SPEA-V-202

Contemporary Economic Issues in Public Affairs

Externalities II

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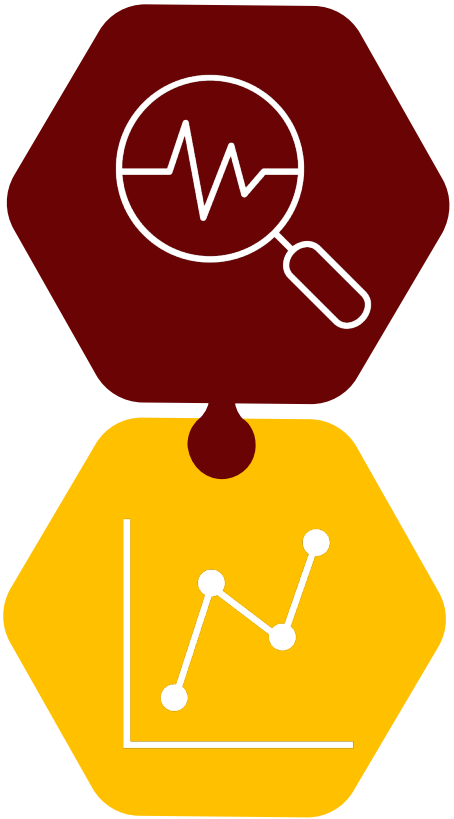
Outline for Today



Solutions to Externalities

- Types of Solutions
- Private Solutions
- Government Intervention
- Intuition and visual representation

Public Sector Remedies

- Corrective Taxation
- Regulation-based policies

Externalities

Externality: an externality arises when a person engages in an activity that influences the well-being of a bystander but neither pays nor receives compensation for that effect. Unintended consequences of free-market exchange. Effects not occurring through the price system.

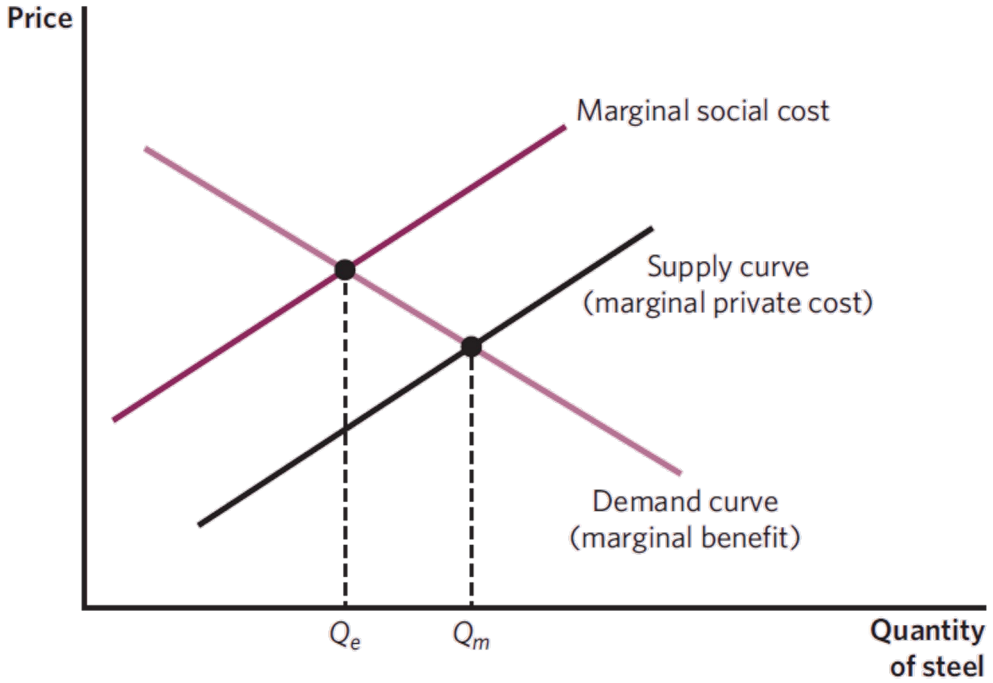
- **Market failure:** property rights are not well defined.
- If markets operate properly, only the agents engaging in the exchange should experience the benefits/costs. Supply and demand reflect the willingness to sell/buy.
- This type of failure implies that private and social willingness to sell/buy differ. There is some marginal damage experienced by third parties.
- **Free Market Exchange:** private marginal benefit = private marginal cost.
- **Social Planner (Efficiency):** social marginal benefit = social marginal cost.
- **Externalities:** private ≠ social → there is DWL due to over/under consumption/production.

