

Professional Career Program

Environmental Economic Theory

No. 9

(11 December 2018)

Chapter 11. Command-and-control strategies: The case of standards

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Textbook: Barry .C. Field & Martha K. Fields (2009)
Environmental Economics - an introduction, McGraw-Hill,
International Edition

PCP Environmental Economic Theory (Hosoda)

Homework 9

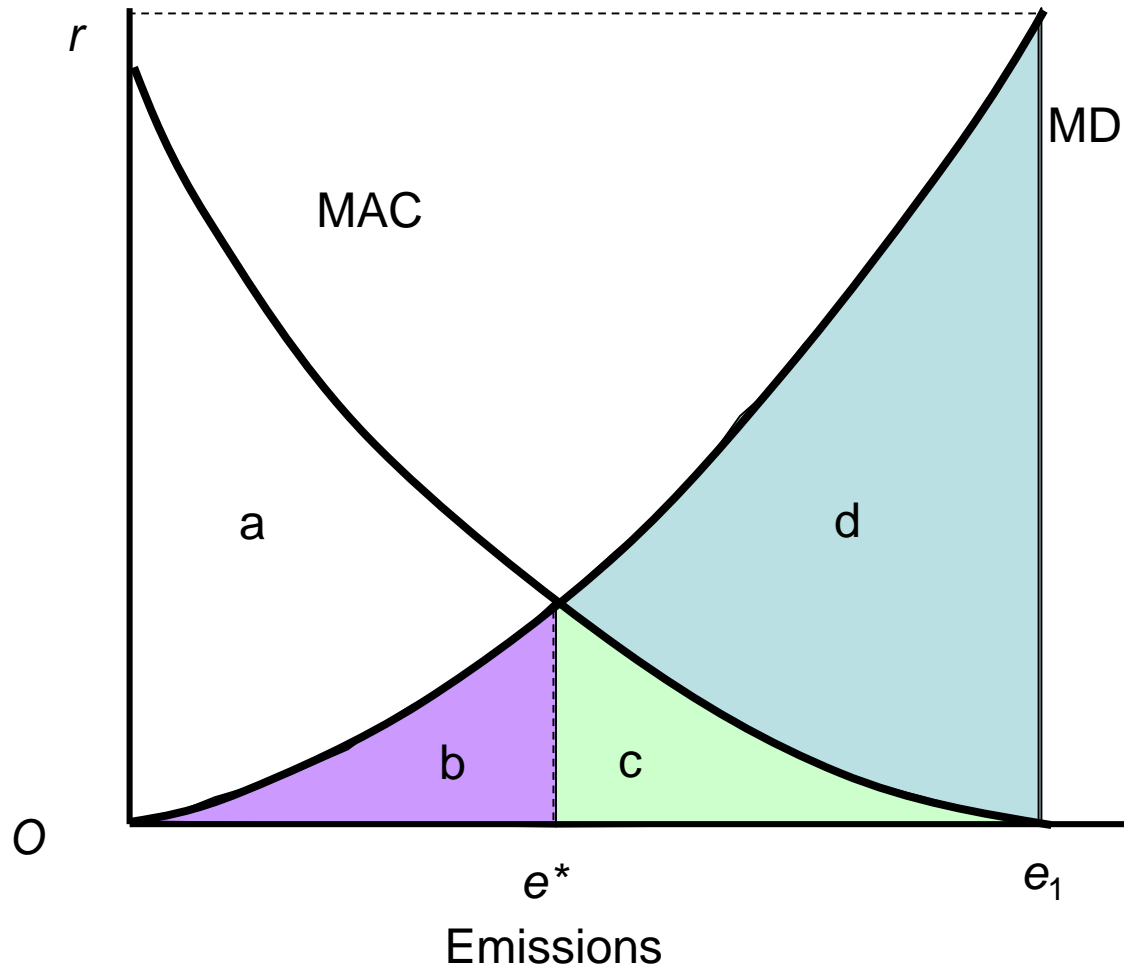
11 December 2018

- Theme: *“Choose any pollution which occurred in your country in the past, say, water pollution, air pollution, soil pollution etc, and explain how the government or communities tried to solve the problem, whether the result is acceptable or not.*
- Language: English.
- Volume: A4 two pages. Single space. 12 points.
- **Submission period: 9 a.m. 17 December 2018 – 9 a.m. 18 December 2018.**
- Submission: Submit your paper in a pdf file. A file name must be **“HW9.xxx.pdf”** (xxx=your name). Send your file to hosoda@econ.keio.ac.jp.

