UNIVERSITY OF HOHENHEIM
Institute for Agricultural Policy and Agricultural Markets

Environmental Policy and Legislation

4201-431

ENVIRONMENTAL POLICY

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Lecture Topic 4

Lecture notes and further information:
http://www.uni-hohenheim.de/apo

OUTLINE TOPIC 4

- **Environmental Regulation**
  - Command and Control Approaches
  - Taxes and Subsidies
  - Tradable Permits

Key criteria concerning the choice of environmental policy instruments

1. Environmental effectiveness
2. Economic efficiency
3. Incentive
4. Flexibility
5. Simple mode of operation
6. Cost of implementation

Key criteria concerning the choice of environmental policy instruments

7. Integration in sectoral policies
8. Minimization of regressive distributional effects
9. Political acceptability
10. Economic impact
11. Trade and international competitiveness
12. Conformity with international agreements

Command and Control Policies for the Environment

⇨ **Command and Control Regulation uses the *setting of standards*.**

- A standard is a mandated level of performance that is enforced by laws and regulations.
- A standard simply makes excessive amounts of pollution illegal.
- In principle, the government can set the standard to yield the efficient level of pollution control.
- Different types of standards: Ambient, Emission and Technology Standards

Command and Control Policies for the Environment

1. AMBIENT STANDARD

- Regulates the amount of pollutant that is present in the surrounding (ambient) environment.
- Examples:
  - parts per million (ppm) of dissolved oxygen in a river;
  - sulphur dioxide (SO2) in an air shed;
  - ground level ozone levels (ppm).
- Measures are often an average (e.g. over a 24 hour period, or per year). ⇨ Why?
- Note: The level itself cannot be directly enforced to secure that the ambient standard is met; ⇨ it is rather the ***source of pollution*** *that must be found and regulated*

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Command and Control Policies for the Environment

2. EMISSION STANDARD

- Regulates the level of emission that is legally allowed (i.e. pollution is allowed, but the level of pollution is regulated)
- Examples:
  - emission rates (pounds of SO2 per hour);
  - concentration (ppm of biochemical oxygen demand in wastewater);
  - total quantity of a pollutant;
  - residuals per unit of output (sulphur content of coal);
  - percentage removal of pollutant (90% of SO2 scrubbed).
- But: Emission standards do not guarantee a specific ambient level of pollution. ⇨ Why?

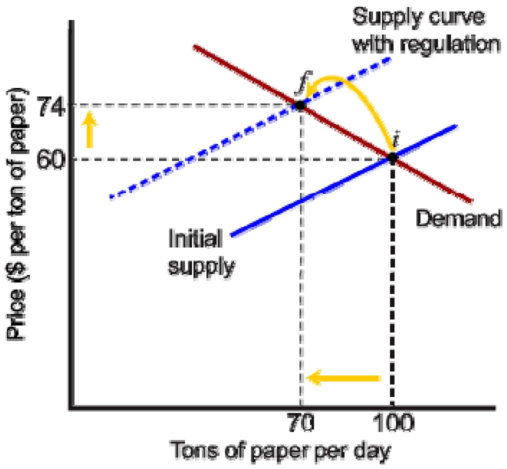
Command and Control Policies for the Environment

3. TECHNOLOGY STANDARDS

- Require polluters to use certain technologies, practices, or techniques.
- Often, government mandates that the Best Available Control Technology (BACT) must be used.
  But: BACT is often not clearly defined.
- Example:
  - catalytic converters in cars;
  - specific scrubbers in manufacturing industry.

Market Effects of Command and Control

Example:



- The CAC policy increases the cost of producing paper, shifting the market supply curve to the left.
- The equilibrium price increases to $74 per ton, and the equilibrium quantity decreases to 70 tons per day.

➪ that means?