Externalities

FIGURE 6.1

EXCESSIVE PRODUCTION OF GOODS YIELDING NEGATIVE EXTERNALITIES

The presence of a negative externality means that marginal social costs exceed marginal private costs, and the market equilibrium will entail an excessive production of the commodity. Q_m is market equilibrium, Q_e is the efficient level of output.



Source Stliglitz and Rosengard Chapter 6

Solutions to Externalities

- There are two types of solutions to address externalities:
- **Private-sector solutions:**
  - Coasian solution: Market for marginal damages.
- **Government intervention:**
  - Regulation-based solutions: production/consumption limits.
  - Market-based solutions: corrective (Pigovian) taxation and subsidies.

Private-Sector Solutions

Recall the example of the steel factory and the river. Steel suppliers create an externality on the water market by dumping toxic waste down the river, leading to a reduction in supply (hence, water underconsumption in equilibrium).

- What is the basic problem in this example? Steel producers are affecting the way water is supplied by polluting the river.

- Example: suppose that in equilibrium the steel market is producing 2 tons of steel, leading to 20 lb of toxic waste dumped into the river.

Units of Steel Produced	Toxic Waste Created
1 ton	10 lb
2 tons	20 lb
3 tons	30 lb

- The problem is not that toxic waste is created. The problem is that is being dumped into the river.
- But what if we do something different with it?
- Is there anyone willing to buy some units of toxic waste?

Private-Sector Solutions

Suppose there is some laboratory in town that could transform the toxic waste produced by the steel factory into usable chemical compounds that pharmaceutical companies are willing to buy.

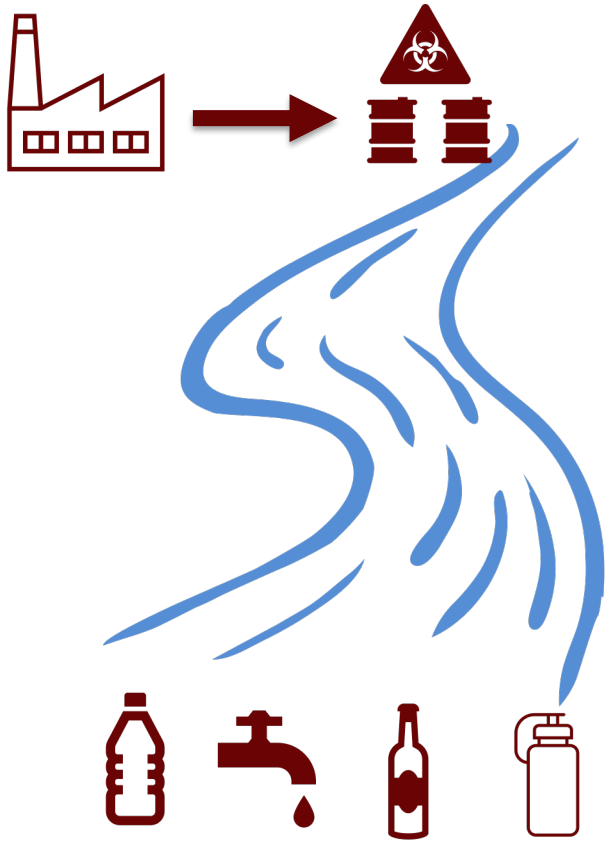
- In this case, this laboratory is willing to buy units of toxic waste from the steel factory (it can transform it and get some profit for it). **There is some demand for toxic waste.**
- Arguably, the steel factory is also willing to sell such units of toxic waste (it was about to dump them anyway, better receive some money from it).
- If the laboratory and the factory make a deal, then the toxic waste is not going to be dumped to the river.
- This is a win-win scenario for everyone.
- There is no damage on the water supply. Steel factory makes an additional profit, and the laboratory sells its products to other consumers.

Private-Sector Solutions

What is the lesson behind the last example?

