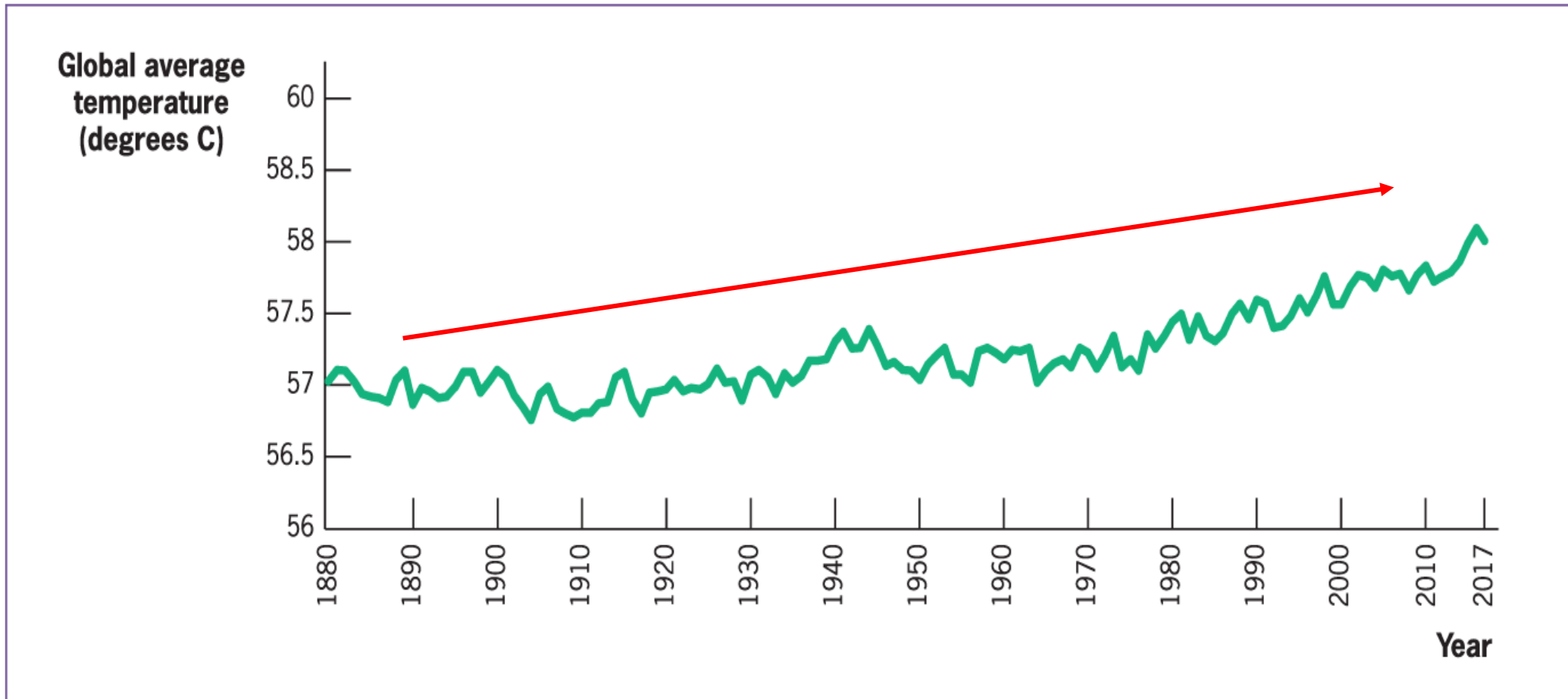# Lecture 4: Externalities

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Introduction to Externalities: Global Warming

- In 2015, representatives from 195 nations met in Paris, France, to negotiate an international pact to limit temperature rise around the world.

- Carbon dioxide emissions contribute to global warming, which could cause enormous damage.

- The cost of reducing the use of fossil fuels, particularly in the major industrialized nations, is immense. Some predict that we will have to reduce our use of fossil fuels to nineteenth-century (preindustrial) levels.

Average Global Temperature, 1880–2014

Global warming as an externality problem

- Global warming is a classic example of an externality, which is a kind of market failure.

- **Externality**: Externalities arise whenever the actions of one party make another party worse or better off, yet the first party neither bears the costs nor receives the benefits of doing so.

- **Market failure:** A problem that causes the market economy to deliver an outcome that does not maximize efficiency.

Negative Externalities

- **Negative production externality:** When a firm's production reduces the well-being of others who are not compensated by the firm.

