Environmental Economics in the Central European Context

Time: Tuesday 4pm – 7pm
Location: at CERGE-EI, Room # 11

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Reading materials: http://home.cerge-ei.cz/richmanova/Teaching.html

What is your background?

- **environmental?**
- **economic (statistical/econometric analysis)?**
- **environmental economics?**
- **experimental economics?**

What do you expect from this course?

OUTLINE OF THE COURSE:

The aim of this course is to introduce students to some basic economic principles and theories explaining environmental issues and problems today and to explore existing policies at the national and international level. Students will learn about basic concepts of environmental economics such as externalities, the tragedy of the commons, enforcement as a public good, interventionist solutions to the externality problem, such as taxes and marketable pollution permits, as well as non-interventionist solutions to the externality problem, such as the Coasian solution and self-regulation. We will also review the debate over the environmental Kuznets curve. We will discuss the field data and environmental policies of the Czech Republic and place them into international context. Finally, we will discuss current topics such as renewable resources and the controversy about their support schemes. Because experimental evidence complements theoretic insights, field data and simulating models nicely, we will review some research articles that draw on the experimental methodology.

GRADING POLICY:

Class participation and activity (10%),
Quick quizzes (20%)
Presentation (30%)
Final exam (40%)

(Tentative) Course Outline:
[Check the online version for changes]

WEEK:	**TOPICS:**
1 – Feb 17	Introduction, Market failures - externalities, tragedy of the commons, enforcement as public good
2 – Feb 24	Interventionist solutions to the Externality problem – Pigouvian taxes and standards and charges; Environmental Kuznets curve; Environmental labeling
3 – Mar 3	Interventionist solutions to the Externality problem – Marketable pollution permits
4 – Mar 10	Non-interventionist solutions to the Externality problem - Environmental labeling; Environmental Kuznets curve
5 – Mar 17	Non-Interventionist solutions to the Externality problem – The Coasian solution **Presentation topics to be agreed on**
6 – Mar 24	Non-interventionist solutions to the Externality problem – Voluntary programs and self-regulation [MIDTERM WEEK]
7 – Mar 31	Environmental Policy in the Czech Republic – History and current issues
8 – Apr 7	**Spring break**
9 – Apr 14	**Students' Presentations**
10 – Apr 21	**Trip to Malesice Waste Treatment Facility; time and date TBA**
11 – Apr 28	Environmental Policy in the EU – History and Current problems
12 – May 5	Environmental Policy in the world context – History and Current problems
13 – May 12	**Final Exam**

Some useful links

- CENIA (www.cenia.cz) – website of the Czech Ministry of the Environment's information agency.
- Environment Center of Charles University (http://www.cuni.cz/COZPENG-5.html)
- European Environment Agency (http://www.eea.europa.eu/) - environment agency of the EU
- http://ec.europa.eu/environment/enveco/index.htm - web site of the EC

READINGS list might be revised as we go, always check out the course website for updates…

the first part of the course follows: **Schotter, Andrew (1997), Microeconomics. A Modern Approach.** Second Edition. Addison-Wesley. Of particular importance: **Chapter 17** in that book – there are several editions of that book, when I refer to page/problem numbers it will always be consistent with the scanned version which can be downloaded from the course web page.

Introduction

Why do we care about the environment?

a) life supporting function (location and the basic conditions for the existence of life)

b) natural resources (inputs for consumption and production)

c) amenity values (natural beauty)

Natural resources:

a) flow resources (solar radiation, wind or water energy – the current use does not affect the future availability)

b) stock resources (the current use affects future availability)

- renewable resources (forests, stock of fish, etc…)
- non-renewable (fossil fuels, mineral ores)

The problem is that with increasing human activity, industrial production, unclean technologies, there are adverse and often permanent impacts on biophysical environment.