- The solution for the externality was to create a market for its marginal effects/damages.
- A simpler example: can you think of another party that might be willing to buy some units of toxic waste?
- The water supplier! He is better-off without the toxic waste on the river, so he might be willing to pay for that to stop. How much is the water supplier willing to pay?
- **Thinking like an economist:** what are the marginal benefits for water suppliers of reducing the production of steel? In other words, at which price are they willing to buy the toxic waste produced?
- A reduction of one unit of steel reduces the DWL in the water market, hence increasing the profits perceived by water producers. As steel production decreases, water suppliers' revenue rises.
- Suppliers are willing to buy the toxic waste so long the price of one unit of toxic waste is not larger than the additional revenue induced by the reduction of such unit of toxic waste in the river.

Private-Sector Solutions



What is the nature of the problem in the previous example? Property rights are not well defined.

What do I mean by that?

- Steel factory could use the river, which is the main input of the water supplier. This is what is inducing that the private and social marginal costs of production differ.
- In this example, the steel factory has some property rights over the river (i.e. the water supplier cannot force him not to dump the toxic waste).
- What if it was the other way around? What if the water supplier has the property rights over the use of the river?

Private-Sector Solutions

- Suppose the water supplier has a license that says he controls the access to the river. Now, the water supplier has property rights over the river.
    - The steel factory still needs to dump the toxic waste somewhere and the river is the only feasible option. Hence, the steel factory now is willing to pay the water supplier some fee so it can dispose off the waste.
- If you were the water supplier, at which price would you be willing to sell vouchers/permits to dump toxic waste on the river? (Hint: think like an economist, what is the opportunity cost?)

Units of Steel	Toxic Waste	Marginal Damage to Water Supplier	Total Damage to Water Supplier	WTS Permits for Pollution (Price for 1 lb of TW)	Marginal Revenue from Selling Permits	Total Revenue from Selling Permits
1 ton	10 lb	$1000	$1000	$100	$1000	$1000
2 tons	20 lb	$500	$1500	$50	$500	$1500
3 tons	30 lb	$300	$1800	$30	$300	$1800

Private-Sector Solutions

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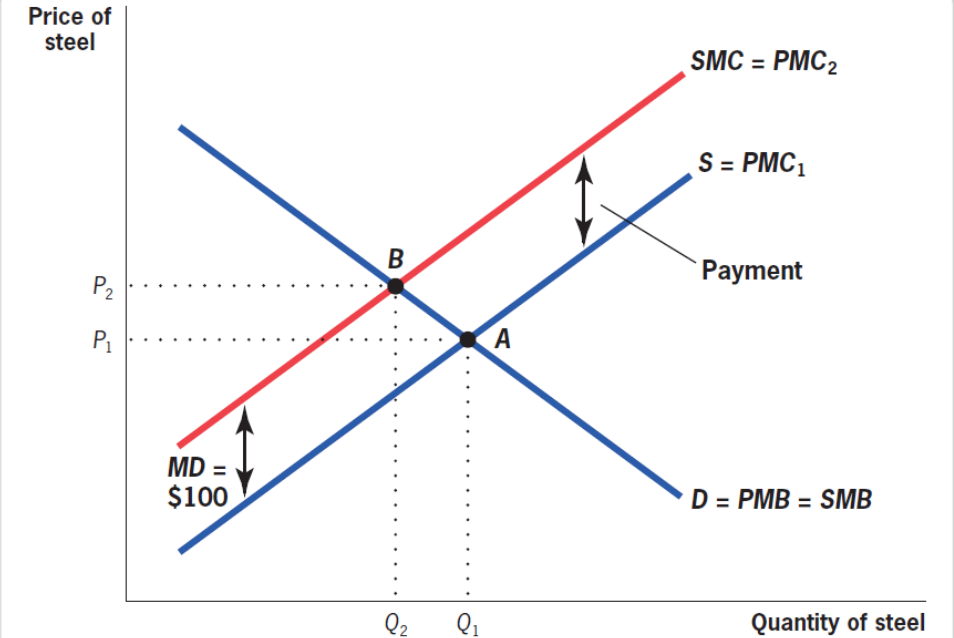
- Same logic! The price of the permits is proportional to the marginal damage induced by toxic waste.
- For the water supplier to be indifferent between the case with and without pollution, the revenue he must receive from selling vouchers should be equal to the revenue lost due to the pollution.
- **Equilibrium in the permits market:** Marginal revenue from selling permits = Marginal costs from pollution. The invisible hand solved this externality!