  - Pollution from steel production, dumped in a river, hurts fishermen.

- **Negative consumption externality:** When an individual's consumption reduces the well-being of others who are not compensated by the individual.

  - Smoking at a restaurant affects the health and enjoyment of others.

Private and Social Marginal Cost

- Negative production externalities drive **a wedge between private and social marginal cost.**

- **Private marginal cost (*PMC*):** The direct cost to producers of producing an additional unit of a good.

- **Social marginal cost (*SMC*):** The private marginal cost to producers plus any costs associated with the production of the good that are imposed on others.

- *The loss from pollution is a cost of production imposed on others.*

Private and Social Marginal Benefit

▪ Negative consumption externalities drive a wedge between private and social marginal benefit.

▪ **Private marginal benefit (*PMB*):** The direct benefit to consumers of consuming an additional unit of a good by the consumer.

▪ **Social marginal benefit (*SMB*):** The private marginal benefit to consumers minus any costs associated with the consumption of the good that are imposed on others.

▪ *The loss of health or dining pleasure is a cost of smoking imposed on others.*

Externalities and Efficiency

How do externalities affect efficiency?

- **Efficiency** requires that:

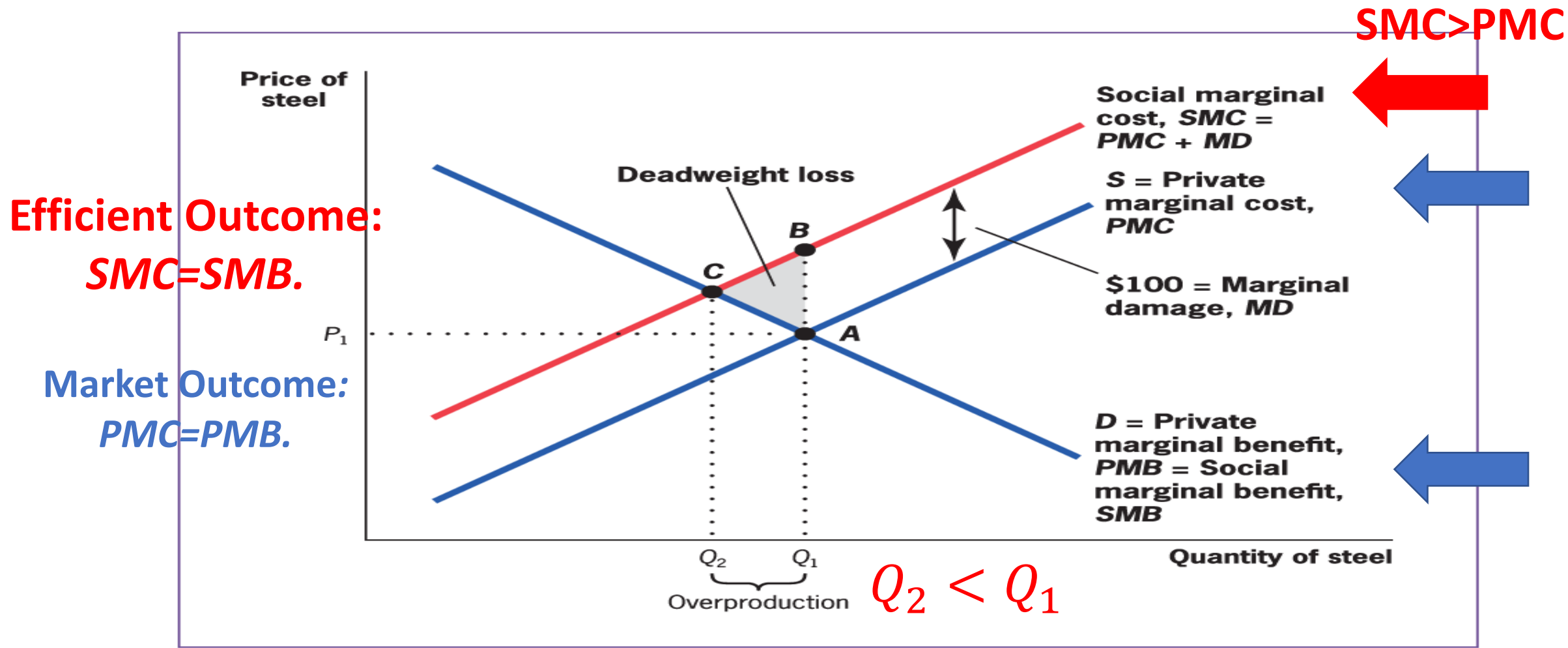$$SMC = SMB.$$

Externalities and Efficiency (cont'ed)