Nature of environmental problems

a) nature degradation due human activity (deforestation, pollution)

b) conflicting usage of the natural resource (e.g. amenity vs. production)

c) distribution of usage over time (this or future generation? concept of sustainability)

d) distribution among agents (problem of too many fishermen)

Current issues in Europe and the CR

a) water and air pollution, greenhouse effect (how to manage with growing industrial production, transportation)

b) soil pollution (industrial fertilizers)

c) energy intensity

d) noise (transportation air/road/railway)

e) waste management

f) decrease in biological diversity and ecological stability (due agricultural production and fragmentation of the landscape due transportation and urbanization)

Instruments of environmental protection

a) regulations,

b) economic and financial (standards and charges, marketable pollution permits, taxes, fines, tax reliefs and subsidies, property rights),

c) voluntary programs (environmental labeling),

d) environmental education and public awareness

Environmental economics

- a subfield of economics concerned with environmental issues
- undertakes theoretical or empirical studies (in search for effective environmental measures)
    - of the economic effects of environmental policies
    - impacts of economic instruments on decision-making when environmental impact is a concern
- e.g. costs and benefits of alternative environmental policies to deal with air pollution, water quality, toxic substances, solid waste, and global warming…

Experimental economics

Use of Experimental Methods is discussed in the following two academic articles

(G&G) Greenstone, M., Gayer, T., (2007), Quasi-Experimental and Experimental Approaches to Environmental Economics, RFF Discussion Paper 07-22.

(L&L) Levitt, S., D., List, J., A. (2009), Field experiments in economics: The past, the present, and the future, European Economic Review 53, 1-18

- we will review couple of experimental articles throughout this course, why? b/c they (not only) provide an important insight on environmental measures employed by governments and NGOs

Merriam-Webster Dictionary:

Experiment is a tentative procedure or policy; an operation or procedure carried out under controlled conditions in order to discover an unknown effect or law, to test or establish a hypothesis, or to illustrate a known law.

Benefits of employing Experimental Methods

- A new drug is tested to make sure that it has the expected effect and at the same time that it is not outweighed by possible side-effects – to minimize potential cost on public health
- The effect of planned policy change can be tested at relatively low cost (compared to allocation of much larger resources to an inefficient program; e.g. training program for the unemployed, new pricing scheme for electricity,…)
- Explaining or predicting non-experimental outcomes (e.g. Barr and Serneels 2004: correlation of wage outcomes of employees with their behavior in a trust game experiment) – again, relevant policy/strategy implications at relatively low cost
- Testing theoretical predictions at relatively low cost (economic theory, game/behavioral theory)
- Help to generate the data which are difficult to be obtained from "the field"
- Estimation of a cost that the firm which produces pollution should internalize so that the (socially) more efficient outcome can be achieved **-> ENVIRONMENTAL ECONOMICS**

Externalities -> correction? -> Environmental Economics -> (G&G)

- Imagine an example of air or water pollution as a byproduct of the production of marketable good
- created pollution imposes health costs on inhabitants and/or costs on the down-the-river company not internalized by the firm which is responsible for producing the pollution
- government intervention might help to maximize net (social) benefits/welfare – require reliable estimates of the costs and benefits (how to set the tax? will the market participants react in expected way?) => ENVIRONMENTAL ECONOMICS
- **EE** addresses the inefficiencies resulting from production externalities –> experimental and quasi-experimental methods
- hinge upon proper design, implementation, appropriate approach to the data analysis

Market failure

- one of the key concepts
- situations when markets alone (without any intervention) fail to allocate resources efficiently
- Hanley, Shogren, and White (2007) in their textbook Environmental Economics: "A market failure occurs when the market does not allocate scarce resources to generate the greatest social welfare. A wedge exists between what a private person does given market prices and what society might want him or her to do to protect the environment. Such a wedge implies wastefulness or economic inefficiency; resources can be reallocated to make at least one person better off without making anyone else worse off."
- market failures can be viewed as scenarios where individuals' pursuit of pure self-interest leads to results that are not efficient – that can be improved upon from the societal point-of-view.

Externality one of the common causes of market failure -> another key concept of environmental economics,

Externality of an economic transaction is an impact on a party that is not directly involved in the transaction. The basic idea is that an externality exists when a person makes a choice that affects other people that are not accounted for in the market price and thus the prices do not reflect the full costs or benefits in production or consumption of a product or service [and therefore typically results in a market failure].

- **Positive externalities -** an action that imposes a positive side effect on a third party
- **Negative externalities -** an action that imposes a negative side effect on a third party; many negative externalities are related to the environmental consequences of production and use.

