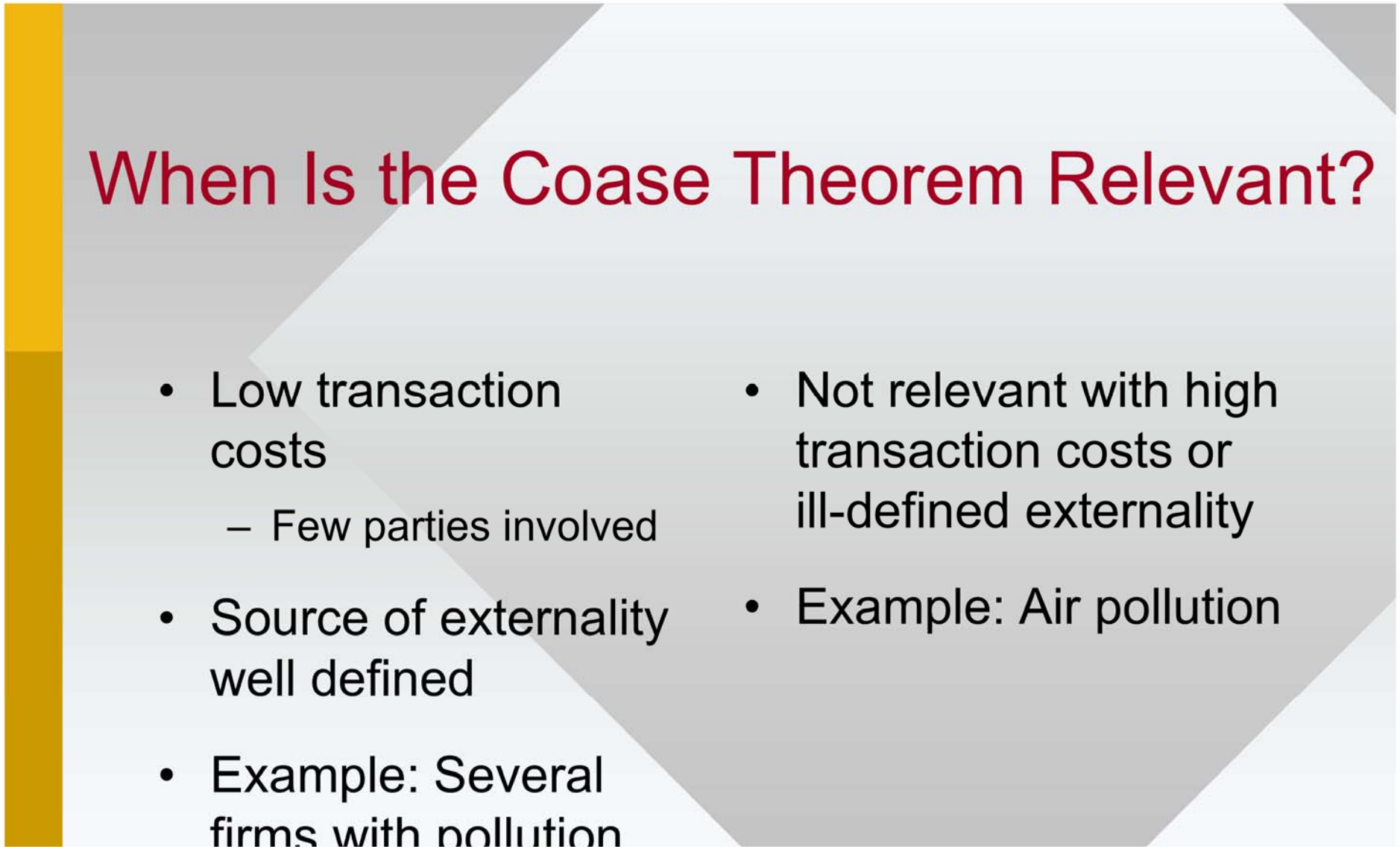
- Similar reasoning follows when the fishery has property rights, and initially allows zero production.
  - The fishery's damages are increased by the area under the MD curve by moving from 0 to 1. On the other hand, the steel firm's surplus is increased.
  - The increase in damages to the fishery is initially very small, while the gain in surplus to the steel firm is large.
  - A bribe from the steel firm to the fishery could therefore make all parties better off.

– A bribe from the steel firm to the fishery could therefore make all parties better off.

Coase Theorem: Assign Property Rights to Fishery

- When would the process of bribes now stop?
  - Again, when the parties no longer find it beneficial to bribe.
  - The fishery will not accept a bribe smaller than its MD for a given quantity, and the steel firm will not offer a bribe larger than its gain in profits (MB-MPC) for a given quantity.
  - Again, the quantity where MD=(MB-MPC) will be where the parties stop bribing and reducing output.

- Again, the quantity where MB=(MB-MP*C) will be where the parties stop bribing and reducing output. This still occurs at Q^*.


When Is the Coase Theorem Relevant?
• Low transaction costs
– Few parties involved
• Source of externality well defined
• Example: Several firms with pollution
• Not relevant with high transaction costs or ill-defined externality
• Example: Air pollution

- Example: Several firms with pollution

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