

Lecture 8: Externalities

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April 7, 2020, Public Finance

Course schedule

[▶ Syllabus](#)

Week	Date	Topic	Chapters	Lecturer
1	Feb 18	Economic rationale for the government	1, 2, 3, 4, 5	Miroslav Palanský
2	Feb 25	Public budgets	10, 26, 27	Natalia Li
3	Mar 3	Inequality		Marek Šedivý
4	Mar 10	Old-age pensions		Ondřej Schneider
5	Mar 17	Health economics	12	Ondřej Schneider
6	Mar 24	Public choice theory	7, 8	Miroslav Palanský
7	Mar 31	Cost-benefit analysis	6, 10, 11	Petr Janský
8	Apr 7	Externalities	9	Miroslav Palanský
9	Apr 14	Public procurement		Miroslav Palanský
10	Apr 21	Taxation, tax incidence	17, 18	Miroslav Palanský
11	Apr 28	Optimal taxation, personal income taxation	19, 20, 22	Miroslav Palanský
12	May 5	Tax evasion	23, 24	Petr Janský
13	May 12	Corporate taxation	21, 25	Petr Janský

Course requirements

▶ Syllabus

Requirement	Maximum points	Announced	Deadline
Problem Set 1	10	Mar 24	Mar 31, 23:59
Problem Set 2	10	Apr 14	Apr 21, 23:59
Wiki Edits	20	Feb 18	Apr 28, 23:59
Final Exam	60	Exam 1 on May 19, 14:00 Exams 2, 3 in June Exam 4 in September	
Total	100		

Today's lecture

Externalities

Internalizing externalities

- Private sector solutions

- Public sector solutions

 - Price regulation

 - Quantity regulation

Protecting the environment

Market failures

1. Failure of competition
2. Incomplete markets
3. Imperfect information
4. Inequality, vicious circles
5. Public goods
6. **Externalities**
7. Unemployment and other macroeconomic disturbances

What are externalities?



Changchun, China; Source: Link

What are externalities?

- ▶ Externality = a cost or benefit that arises whenever an agent undertakes an action that has an **uncompensated** effect on another agent.
→ inefficient resource allocation (i.e., market failure)
- ▶ Examples:
 - ▶ A steel plant that pollutes a river used by people for recreation
 - ▶ Beehives of honey producers have a positive impact on pollination and agricultural output

Classification of externalities

- ▶ Positive vs. negative
- ▶ Production vs. consumption
- ▶ Real vs. pecuniary (sometimes disregarded)
- ▶ Local vs. global
- ▶ Other types: common resource problem, positional externality

▶ Some definitions

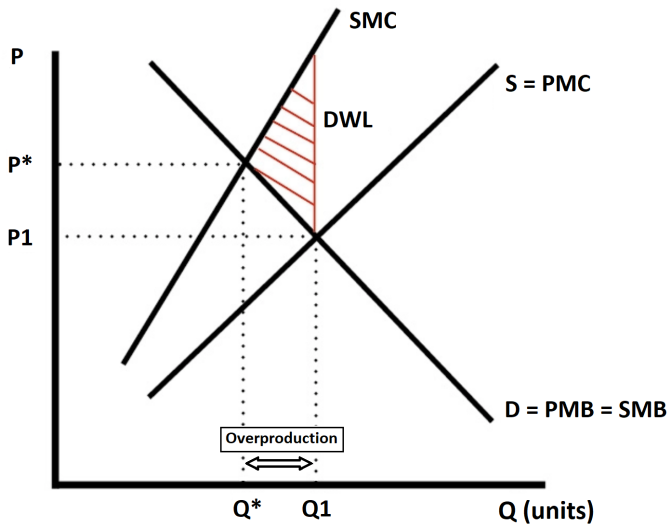
Externalities formally

- ▶ Buchanan and Stubblebine (1962)
- ▶ Individuals A and B carry out activities X and Y , respectively
- ▶ $u^A = u^A(X_1, X_2, \dots, X_m, Y_1)$
 - ▶ $X_i, i = 1, \dots, m$ are activities carried out by individual A
 - ▶ Y_1 is an activity carried out by individual B
- ▶ Individual A maximizes his utility by carrying out activities $X_i, i = 1, \dots, m$, taking into account Y_1
- ▶ An externality arises when $\frac{\partial u^A}{\partial Y_1} \neq 0$
 - ▶ Positive externality: $\frac{\partial u^A}{\partial Y_1} > 0$
 - ▶ Negative externality: $\frac{\partial u^A}{\partial Y_1} < 0$