Can you think of couple of examples on

a) positive externalities

b) negative externalities

Examples of positive externalities:

- A **beekeeper** keeps bees for their honey. A side effect or externality associated with his activity is the pollination of surrounding crops by the bees. The value generated by the pollination may be more important than the value of the harvested honey.
- An individual planting an **attractive garden** in front of his or her house may provide benefits to others living in the area, and even financial benefits in the form of increased property values for all property owners.
- **Home ownership** creates a positive externality in that homeowners are more likely than renters to become actively involved in the local community.
- **Education** creates a positive externality because more educated people are less likely to engage in violent crime, which makes everyone in the community, even people who are not well educated, better off.

Examples of Negative Externalities

- **Transportation:** drivers imposing congestion cost on other drivers, pollution created affects health and quality of life of those living nearby roads
- **Industrial Production:** producing (as a by-product) greenhouse gas emissions from burning oil, gas, and coal -> climate change imposing cost on whole society
- **Water pollution** by industries that adds poisons to the water, which harm plants, animals, and humans.
- **Industrial farm animal production** – farms that were maybe more efficient as regards the production costs/revenues but they contributed to the increase in the pool of antibiotic-resistant bacteria because of the overuse of antibiotics + air quality problems + the contamination of rivers, streams, and coastal waters with concentrated animal waste + animal welfare problems, mainly as a result of the extremely close quarters in which the animals are housed.
- **Fishing:** harvesting by one fishing company in the ocean depletes the stock of available fish for the other companies and overfishing may be the result. This is an example of a common property resource, sometimes referred to as the **Tragedy of the commons**.
- **Consumption of alcohol** in some cases leads to drinking and driving accidents which injure or kill pedestrians and other drivers.

In these situations (speaking of negative externalities) the marginal social benefit of consumption (i.e. benefit of consuming one more unit of a product) is less than the marginal private benefit of consumption. This leads to the good or service being over-consumed relative to the social optimum -> **Market failure.** Without any corrective measure, the good or service will be under-priced as the negative externalities will not be taken into account.

Illustration

FIGURE 17.1 Dolan's water-paper society.

The paper mill imposes an external cost on the water treatment plant by dumping its wastes into the river. These wastes increase the treatment plant's cost of cleaning the water.

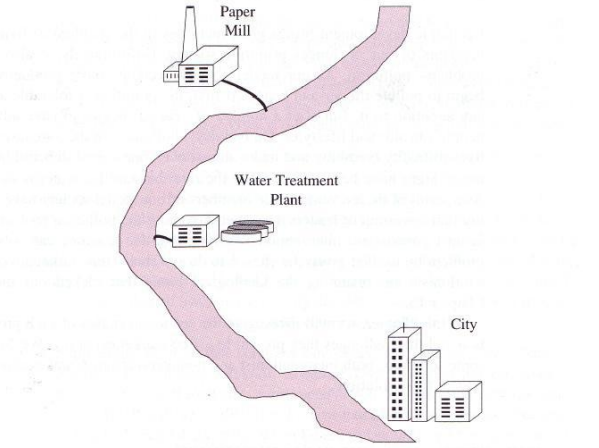
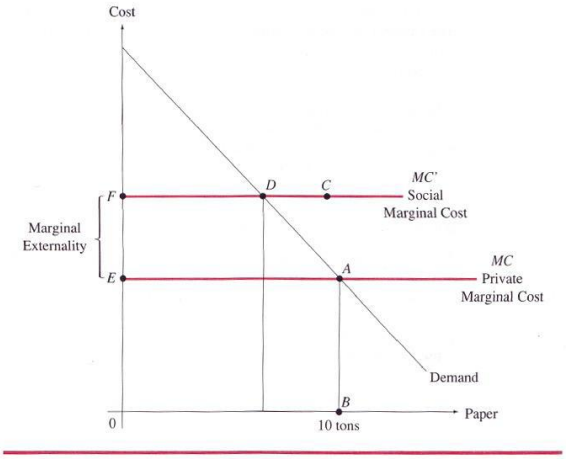


FIGURE 17.2 Pigouvian taxes.