- The market equilibrium:

$$PMC = PMB.$$

- When $PMC = SMC$ and $PMB = SMB$, **the market is efficient.**

- Production or consumption externalities lead to inefficiency.
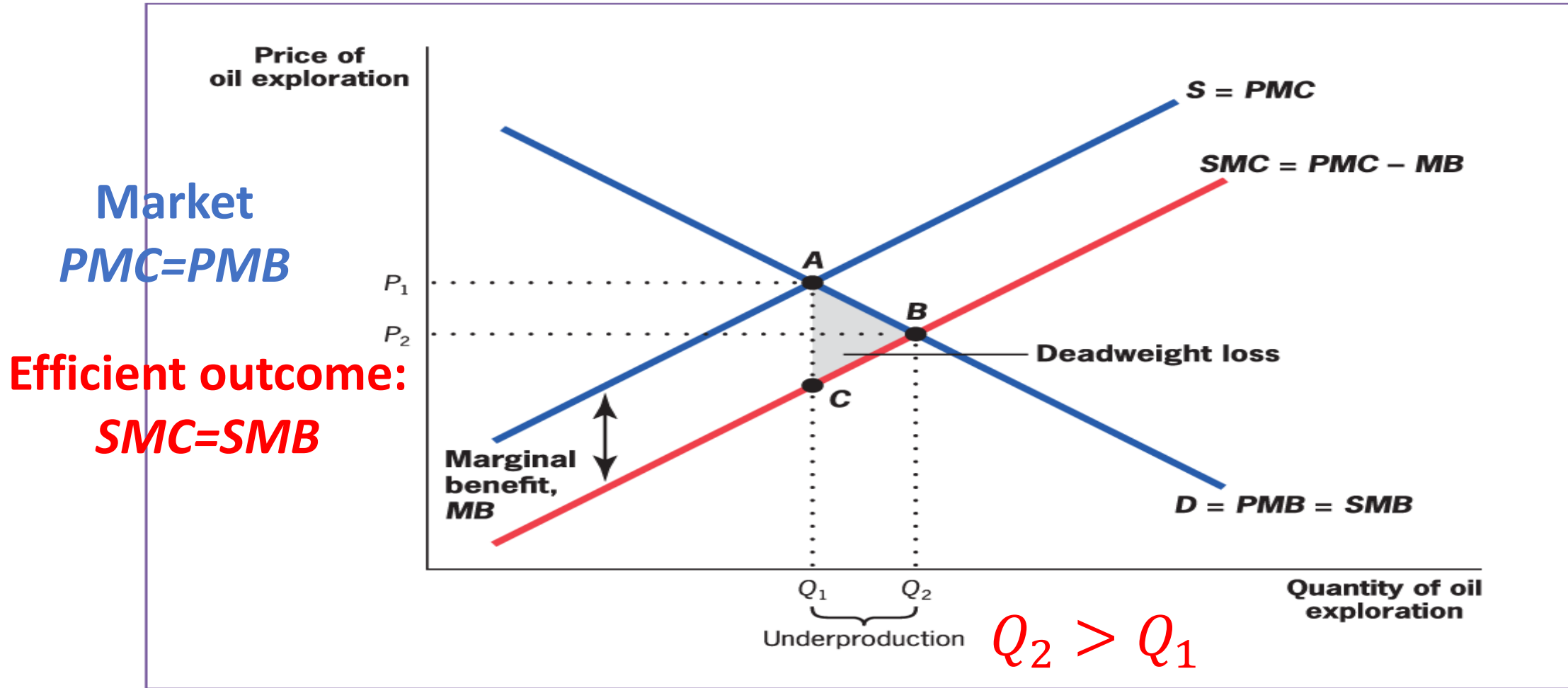
  $PMC < SMC \text{ or } PMB > SMB$

Economics of Negative Production Externalities: Steel Production

SMC>PMC

Efficient Outcome: *SMC=SMB.*

Market Outcome: *PMC=PMB.*

Price of steel

Deadweight loss

Social marginal cost, *SMC = PMC + MD*

S = Private marginal cost, *PMC*

$100 = Marginal damage, *MD*

B

C

P_1

A

D = Private marginal benefit, *PMB* = Social marginal benefit, *SMB*

Q_2 Q_1

Quantity of steel

Overproduction

$Q_2 < Q_1$

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Positive Externalities

- Externalities can be positive as well as negative.