Command and Control Policies for the Environment

Economic Analysis of Standards:

A. SETTING THE STANDARD

- First question: deciding at what level to set the standard.
- Efficiency calls for setting the standard where MAC=MD. Problem: Does the regulator know MAC and MD?
- Alternative guide to setting regulation:
  - ‘zero-risk’ ➪ appropriate for cases in which there is a threshold;
  - allow ‘reasonably small’ damages ➪ but: what is reasonable?

Command and Control Policies for the Environment

Economic Analysis of Standards:

B. SHOULD STANDARDS BE APPLIED UNIFORMLY?

- **Is it appropriate to have uniform standards across regions?**
  - If marginal damages differ across regions, an uniform standard cannot be efficient in both jurisdictions.
  - But: having different standards increases costs to the government.
- **Should standards be the same across firms?**
  - Efficiency is achieved when MAC is equal across firms, which won't happen with uniform standards unless the MAC curves are the same.

Command and Control Policies for the Environment

Economic Analysis of Standards:

C. ENFORCEMENT

- Self-monitoring is often used
  (i.e. firms have to keep own records of emission, because they are subjected to surprise audits)
- Enforceability helps to determine which types of standards are appropriate (e.g.….)

D. INCENTIVE TO DO INNOVATION

- *Command and Control provides little incentive to innovate!*
  - there are incentives to avoid the costs of regulation, <u>but</u> no incentives to exceed the level of regulation (e.g.….)

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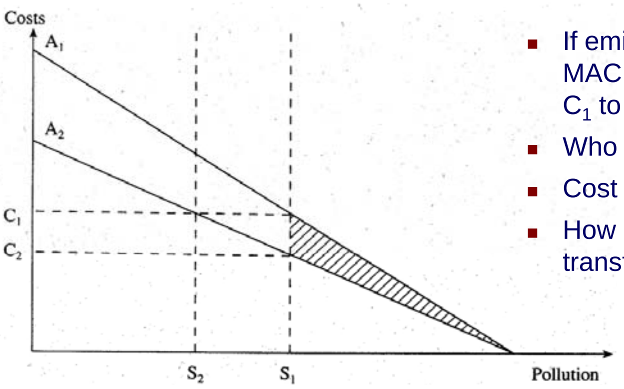
Command and Control Policies for the Environment

Innovation and Pollution Abatement Costs:

- *Assumption:* technical progress enables industry to lower its marginal cost of pollution abatement from A_1 to A_2.



- If emission standard is S_1: MAC will decrease from C_1 to C_2
- Who benefits?
- Cost reduction for industry
- How can the benefit be transferred to society?

⇨ Industry will be reluctant to reveal new technologies. ⇨ Why?
⇨ Not easy to ensure that benefits of TP are effectively transferred to society.

CAC and VINTAGE-DIFFERENTIATED REGULATION

Vintage-Differentiated Regulation (VDR) is a common feature of many environmental and other regulatory policies.

<u>What does VDR mean?</u>

⇨ Standards for regulated units are fixed in terms of the units' respective dates of entry, with later vintages facing more stringent regulation.

⇨ most common application (referred to as *"grandfathering"):* units produced prior to a specific date are exempted from a new regulation or face less stringent requirements.

- Examples can be found in environmental laws concerning air and water pollution, or affecting the generating and disposal of hazardous and solid waste.

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CAC and VINTAGE-DIFFERENTIATED REGULATION

- Example for VDR outside environmental issues:
  Safety standards in cars

What is the general argument for VDR?

⇨ Emissions will decline as old plants/factories are retired and replaced by new ones

- The VDR approach appeals to many in the policy community
  - looks like it would be cost-effective?
  - seems fair?

CAC and VINTAGE-DIFFERENTIATED REGULATION

BUT:

- VDRs might retard turnover in the capital stock!

  (e.g. think about energy efficiency & other standards for new residential construction; new enviro. standards at power plants).