The imposition of a tax equal to the marginal externality (distance *EF*) equates the private marginal cost *MC* faced by the paper mill with the social marginal cost *MC'* and thereby induces the mill to produce at the optimal level for society (point *D*).



Pareto efficiency (= Pareto optimality)

- a concept in economics
- named after Vilfredo Pareto (an Italian economist who studied economic efficiency and income distribution)
- Situations in which it is **impossible to make one person better off without necessarily making someone else worse off**.

…a related concept is that of

Pareto improvement

- given a set of alternative allocations of goods (or outcomes) for a set of individuals, Pareto improvement is a change from one allocation to another that **can make at least one individual better off without making any other individual worse off**
- an allocation is defined as "**Pareto efficient**" or "**Pareto optimal**" when **no further Pareto improvements can be made**.

… so if the market fails to achieve the most efficient outcome, looking for Pareto improvement means looking for ways to make things work more efficiently (i.e. allocate resources more efficiently, or make consumption decisions of individuals more efficient)… when the efficiency cannot be improved anymore, the market is at Pareto optimal state = Pareto Efficient allocation = Allocative efficiency

a) **on consumption side:** resources cannot be re-allocated to make one consumer better off (in terms of utility) without making another worse off; or

b) **on production side:** allocation of production inputs (capital and labor) is Pareto-efficient if it is not possible to re-allocate these inputs and produce more of at least one good in the economy without decreasing the amount of some other good that is produced

A simple illustrative example:

Imagine that Robinson Crusoe has invented a machine that can make two mangoes out of one coconut. Conversely, the machine can make one coconut out of two mangoes.

Assume that Crusoe's utility is U(c,m)=c*m (and thus marginal utilities are U'_m=c and U'_c=m meaning that the more of mangoes he consumes the happier he is from each additional piece of coconut and vice versa) .

Suppose Crusoe has, initially, four mangoes and four coconuts. Is that Pareto-optimal allocation? If not, what would Crusoe have to do to get a P-O allocation?

	he'll end up with	Robinson's final utility (c*m)
doing nothing	4 coconuts + 4 mangoes	16
converting 1 coconut into 2 mangoes	3 coconuts + 6 mangoes	18
converting 2 coconuts into 4 mangoes	2 coconuts + 8 mangoes	16
converting 2 mangoes into 1 coconut	5 coconuts + 2 mangoes	10
converting 4 mangoes into 2 coconuts	6 coconuts + 0 mangoes	0

You can work through all the alternative allocations but it is easy to see in which case his utility function will be the highest… Robinson would obviously end up with 3 coconuts and 6 mangoes in the P-E allocation.

Note that more formally, you can solve the problem using the concepts of Marginal rate of transformation… those interested can find the solution in Schotter's textbook, Chapter 15, Solved Problem 15.1 (p. 581 in the 3rd edition)

This is just a simplest case, with just one individual, Robinson Crusoe. What if we take into account also his "Man Friday", whose utility over coconuts and mangoes might be different? Or even a larger economy with number of consumers and producers…. with potential externalities…

⟶ **Social efficiency** – efficient allocation from the social point of view when the total social (including external) costs are accounted for

Typical causes of market failures:

i) **externalities**

ii) **public goods or common goods ("the tragedy of the common")**

iii) market power (imperfect/no competition)

i) and ii) are interesting from the point of view of environmental economics (more details to follow), iii) is not so important for us now…

Public good

- is a good that is **non-rivalrous** and **non-excludable**.
- **Non-rivalrous** means that consumption of the good by one individual **does not reduce availability of the good for consumption by others**;
- **Non-excludable** means that **no one can be effectively excluded from using the good**.
- Non-rivalness and non-excludability may cause problems for the production of such goods
- markets alone might fail to produce optimal (or desired, for that matter) amount of public goods -> market failure.
- environment in general is an example of public good

In real world, there may be no such thing as an absolutely non-rivaled and non-excludable good; but we can get close enough… also, some goods might be mixed…

Examples of public goods (can you think of any?):

Here come some….

a) light houses (cannot exclude ships from using it)

b) defense and **law enforcement**

c) fireworks

d) streetlights

e) roads

f) informational goods (software development, authorship, invention)

g) environmental goods (clean air, clean water….environmental protection in general)