Private-Sector Solutions

- **Recap:** the previous two cases are examples of **Coasian solutions.** Named after Ronald Coase (Nobel Prize, 1991)
- His main contribution to the study of externalities is summarized by Coase's theorem.
- **Coase Theorem:** If property rights are well defined (and there is 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.
- **Key Implication of the Theorem:** The efficient solution to an externality does not depend on which party is assigned the property rights.
- Recall our two examples. Regardless of whether the water supplier pays the steel factory to stop dumping waste, or the factory buys permits for pollution, in both cases creating a market for toxic waste led to socially optimal quantity.

Private-Sector Solutions

■ FIGURE 5-5



A Coasian Solution to Negative Production Externalities in the Steel Market • If the fishermen charge the steel plant $100 per unit of steel produced, this increases the plant's private marginal cost curve from PMC_1 to PMC_2, which coincides with the *SMC* curve. The quantity produced falls from Q_1 to Q_2, the socially optimal level of production. The charge internalizes the externality and removes the inefficiency of the negative externality.

Source Gruber Chapter 5.

Private-Sector Solutions: Some Limitations

- Coasian solutions are market-based solutions that do not require the government. Why not use them all the time?

- For this type of solution to work, property rights need to be well defined and assigned. Sometimes that is not trivial.

- **Assignment Problem:** suppose we ask the water supplier what is the damage induced by toxic waste. During the bargaining process, he has incentives to overstate the damage, so he receives a larger compensation. Information asymmetries hide the true effects of the externality.

- **Transaction Costs:** Coase's theorem requires that transaction costs are low (costless bargaining). In most cases, this is not true. Creating a new market entails costs that could dissuade potential buyers.

Common Pool Resources: A caveat

- A special type of externalities arise under the presence of common pool resources (CPR).
- **Common Pool Resources (CPR)**, as the name suggests, are goods shared by several market participants (could be both consumers and producers).
- The river is a good example. Suppose that on top of the water supplier, there are fishermen also using the river for fishing, and other factories dumping waste.
- The classic CPR example is a shared piece of land that farmers use to feed their cows. If one farmer brings an additional cow to the land, then it reduces the amount of grass that the cows from the rest of the farmers can eat. (More on this later!)
- The actions of one farmer influence the outcomes of the others.
- CPRs are associated with two main problems: **the holdout problem and the free-rider problem**.

Private-Sector Solutions: Some Limitations

- **Holdout Problem:** suppose that instead of one water supplier, we have 10 identical firms using the river for water bottles production. Water suppliers own the property rights of the river. Hence, in order to produce, the steel factory needs to compensate first all water suppliers for the damages incurred.

- The Coasian solution implies the factory needs to pay the same amount to all water suppliers in order to produce steel. The amount paid should be equivalent to the marginal damage experienced by each individual supplier. For simplicity, say such payment is set at $100.

- Suppose 9 out of the 10 suppliers went to the factory and received their checks. Are the incentives of the 10^{th} supplier the same?

- No! He holds the fate of the market in his hands. If he says no to the payment, then the factory cannot produce steel at all. Hence, he could ask for $101 and the steel factory would arguably agree (because it has already paid $900 to the rest). Then, why not ask for more?

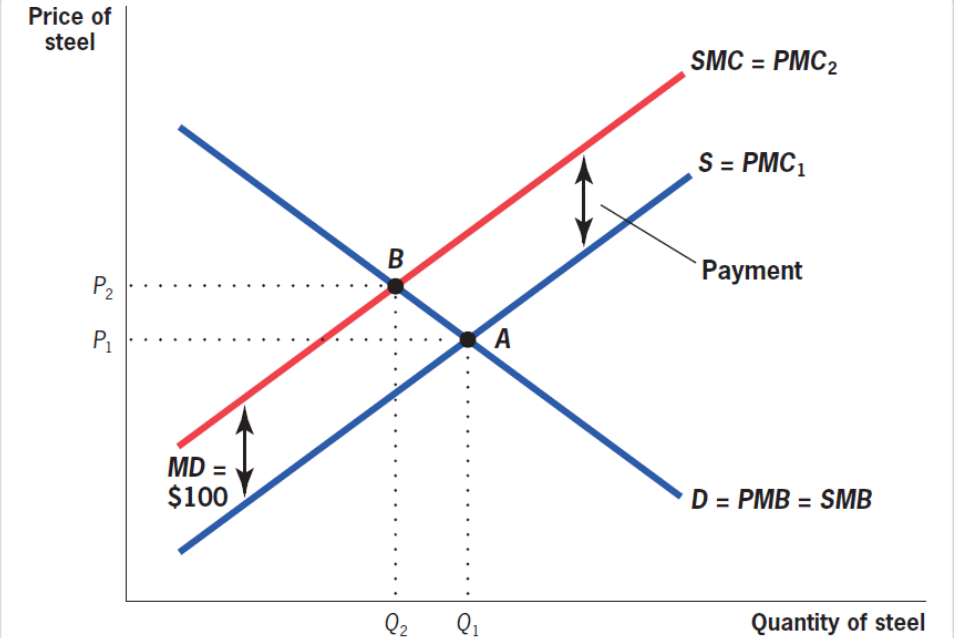
- **Holdout problem:** shared ownership of property rights gives each owner power over all the others.