⇨ VDR can be costly and environmentally counterproductive:

- Higher costs for new or upgraded sources than for existing sources = disincentive for investment in new plants or upgrading existing ones.
- Firms are motivated to keep old (and dirty) plants operating, and hold back on investments in new (and cleaner) technologies.
- As a consequence, due to VDR we might end up with higher levels of pollution, than would occur in the absence of regulation.

CAC and VINTAGE-DIFFERENTIATED REGULATION

Explanation of Prevalence of VDRs:

- Policy makers & others frequently claim that VDRs are efficient and equitable.
- In short term, it's often cheaper to control pollution by adopting technology at new plant rather than retrofitting an older, existing plant. ⇨ So, VDRs can be cost-effective;

BUT:

- static (short-term) view ignores the negative dynamic incentive that VDRs can create.
  - ⇨ Old plants emit the vast majority of total pollution in any sector;
  - ⇨ With VDR there is no continuous and effective incentive for emissions reduction at those plants.

CAC and VINTAGE-DIFFERENTIATED REGULATION

⇨ that means: with VDR many of the most cost-effective emissions reduction opportunities are left untouched!

- In terms of equity, it may appear to be *fair* to avoid changing rules for facilities that have already been built, and focus only on *new* facilities.

  BUT: is VDR fair to everybody?

⇨ Explanations for VDR often comes from positive political economy

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TAXES and EMISSION FEES

"PIGOUVIAN TAX":

= a tax levied on each unit of a polluter's output (that is: output of the final product) in an amount equal to the marginal damage that it inflicts at the efficient level of production.

⇨ the goal is to set the tax so that the polluter incorporates the social cost.

- Note: Pigouvian taxation is a *second-best solution*, as we are taxing the output of the final product
  - It would be better to tax the pollution directly (as we do with emission fees/taxes) ⇨ but that's not always possible
- The Pigouvian tax works by internalizing the cost of the externality ⇨ the same thing can be done by a *subsidy*.

TAXES and EMISSION FEES

SUBSIDY (= negative tax):

⇨ In the case of a subsidy, the opportunity cost of polluting would be to lose the subsidy.

- Types of subsidies:
  - abatement equipment subsidy: pays a firm for adopting a specific abatement technology.
  - per unit subsidy: pays a firm for each unit of pollution reduced below some predetermined level.
- Problems with subsidies:
  - distributional effects;
  - firms may enter market to make a profit out of the subsidy, i.e....
  - need to raise taxes to pay for subsidies;
  - ethics? Should we have to pay to avoid pollution?
  - often politically motivated, and inefficient.

TAXES and EMISSION FEES

EMISSION FEE/TAX:

= a payment (fee) for each unit of pollutant discharged into the environment or for each unit of environmental damage.

- Recall: the problem with externalities is that they are not reflected in prices (market failure).
  - ➪ The government can rectify the problem by setting a price for a pollution.
  - ➪ Goal: set the fee so that the polluter incorporates the social cost.
- If MAC is known, simply set the fee equal to MAC at the optimal level of pollution. The firm will find it beneficial to abate up to this point ➪ Why?
- If MAC is unknown, the fee should be based on the expected value (the 'best guess' of MAC).

TAXES and EMISSION FEES

EMISSION FEES (cont.):

- Main advantage of emission fees:
  When there is more than one polluter, they achieve a given level of pollution control at the lowest possible cost.
- An efficient solution is found when the MAC are equal across all firms. ➪ At this point, there is no way to shift abatement responsibilities among the firms and achieve a lower total cost.
- BUT: The cost to each individual firm is higher, because firms pay both, abatement costs and the fees ➪ thus emission fees are political unpopular
- What about innovation?
  - ➪ *Emission fees encourage innovation!*
    - If a firm lowers its MAC, it can abate more and pay less in fees.