Private vs. social value

- ▶ Private marginal cost (PMC): Direct cost to supplier of producing one additional unit
 - ▶ Social marginal cost (SMC): Cost to society of the supplier producing one additional unit
 - ▶ Private marginal benefit (PMB): Direct benefit to supplier of selling one additional unit
 - ▶ Social marginal benefit (SMB): Benefit to society of the supplier selling one additional unit
1. In case of no externalities: $PMC = SMC, PMB = SMB$
 2. With negative externality: $PMC < SMC, PMB = SMB$
 3. With positive externality: $PMC = SMC, PMB < SMB$

Negative externality



Inefficient allocation

- ▶ Negative production externalities lead to overproduction
- ▶ Positive production externalities lead to underproduction
- ▶ Negative consumption externalities lead to overconsumption
- ▶ Positive consumption externalities lead to underconsumption

Examples of externalities



Solving the problem of externalities

- ▶ Common misconception: There should be no activity that generates negative externalities.
- ▶ Actually, there is a non-zero optimal level of negative externality-generating activity.
 - ▶ Example: driving cars produces some pollution, but we still want to use them
 - ▶ Even externality-generating activity brings benefits—and these need to be weighed against the (social) costs
- ▶ Solution = **internalizing externalities**

Internalizing externalities

- 1) Private sector solutions
 - ▶ Coase theorem
- 2) Public sector solutions
 - 2a) Price regulation
 - 2b) Quantity regulation
 - 2c) Combination: Marketable permits

1) Private sector solutions

- ▶ Coase (1960): Are externalities really outside the market mechanism?
- ▶ In other words, can private negotiations lead the price of an action to fully reflect the external costs or benefits of that action?

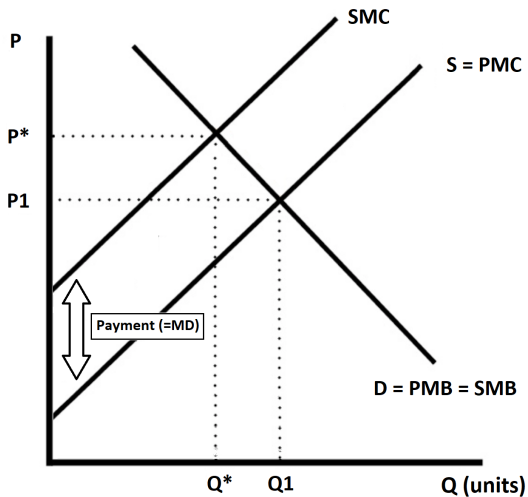
Coase theorem

- ▶ Coase theorem (part I): When there are (i) well-defined property rights and (ii) 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 quantity for an externality-generating activity does not depend on which party is assigned the property rights, as long as someone is assigned those rights.

Coase theorem: Example

- ▶ Firms pollute a river enjoyed by swimmers. If firms ignore swimmers, there is too much pollution
- ▶ Coase theorem: well-defined property rights, no bargaining costs → optimal amount of pollution will be achieved (this is part I of Coase theorem)
- ▶ Option 1: Swimmers own river
 - ▶ Swimmers charge firms for polluting the river
 - ▶ How much? Marginal damage (MD) per unit of pollution
- ▶ Option 2: Firms own river
 - ▶ Firm charges swimmers in exchange of polluting less
 - ▶ How much? MD per unit of pollution
- ▶ Same outcome (this is part II of Coase theorem)

Coase theorem graphically



Coase theorem: Problems

- ▶ In practice, private sector solutions are not likely to solve most externalities, because Coase theorem assumptions are often not met
- 1. The assignment problem: Assigning property rights is difficult
 - ▶ Especially when externalities affect many agents
- 2. Transaction costs: Negotiations are costly
 - ▶ Again, especially when externalities affect many agents
- ▶ Private sector solutions likely to be more effective for small, localized externalities (e.g., beehives) than for larger, more global externalities (e.g., global warming)

2) Public sector solutions

- ▶ With larger numbers of agents, governments can provide a way to reach the social optimum
- ▶ Recall the sophisticated mechanisms we have in place
 - ▶ Representative democracy
 - ▶ Voting systems to extract and aggregate preferences
 - ▶ Cost-benefit analysis in policymaking
 - ▶ Progressive tax systems to finance it all
- ▶ Global externalities need cooperation at international level (EU, UN, OECD, ...)