- **Positive production externality**: When a firm's production increases the well-being of others but the firm is not compensated by those others.

- **Positive consumption externality**: When an individual's consumption increases the well-being of others but the individual is not compensated by those others.

Economics of Positive Production Externalities

Market
PMC=PMB

Efficient outcome:
SMC=SMB

$Q_2 > Q_1$

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Private-Sector Solutions to Negative Externalities: The Solution
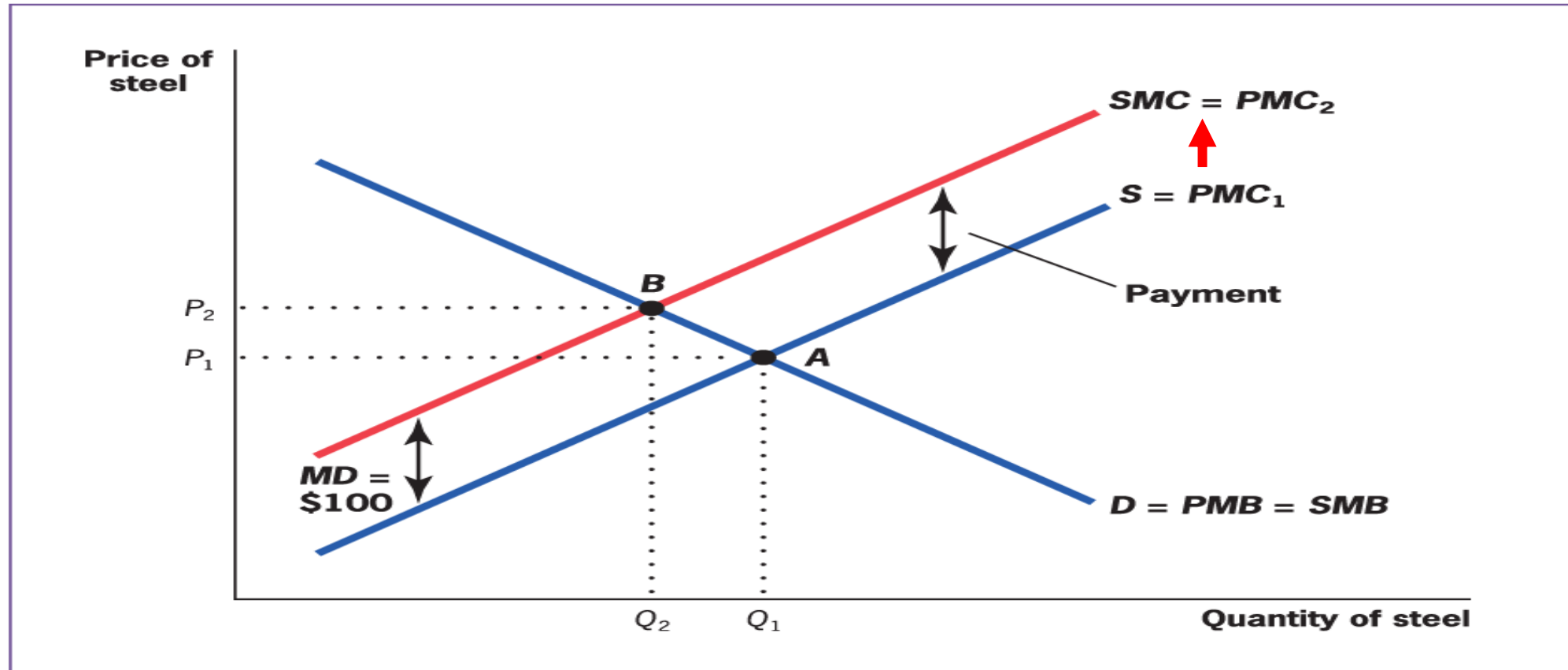
- Externalities undermine efficiency because one party does not pay the costs or get all the (net) benefits of its actions.

- The solution to this, therefore, is to <u style="color:red">internalize the externality</u>.

- **Internalizing the externality**: When either private negotiations or government action lead the party to fully reflect the external costs or benefits of that party's actions.

  - The fishermen could pay the steel producer to reduce production.

The Coase Theorem

The Coase theorem says that private parties will be able to solve the problem of externalities. This is accomplished by internalizing the externality.

- **Coase theorem (Part I):** When there are well-defined **property rights** and **costless bargaining**, then negotiations between the party creating the externality and the party affected by the externality can bring about the **socially optimal market quantity**.