Some goods are **"mixed"** in a sense that they have the properties of both, private and public goods

a) excludable but non-rival (like cable TV)

b) non-excludable but rival (like public park… with too many visitors it becomes less enjoyable)

Free rider problem

- **is a central problem and a reason why public goods often lead to an instance of market failure…**
- individually-rational and self-interested behavior on the market might result in an inefficient outcome – typically in underproduction, or no production at all, of public good… as individuals cannot be excluded from consumption of public good, they can often take advantage of public goods without contributing sufficiently to their creation. If private organizations don't reap all the benefits of a public good which they have produced, their incentives to produce it voluntarily might be insufficient.
- this is called the **free rider problem** and relies on assumption of individual rationality and self-interest maximization – if in unregulated market an individual cannot be excluded from consumption of public good (breathing clean air, riding good roads…etc) and there is no mechanism to ensure his contribution to creation of that good, why should a self –interested rational individual pay for something s/he would get to consume anyway? that is why the government often has to step-in regulating, collecting taxes, etc… to correct the market failure and ensure the production of public good

Example

- consider national defense, a standard example of pure public good.
- suppose an individual thinks about exerting some extra effort to defend the nation.
- benefits to that particular individual might be very low (especially if the "defending activity" is not geographically close to our individual and he/she might not face immediate threat of being affected by the war)

- on the other hand, there is a high possibility that he or she could get injured or killed during the course of his or her military service.
- importantly, a free rider knows that he or she cannot be excluded from the benefits of national defense, regardless of whether he or she contributes to it (as long as the army exists, it does not matter too much whether there is one more soldier or not).
- thus a rational individual would not voluntarily exert any extra effort, unless there is some inherent pleasure or material reward for doing so (for example, money paid by the government, as with all-volunteer army or mercenaries).

Now, **to establish a national defense system**, the government needs to

- determine how much money to spend on it – small vs. huge military complex
    - needs to know the cost of each alternative
    - and know the maximum willingness of each member of the society to pay these costs

      -> how to find out? Well, the government could try to ask…

But that is not so simple…

…Suppose you know that everyone is reporting their true willingness to pay. You also know that there are so many people in the society that your response, however small, will not affect the level of national defense. In that case, you have no incentive to report truthfully -> your "economically rational" response would be to say that you are not willing to pay for national defense. But if everyone would do so…..

Questions for an economist? (Schotter, Chapter 18)

i) what is the optimal amount of public good to produce , and what conditions must be satisfied at such optimum?

ii) How can economy achieve that optimum?

iii) Will free markets be able to achieve that optimum, or must the government help the economy to coordinate its activities?

Solutions:

a) **Lindahl "free market solution"**

– relies on everyone truthfully revealing their preferences for public good; then the government serves as a "coordinator" (no intervention)

- sets everyone's' share on the total cost if the good is provided
- people face prices and the market will take care of the rest: people will maximize their utility and state their demand for the public (as well as private) good.

– In the equilibrium, prices of private goods and shares on cost of public good are set such that no one wishes to change his/her demand for private and for public goods + supply of private

good equals the demand + everyone consumes the same amount of public good (due to non-excludability).

Problem: incentives not to be truthful in revealing one's preferences.

Proposed solution:

i) a **demand-revealing mechanism**

- imagine a dark street and three equally costly plans to install streetlights (one very bright streetlight or combinations of less bright streetlights)
- ask inhabitants, how much they are willing to pay for each of the proposed plans and implement the one that maximizes the total willingness to pay)

  → still there is no guarantee that collected contributions will cover the total cost of implementing the streetlight plan.

ii) an **auction election mechanism:**

- people submit their bids (bidding the money one is willing to pay and the quantity demanded);
- then if public good is produced, everyone pays the difference between the cost and sum of the bids made by other people multiplied by average quantity demanded
- Everyone has a right to refuse his or her cost share
- If all people agree to pay their costs share the demanded quantity is produced.
- If no agreement is reached, public good is not produced – the experimental evidence suggests that people in general do not seem to be truth-telling (Smith, 1977)

b) **Coase argument**: with no transaction cost and unilateral property rights, most conflicts could be resolved by private bargaining [more on that later]

c) **Government provision** (public good financed by tax revenues)