Review of the last lecture

- Decentralized policies represented by (1) liability laws (rules), (2) property rights and (3) voluntary action work very well in certain circumstances.
- This is because the individuals involved in a case of environmental pollution try to sort out problems themselves.
- One of the good examples is the voluntary negotiation which is considered by the Coase Theorem.

Review of the Coase Theorem



If a polluter is liable for the damages which he/she has caused, he/she must compensate the amount represented by the area $(b + c + d)$ when e_1 amount of pollutant is emitted.

If the liability rule is given, a would-be polluter should choose e^* . (Consider why so.) Notice that some damages (b) remain.

Yet, whether this actually happens depends upon the legal process.

Review of the Coase Theorem

- The Coase Theorem was derived from observations of the real problems related to externalities.
- In those problems, the core of the argument is this: to whom should property rights belong?
- People often appeal to courts in order to settle things down.

Ronald Coarse

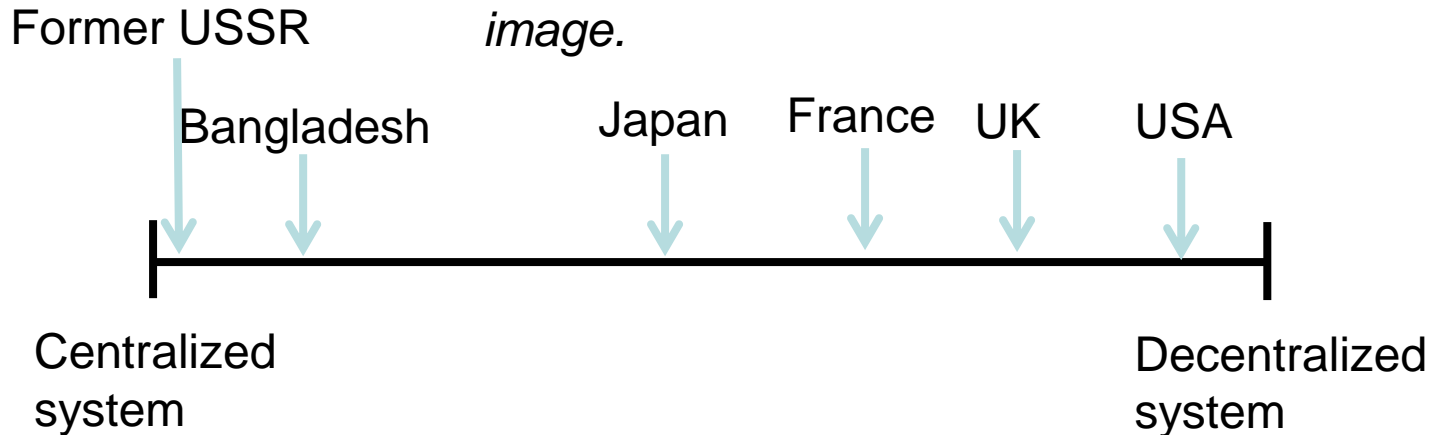
His articles are full of new insights, and without any mathematical expression.

A great economist.



Review of the last lecture (cont.)

Each country is located on the following line-segment in terms of decentralization, although this is a *rough image*.



Clearly, decentralized policies work well in a democratic society, in which legal system is well developed so that individual freedom is guaranteed. (See Erin Brockovich.)