Private-Sector Solutions: Some Limitations

- Let's keep the same example. A simple solution for the holdout problem is to choose one out of the 10 water suppliers as a negotiator with the steel factory.
- Nonetheless, this solution entails other complexities. Suppose now the steel factory has the property rights and it is selling vouchers for toxic waste reduction to water suppliers.
- Like before, the Coasian solution implies water suppliers pay $100 each to the steel factory so it reduces the amount of waste dumped into the river.
- **Key implication:** In this case, for each supplier it pays, the rest of them benefit from the induced pollution reduction.
- Suppose 9 out of the 10 suppliers already made the payment. Are the incentives of the 10^{th} supplier the same?
- No! Now he has incentives to **free-ride.** Pollution is already down because the other 9 paid their share.
- **Free rider problem:** when an investment has a personal cost, but common benefit. (More on this later!)

Private-Sector Solutions

■ FIGURE 5-5



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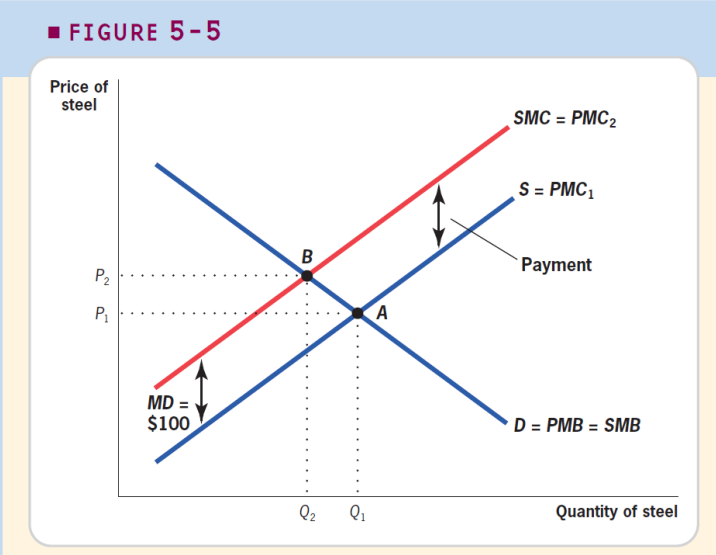
Public-Sector Remedies: Corrective Taxation



Source Gruber Chapter 5.

- What is the geometric lesson from this diagram?
- The payment that steel producers need to make in order to dump waste in the river, increases their costs from PMC_1 to $PMC_2 = SMC$. The basic idea is to increase private marginal costs such that they correctly resemble the social marginal costs (internalize the externality).
- Which government tools allow us to do that? One way to do it is through **corrective taxation.**
- **Corrective taxation** is often called **Pigovian taxation** after economist Arthur C. Pigou.
- Suppose the government imposes a tax on steel production. Such tax raises the price of steel and reduces the quantity consumed in equilibrium.

Public-Sector Remedies: Corrective Taxation

- **Question:** which tax rate will the social planner choose?
- The one that induces the optimal quantity in the market!
- The basic idea is to set a tax per unit of steel produced equal to the marginal damage experienced by the water supplier.
- This will shift the private marginal cost by MD for each unit of steel produced. This will result in a new private marginal cost curve, which is identical to the social marginal cost curve.
- Hence, the result effectively internalizes the externality and leads to the socially optimal outcome.