- it might be difficult to ensure the government has an incentive to provide the optimum amount even if it were possible for the government to determine precisely what amount would be optimum

d) A government may **subsidize production of a public good in the private sector;**

- unlike government provision, subsidies may result in some form of competitive market.
- Principal-agent problems can still arise between the citizens and the government or between the government and the subsidized producers.

e) an **exclusion mechanism (club goods)** is another solution, which has evolved for information goods, is to introduce exclusion mechanisms which turn public goods into club goods. One well-known example is copyright and patent laws. These laws, which in the 20th century came to be called intellectual property laws, attempt to remove the natural non-excludability by prohibiting reproduction of the good. Although they can address the free rider problem, the downside of these laws is that they imply private monopoly power and thus are not Pareto-optimal.

f) support public mindedness by **tradition** and **social norms** (a non-market solution)

Tragedy of the commons (Hardin, 1968)

Tragedy of the commons

(From Wikipedia, the free encyclopedia)

"The Tragedy of the Commons" was an influential article written by Garrett Hardin and first published in the journal Science in 1968. The article describes a dilemma in which ***multiple individuals acting independently and solely*** *and rationally consulting their* ***own self-interest*** *will* ***ultimately destroy a shared limited resource*** *even when it is clear that it is not in anyone's long term interest for this to happen. More usually, the phrase does not refer to the article per se, but to the dilemma itself, typically in application to some circumstance to which it is thought to apply. Many, perhaps most, who use it are not aware of, nor have read, Hardin's essay, but are looking at conceptually parallel situations.*

Central to Hardin's article is an example, a hypothetical and simplified situation from medieval land tenure in Europe, of herders sharing a common parcel of land (the commons), on which they are each entitled to let their cows graze. In Hardin's example, it is in each herder's interest to put the next (and succeeding) cows he acquires onto the land, even if the carrying capacity of the commons is exceeded and it is damaged for all as a result. The herder receives all of the benefits from an additional cow, while the damage to the commons is shared by the entire group. If all herders make this individually rational economic decision, the commons will be destroyed to the detriment of all.

- the problem arises when property rights are not well defined (hence the “commons”)
- private property then provides a mechanism to avoid externalities – he who owns, cares about the property and controls its use + can exclude others from overusing it (see the discussion in Hardin as well)
- private property is not the only available mechanism – regulations work as well (with legal system to enforce them)

Examples (can you think of any?):

a) over-herding cows (see Hardin)

b) over-fishing (each fisherman has a negligible impact on the total fish stock… but too many fisherman might result in serious depletion)

c) automobile pollution – each automobile lowers the air quality and it is not likely that the free market would result in the optimal amount of pollution → emission standards for automobiles → **Illustration:**

- 1963 Clean Air Act and its amendments set automobile emission standards for the manufacturers of vehicles in the US and Lawrence White examined the costs and benefits of this program
- cost of emission control equipment is estimated at $600 per car, extra maintenance cost at $180 per car, the cost of reduced gasoline mileage and the necessity of unleaded gasoline at about $670 per car → total cost at $1450 (in 1981 dollars)
- White identifies following problems:
  - everyone who buys a car must pay extra $1450, whether they live in high pollution area or not
  - most of the responsibility falls on the manufacturer, only little on the user → car owners have little incentives to keep the pollution control equipment in working order unless they are inspected
  - no incentive to economize driving – people who drive 2000 miles in less polluted areas pay exactly the same amount of money as people who drive 500,000 miles in heavily polluted areas → it would make sense to encourage people to drive less (at least in heavily polluted areas)
- Alternative solution that White offers: **effluent fees**
  - annual inspection of all vehicles estimating the car's likely emissions during the past year
  - different communities (areas) could levy different fees → people would face the true cost of generating pollution, which would encourage them to generate "socially optimal amount of pollution" (or, well, at least closer to it)
  - **Why should it work better?**
  - the system would encourage the owners to search for low-cost ways of reducing their emissions, including changing their driving habits and type of vehicle (more eco)