- **Coase theorem (Part II):** The efficient solution to an externality does not depend on which party is assigned the property rights as long as someone is assigned those rights.

The Solution: Coasian Payments

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The Problems with Coasian Solutions 1

There are difficulties with Coasian solutions, making them less likely to arise as more people become involved.

- **The assignment problem:** The first problem is assigning blame. Does the fisherman pay the steel plant for not polluting? Or does the steel plant pay for polluting?

- **The holdout problem:** Shared ownership of property rights gives each owner power over all the others. Each person has veto power and so may demand enormous payments.

The Problems with Coasian Solutions 2

- **The free rider problem:** When an investment has a personal cost but a common benefit, individuals will underinvest. Individuals may not want to pay enough to reduce pollution.

- **Transaction costs and negotiating problems:** It is hard to negotiate when there are large numbers of individuals on one or both sides of the negotiation.

  - This problem is amplified for an externality such as global warming, where the potentially divergent interests of billions of parties on one side must be somehow aggregated for a negotiation.

Bottom Line

- Ronald Coase's insight that externalities can sometimes be internalized was a brilliant one.

- It provides the competitive market model with a defense against the onslaught of market failures.

- It is also an excellent reason to suspect that the market may be able to internalize some small-scale, localized externalities.

- It won't help with large-scale, global externalities.

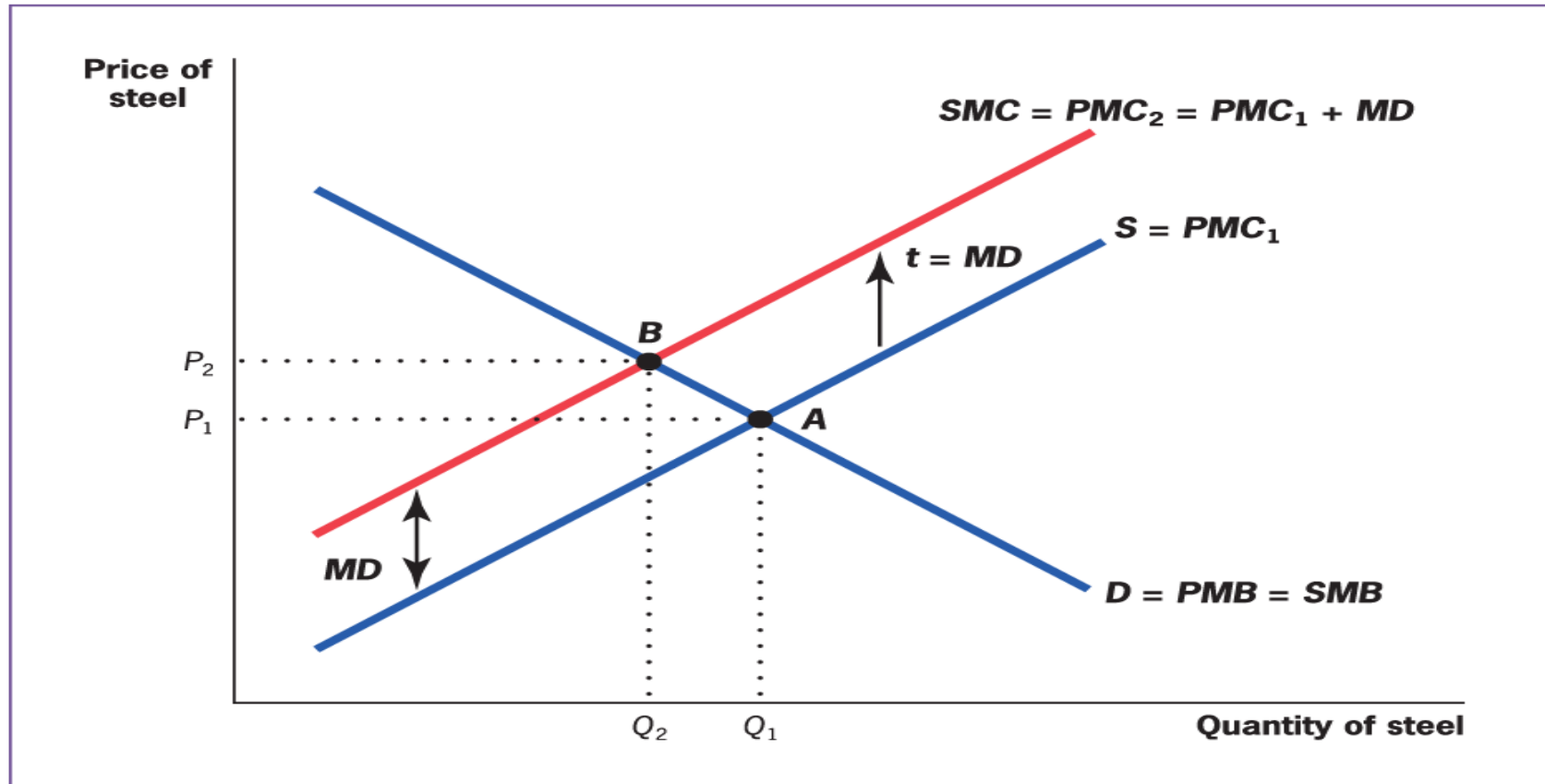# Public-Sector Remedies for Externalities