2a) Price regulation

2b) Quantity regulation

2c) Combination: Marketable permits

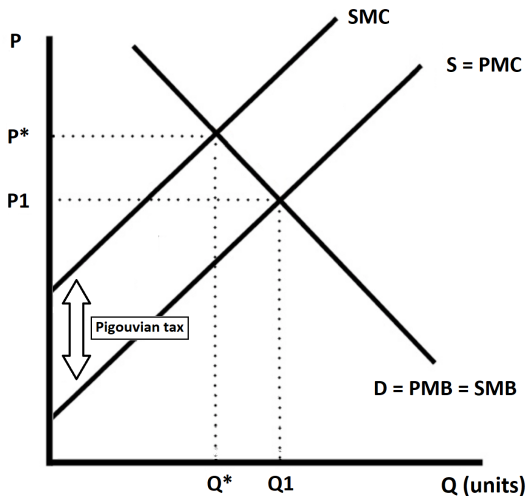
2a) Price regulation

- ▶ Taxes/Subsidies
- ▶ Fines

Taxes/Subsidies

- ▶ Taxes and subsidies (=negative taxes) change price → change in demand and supply
- ▶ A properly calculated tax can shift the outcome to the social optimum.
- ▶ Such taxes are called corrective taxes, or Pigouvian taxes (Pigou, 1920).

Effect of a Pigouvian tax



Fines

- ▶ Similar effects to tax (but more indirect)
- ▶ May improve production methods: Firms will aim to undertake measures in an efficient manner (which they determine) to avoid fines

2b) Quantity regulation

- ▶ If we know the socially optimal amount of an externality-generating activity, we can directly mandate that only that amount can happen
- ▶ Much more straightforward, and necessary in some cases
- ▶ Performance-based (output) regulation vs. input regulation
- ▶ Examples: ban on smoking, emission standards, fishing restrictions, driver's licenses
- ▶ Efficiency and equity concerns

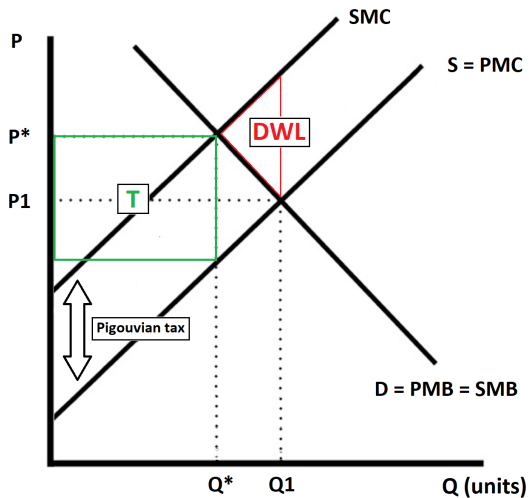
Price vs. quantity regulation

- ▶ In an ideal world, they are identical (in that they achieve the same outcome, i.e., the socially optimal level)
- ▶ In practice, price regulation is often more effective, but harder to implement
- ▶ Since we cannot observe demand and supply precisely, it is difficult to establish the size of an efficient corrective tax

Externalities and deadweight loss

- ▶ We know that taxation creates deadweight loss by rendering some activity unprofitable, so that surplus, which would otherwise have been gained, is not gained
- ▶ However, when we tax activity that generates negative externalities, we not only eliminate deadweight loss, but also gain tax revenue
- ▶ This is called the **double dividend of taxation**
- ▶ This tax revenue can be used to compensate for other (positive) externalities, such as education → better overall economic outcome
- ▶ Deadweight loss and (in)efficiency → deadweight gain of taxation?

Double dividend of taxation



2c) Combination: Marketable permits

- ▶ Increasingly popular
- ▶ Cap and trade system: each firm is allowed to emit a limited amount of a pollutant
- ▶ Permits are then allowed to be traded among firms (the gov't only cares about the total amount of the pollutant)
- ▶ Not only among firms, but also among countries
- ▶ Problems: equity concerns when first assigning the permits, pressure of special interest groups to issue more permits, location of pollution might be important

Protecting the environment in practice

- ▶ The current debate is not whether, but **how much**.
- ▶ Environmental externalities are global → we need global solutions (international organizations, the Kyoto protocol, ...)
- ▶ Air: taken for granted since the beginning of time, but this has changed by the middle of the twentieth century
 - ▶ The Great Smog of 1952, London: estimates of 12,000 dead, 200,000 injured (see Season 1, Episode 4 of The Crown on Netflix)
 - ▶ Later (and ongoing) in developing nations
 - ▶ Ozone depletion, acid rain, global warming
- ▶ Water, land: toxic waste, pesticides, hormonal birth control, ...