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TAXES and EMISSION FEES

Example: Cost per ton of paper with varying amounts of pollution

Waste per Ton (Gallons)	Average Production Cost per Ton	Tax Cost per Ton	Average Total Cost per Ton
5	**$ 60**	**$20**	$ 80
4	**$ 61**	**$16**	$ 77
3	**$ 64**	**$12**	**$ 76**
2	**$ 71**	**$ 8**	$ 79
1	**$ 86**	**$ 4**	$ 90
0	**$116**	**$ 0**	$116

- As the firm decreases the volume of waste, it becomes progressively more expensive to decrease it further.
- The production cost increases while the tax cost decreases.
- The total cost per ton is minimized at $76 with 3 gallons of waste.

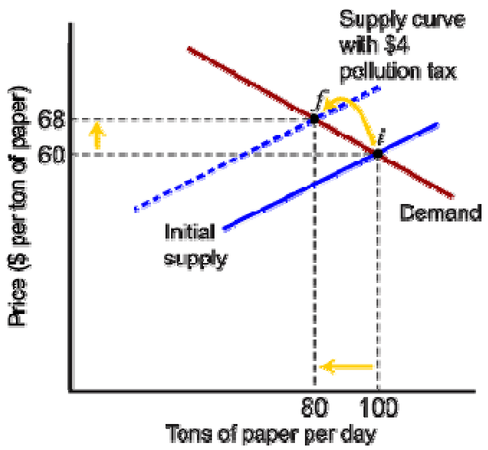
TAXES and EMISSION FEES

So what will be the firm's response to a Pollution Tax?:

- ⇨ Pollution abatement is subject to diminishing returns.
- ⇨ As the firm continues to decrease the volume of waste it produces, it becomes progressively more expensive to decrease it further.
- ⇨ The firms will question whether to continue to generate waste and pay taxes, or to spend some money to reduce waste.

TAXES and EMISSION FEES

The Market Effects of a Pollution Tax:



- The pollution tax increases the cost of producing paper, shifting the market supply curve to the left.
- The equilibrium moves from point *i* to point *f*.
- The tax increases the equilibrium price from $60 to $68 per ton and decreases the equilibrium quantity from 100 to 80 tons per day.

TAXES and EMISSION FEES

The Market Effects of a Pollution Tax (cont.):

As seen from the example:

⇨ The pollution tax affects the total volume of waste dumped in two ways:

- *Abatement:* there is less waste per ton of paper (3 gallons instead of 5 gallons per ton).
- *Lower output:* the industry produces less paper (80 instead of 100 tons per day).

EMISSION FEES/TAXES - *Implementation issues:*

- **What is to be taxed (what is the tax base)?**

  ⇨ might be direct or indirect

- **Who is to be taxed?**

  ⇨ this question focuses more on administration than on the ultimate incidence

- **What tax rate to impose?**

  ⇨ knowing MD is difficult

- **Are there ancillary policy goals?**

  ⇨ common conflict: revenue vs. abatement

EMISSION FEES/TAXES - *Implementation issues* (cont.)*:*

- **What should be done with the revenue?**

  Some economists have argued that these taxes not only help the environment, but that they also improve economic efficiency ⇨ *double-divided hypothesis*.

  - Theoretical argument for *ddh:* most taxes cause distortions in the economy. However, environmental taxes correct a distortion
  - If we use the revenues from environmental taxes to lower other taxes, the economy as a whole benefits

  BUT: Economists have not found evidence for such benefits (mainly because the tax base for environmental taxes is much smaller than the one for more general taxes, e.g. income taxes)

- **Distributional issues**

  ⇨ concerns about equity might make some environmental taxes politically unpopular

TRANSFERABLE EMISSION PERMITS

⇨ ***Underlying principle***: any increase in emissions must be offset by an equivalent decrease elsewhere.

HOW IT WORKS:

1. **Government begins by setting the desired level of emissions** (considering overall MAC and MD).

   ⇨ Thus, government has control over the final amount of pollution.

2. **Firms are issued permits to emit pollutants.**

   - Only the desired number of permits is issued.