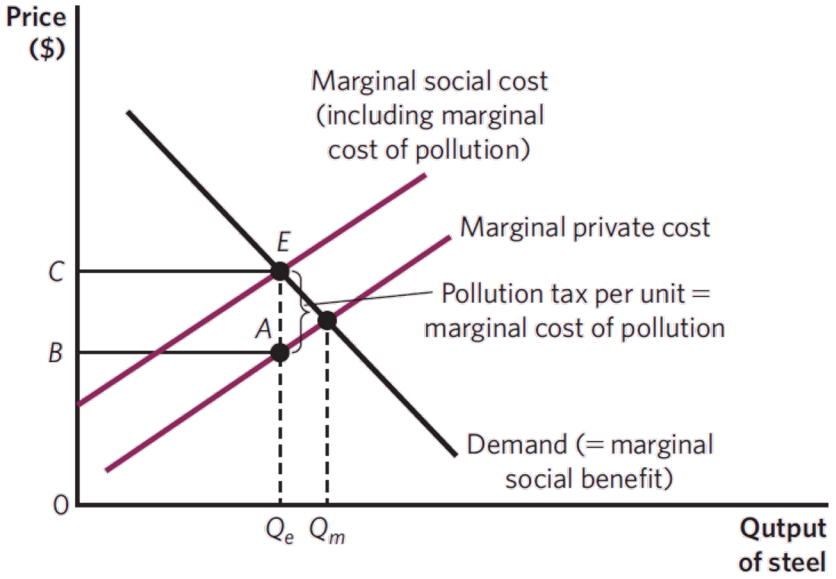
Corrective Taxation

We can think of tax as the difference between the marginal social and private costs of pollution.

FIGURE 6.3

MARKET EQUILIBRIUM WITH AND WITHOUT FINES

In the absence of a tax on pollution, firms will set price equal to marginal private cost. There will be excessive production (Q_m). By setting a tax equal to the marginal pollution cost, efficiency is obtained.

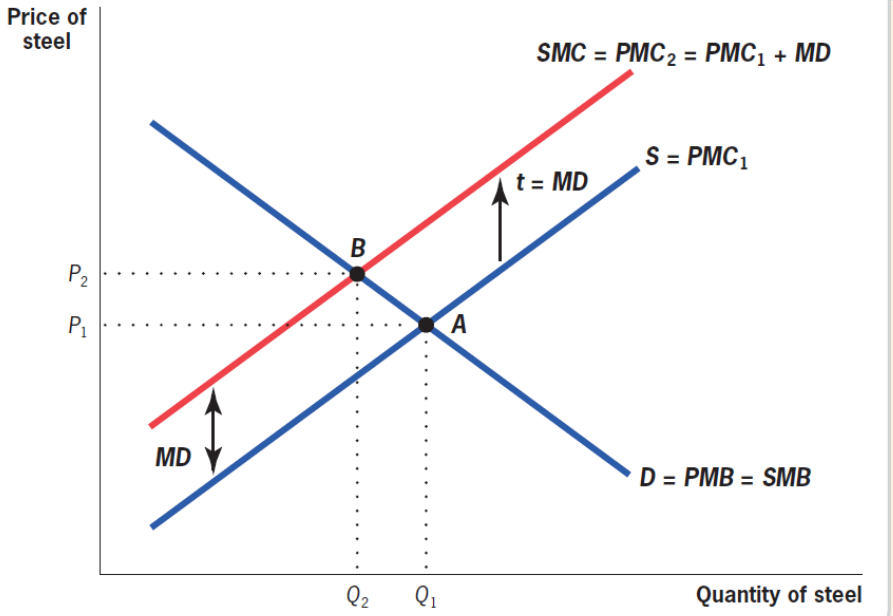


Note: tax revenue from corrective taxation is determined by rectangle CBAE.