Public policy makers employ three types of remedies to resolve the problems associated with negative externalities:

1. Corrective taxation to discourage use

2. Subsidies to encourage use

3. Regulation to directly change use

Corrective Taxation and Subsidies

- Taxes and subsidies change the private marginal cost or marginal benefit without affecting the social marginal cost or benefit.

- They can therefore be used to internalize the externality.

- Taxes that correct externalities are called "**Pigouvian taxation**," after A. C. Pigou.

Corrective Taxation

How to find the Pigouvian tax

▪ Solve for the market equilibrium:

$$PMB = PMC$$

▪ Solution:

$$Q_E$$

How to find the Pigouvian tax (cont'ed)

- Solve for social optimum:

$$SMB = SMC = PMC + MD$$

- Solution:

$$Q_S$$

- Negative externality will lead to overproduction:

$$Q_E > Q_S$$

Solving for the Pigouvian Tax

- Pigouvian Tax, T, so as to reduce the equilibrium outcome by $Q_E - Q_S$

- Thus, we solve:

$$PMB(Q_S) = PMC(Q_S) + T$$

- Pigouvian Tax is:

$$T = PMB(Q_S) - PMC(Q_S)$$

or

$$T = MD(Q_S)$$

Exercise

The private marginal benefit associated with a product's consumption is *PMB = 350 − 4Q* and the private marginal cost associated with its production is *PMC = 6Q*.

Furthermore, the marginal external damage associated with this good's production is *MD = 4Q*.

i)   Find the market equilibrium level of *Q.*

ii) Find the social optimum level of *Q.*

iii) To correct the externality, the government decides to impose a tax of *T* per unit sold. What tax *T* should it set to achieve the social optimum?

Find the market equilibrium

i) 25

ii) 43.75

iii) **<u>35</u>**

Solution

- The market equilibrium is:

$$PMB = 350 - 4Q = PMC = 6Q$$

- Solution:

$$Q_E = 35$$

Find the social optimum level of Q

i) **<u>25</u>**

ii) 43.75

iii) 35

Solution (cont'ed)

- The socially optimum is:

$$PMB = 350 - 4Q = SMC + MD = 6Q + 4Q$$

- Solution:

$$Q_S = 25$$

To correct the externality, the government decides to impose a tax of T per unit sold. What tax T should it set to achieve the social optimum?

i) T=150

ii) T=140

iii) **T=100**

Solution (cont'ed)

$$T = PMB(Q_S) - PMC(Q_S) = 350 - 4(25) - 6(25) = 100$$

or

$$T = MD(Q_S) = 4(25) = 100$$

Exercise

Suppose that demand for a product is *Q* = 1,200 − 4*P* and supply is *Q* = −240 + 2*P*. Furthermore, suppose that the marginal external damage of this product is 12E per unit.

- How many more units of this product will the free market produce than is socially optimal?

Answer

To answer this question, first calculate what the free market would do by setting demand equal to supply:

$1{,}200 - 4P = -240 + 2P$ or $1{,}440 = 6P.$

$P = 240,$

so $Q_{Free\ Market} = 1{,}200 - 4(240) = 240.$

Answer (cont'ed)

The socially optimal level occurs when the marginal external cost is included in the calculation. Suppose the 12E externality was added to the price each consumer had to pay. Then demand would be $Q = 1{,}200 - 4(P + 12)$.

- Solving for P, $1{,}200 - 4(P + 12) = -240 + 2P$, or $P = 232$.

- Solving for Q, $1{,}200 - 4(232 + 12) = 1{,}200 - 976$.

- $Q_{Social\ Opt} = 224$

- 16 units less than provided by the free market.

Corrective Subsidies

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