   ⇨ Thus, the quantity is assured.

TRANSFERABLE EMISSION PERMITS

HOW IT WORKS (contd.):

3. **Allow firms to buy and sell permits.**

   ⇨ Firms with higher MAC will be willing to buy permits from firms with lower MAC.

   - If the price paid is less than the MAC of the high-cost firm, it is better off.
   - If the price is greater than the MAC of the low-cost firm, it is better off.
   - Such trades are possible until MAC is equal across firms.

   ⇨ Thus, permit trading allows a given level of pollution control to be achieved for the least possible cost.

TRANSFERABLE EMISSION PERMITS

Example: Abatement Costs: Low-Cost Firm Versus High-Cost Firm

Waste per Ton (Gallons)	Production Cost per Ton: Firm with *Low* Abatement Cost	Production Cost per Ton: Firm with *High* Abatement Cost
5	$60	$60
4	$61	$67
3	$64	$82
2	$71	$112
1	$86	$172
0	$116	$300

- Half the paper mills can abate pollution at a low cost.
- Half the paper mills have high abatement costs.

⇨ Suppose the government issues 4 marketable permits to each paper mill.

TRANSFERABLE EMISSION PERMITS

Example (cont.): Abatement Costs: Low-Cost Firm Versus High-Cost Firm

- Each firm holds 4 permits
- If a firm wants to generate 5 gallons of waste per day, it can buy a fifth permit from another firm.
- The high-cost firm saves $7 in production costs from the fifth permit, so it is willing to pay up to $7 to obtain it.
- If the firm with low abatement costs sells one of its four permits, it could generate only 3 gallons of waste, thus increasing its production cost by $3.
- The low-cost firm is willing to accept any amount greater than $3 for a permit.

TRANSFERABLE EMISSION PERMITS

IMPLEMENTATION ISSUES – *Initial Distribution*:

Can be done in different ways:

- The government can auction permits to highest bidder
  – raises revenue for the government
- Equal distribution among firms
  – may seem more fair, but what if firms are of different sizes?
- Historical emission rates
  - i.e. more permits to bigger polluters (“grandfathering”)
  Problem: this is a penalty for early actors
- Combined systems are also possible
  – e.g. all firms receive a basic volume of emission permits, but government holds back some permits for auction

TRANSFERABLE EMISSION PERMITS

IMPLEMENTATION ISSUES – *Establishing Trading Rules:*

- For a market to work, transaction costs must be considered.
- But: monitoring and enforcement are necessary.
  - monitoring can be very costly;
  - enforcement: stiff penalties provide incentive for a high degree of compliance.
- Who should be able to participate?
  - e.g. should environmental groups or private individuals be allowed to buy permits and then not use them?

TRANSFERABLE EMISSION PERMITS

IMPLEMENTATION ISSUES – *Geographical Considerations*:

- For some types of pollution (e.g. CO2), it doesn't matter where it is emitted.
- For others (e.g. carbon monoxide in a city) location does matter.

⇨ A *tax system* would deal with this by charging higher fees in areas where pollution is a bigger concern.

Ways for a permit system to deal with geographical concerns:

a) ambient-based permit system
  - permits needed for pollution as measured at each receptor

b) limit trading to within regions
  - limits trades to areas where the emission have the same effect
    BUT: this might prohibit some beneficial trades

TRANSFERABLE EMISSION PERMITS

IMPLEMENTATION ISSUES – *Incentives for innovation*

- The incentives for innovation are the same as with an emission fee.
- Consider two cases:
  1. A firm has enough permits to cover its pollution...
  2. A firm does not have enough permits to cover its pollution...
- BUT: Even with more incentives for innovation than under CAC, the *total* level of pollution need not to fall, since permits that are sold may be used by someone else.
- *BUT:* if government reduces the amount of permits (i.e. retracting permits) *total* level of pollution will fall!