Source Stliglitz and Rosengard Chapter 6

Corrective Taxation

■ FIGURE 5-6



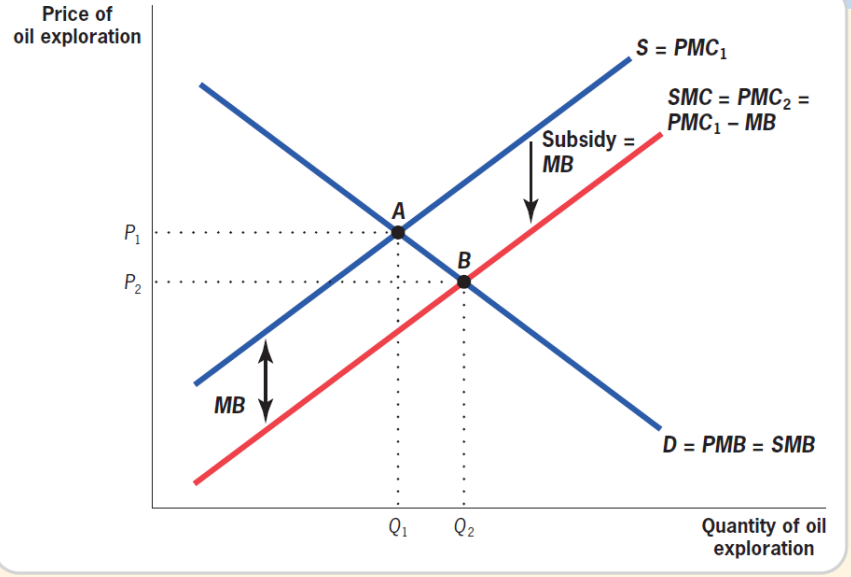
Taxation as a Solution to Negative Production Externalities in the Steel Market • A tax of $100 per unit (equal to the marginal damage of pollution) increases the firm's private marginal cost curve from PMC_1 to PMC_2, which coincides with the *SMC* curve. The quantity produced falls from Q_1 to Q_2, the socially optimal level of production. Just as with the Coasian payment, this tax internalizes the externality and removes the inefficiency of the negative externality.

Source Gruber Chapter 5.

Corrective Taxation

Same logic applies to subsidies! The government ought to choose the subsidy that induces the optimal quantity in the market.

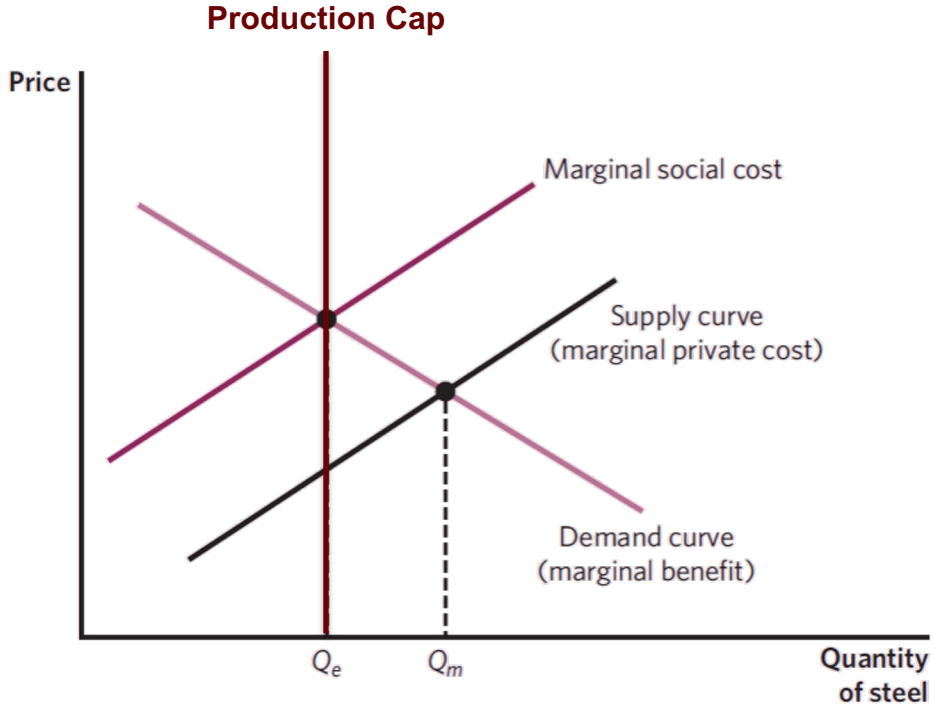
■ FIGURE 5-7



Subsidies as a Solution to Positive Production Externalities in the Market for Oil Exploration • A subsidy that is equal to the marginal benefit from oil exploration reduces the oil producer's marginal cost curve from PMC_1 to PMC_2, which coincides with the *SMC* curve. The quantity produced rises from Q_1 to Q_2, the socially optimal level of production.