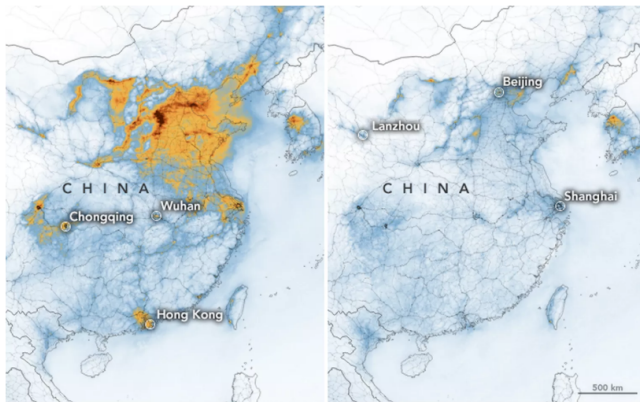
The Kyoto protocol

- ▶ United Nations Framework Convention on Climate Change, signed 1997, entered into force in 2005
- ▶ Objective: “To reduce the onset of global warming by reducing greenhouse gas concentrations in the atmosphere to a level that would prevent dangerous anthropogenic interference with the climate system”
- ▶ 36 developed countries set a limit on greenhouse gas emissions and had to buy carbon permits if they exceeded these limits

The Paris agreement

- ▶ Objective: “to keep the increase in global average temperature to well below 2 degrees Celsius above pre-industrial levels”
- ▶ No specific targets, but these should be “more ambitious” than previous targets
- ▶ Trump has announced in 2017 the intention to withdraw in 2020 (but the US has already implemented policies contrary to the Paris agreement)

COVID-19 and pollution: China



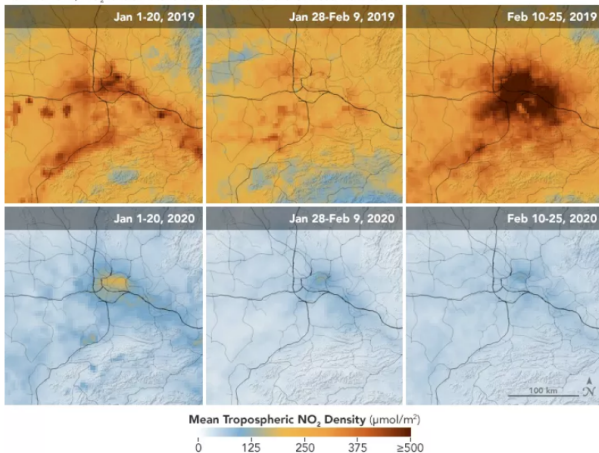
Mean Tropospheric NO₂ Density ($\mu\text{mol}/\text{m}^3$)

Source: The Verge, Nasa, European Space Agency; Link

COVID-19 and pollution: Wuhan

Pollutant Drops in Wuhan—and Does not Rebound

Unlike 2019, NO₂ levels in 2020 did not rise after the Chinese New Year.



Source: The Verge, Nasa, European Space Agency; Link

Coase theorem and climate change

- ▶ For global long-term externalities, such as climate change, negotiations are impossible: the negative externality falls largely on people who were not yet born
- ▶ What would people in 2100 be willing to pay for us to stop climate change?
- ▶ One way to think about it that we could “decide for them” and use public debt to reduce pollution now, with future generations repaying that debt



Thank you!

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References I



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Pigou, A. C. (1920). *The Economics of Welfare*. London, United Kingdom: Macmillan (cited on p. 23).



Some definitions

1. Pecuniary externality: An externality that does not change consumption and production, but only price-profit combinations.
 - ▶ Example: a factory increases its electricity consumption, increasing the price of electricity for other agents
 - ▶ Note! Some definitions of externalities exclude this phenomenon from being called externality.
2. Common resource problem: The fact that the consumption of scarce and rival common resources depletes the resource (possibly leading to its elimination).
 - ▶ Example: fish in lakes, oil reserves
3. Positional externality: An externality that arises when the consumption of a good by an agent reduces the scarcity power of this good in other agents' possession.
 - ▶ Example: college degrees