Source Gruber Chapter 5.

Public-Sector Remedies: Regulation



- Another solution the government could implement is to enact some regulation. The simplest version of this consists of imposing limits on the production/consumption of the good creating the externality.
- How does that look in our steel factory example?
- The government determines a production limit equal to the social optimum quantity.

Source Stliglitz and Rosengard Chapter 6

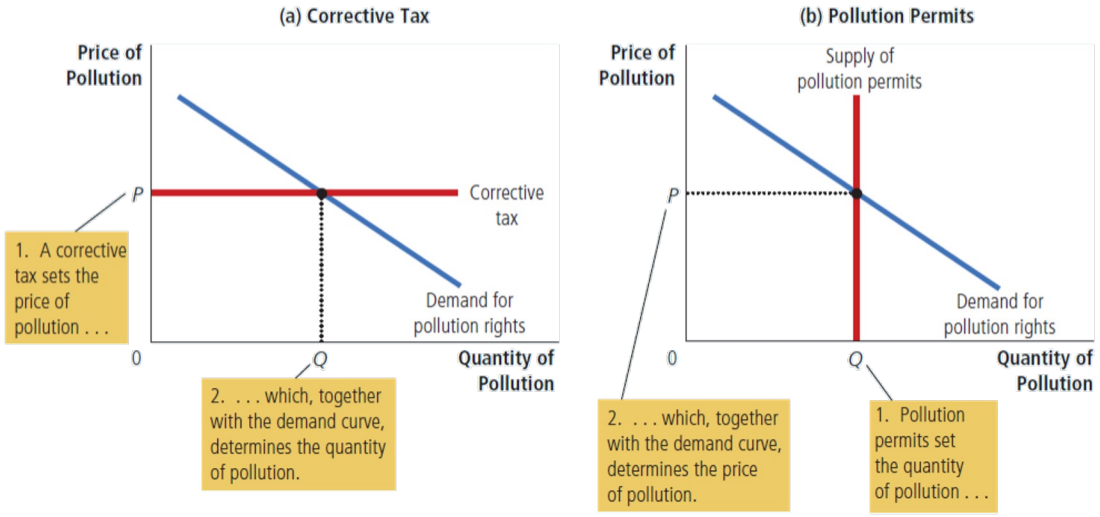
Public-Sector Remedies: Taxes vs Regulation

Both corrective taxation and regulation could lead to the socially desirable outcome, but they operate through different mechanisms.

In panel (a), the EPA sets a price on pollution by levying a corrective tax, and the demand curve determines the quantity of pollution. In panel (b), the EPA limits the quantity of pollution by limiting the number of pollution permits, and the demand curve determines the price of pollution. The price and quantity of pollution are the same in the two cases.

FIGURE 4

The Equivalence of Corrective Taxes and Pollution Permits



Source Mankiw Chapter 10

Public-Sector Remedies: Regulation

- Types of regulation-based solutions:
  - **Performance-based:** the amount paid by the steel factory is determined by the quantity of steel produced. To pollute more, it needs to buy more permits/vouchers.
  - **Input-based regulations:** the government could prohibit using some hazardous materials. Example: high-sulfur coal and the Clean Air Act.

Public-Sector Remedies: Summary

	Description	Key Implications
Private Sector Solutions	Creating a market for marginal damages. Marketable permits.	• Marketable permits provide more certainty about the amount of pollution produced. It is proportional to the number of permits sold. • Marketable permits are subject to the assignment problem: who gets the property rights of the permits? Sometimes hard to determine.
Corrective Taxation	Government imposes taxes/fines that induce the social optimum	• Create incentives to reduce pollution via increasing the price of polluting. • Pollution effectively produced is uncertain. Remember in reality is hard to estimate supply/demand curves.
Regulation	Performance-based and input-based solutions.	• Regulations provide strong incentives to comply with the law (not exceed the limit), but do not provide incentives to reduce pollution below such limit. • Performance-based is more efficient when performance can be measured. • Costs of monitoring inputs may be lower, though.

For Next Class

- **Readings:** Mankiw 10. Gruber 5 and 6. Stiglitz & Rosengard 6

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