The purpose of this lecture

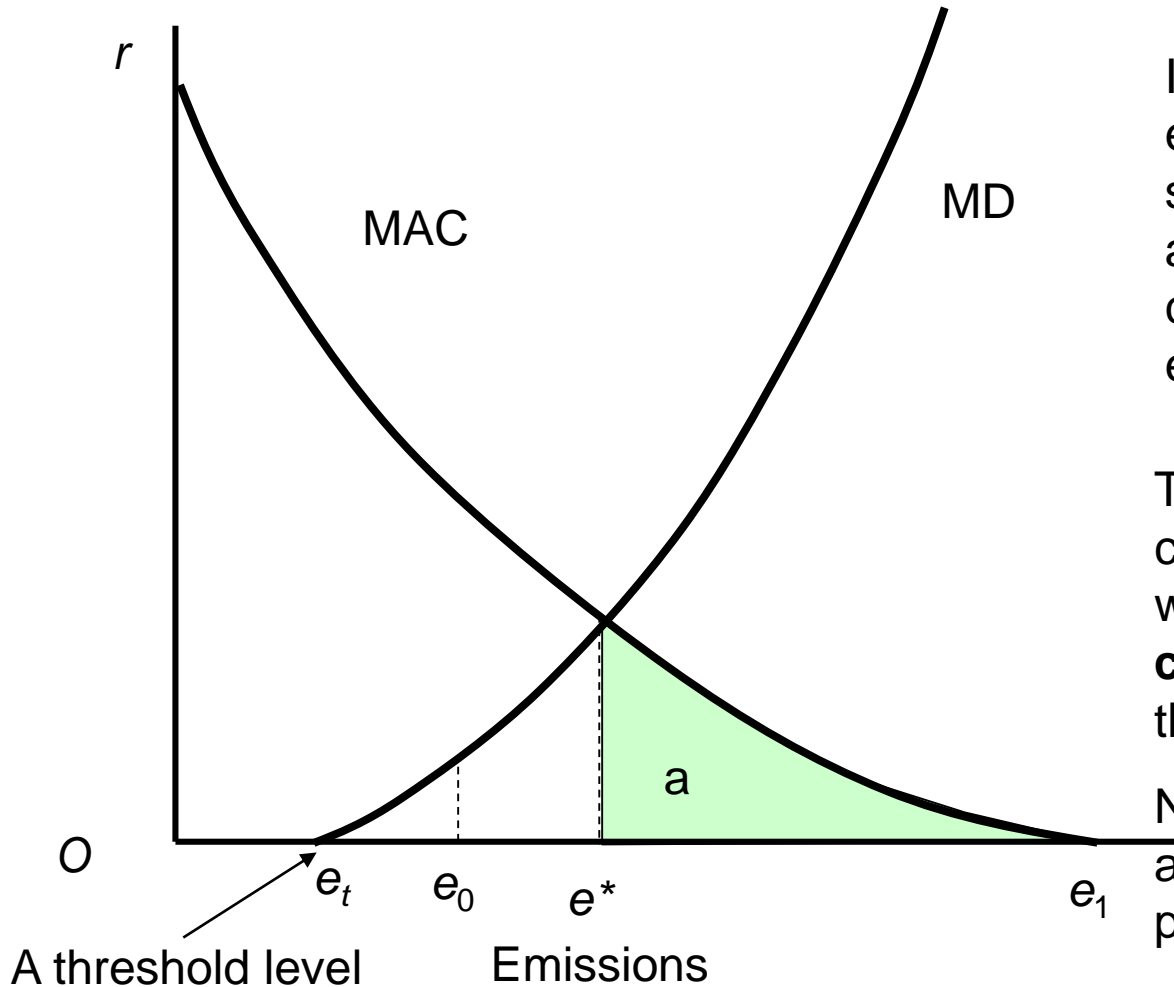
We study command-and-control (CAC) approach, where, in order to bring about socially desirable circumstances, authorities mandate the behavior in law, and then use whatever enforcement machinery – courts, police, fines and so on – that is necessary to get people obey the law.

This approach consists of relying on **standards** of various types to bring about improvements in environmental quality.

CAC and regulations/standards

- Command-and-control is based upon regulations and standards which are stipulated in laws.
- Thus, CAC is used interchangeably with regulations and/or standards.
- The former concept is more often used in the context of governmental action for environmental protection, while the latter in the legislative context.

Explanation by means of a figure



If the authorities are wise enough to be able to set the socially efficient level of emission at e^* , it is just mandated, and can be an upper limit for the emissions.

The total abatement cost in this case is represented by the area a , which can be regarded as **compliance costs** of meeting the standards.

Notice that damages still remain, and the polluter does not have to pay for the damages.

A few remarks

- Zero-emission is not socially optimal in general.
- Suppose that there is a threshold level such as e_t in the previous figure.
- In this case, e_t may be chosen by CAC.
- However, in general, such a threshold level is not socially optimal.
- The point e^* is socially optimal even though there remain damages.

A simple question

- Is the government so clever that it can specify the precise amount of emission represented by e^* in the figure?
- How can the government collect the correct information on MD and MAC?
- What if it is too costly to collect the correct information required for a proper regulation?
- Is a CAC policy efficient for environmental protection?

1. Types of standards

There are three types of standard, *i.e.*,

- (1) Ambient standards: these specify the qualitative dimensions of the surrounding environment.
- (2) Emission standards: these specify the never-exceed levels which are applied to the quantities of emissions coming from pollution sources.
- (3) Technology standards: these specify technologies or practices which potential polluters must adopt.

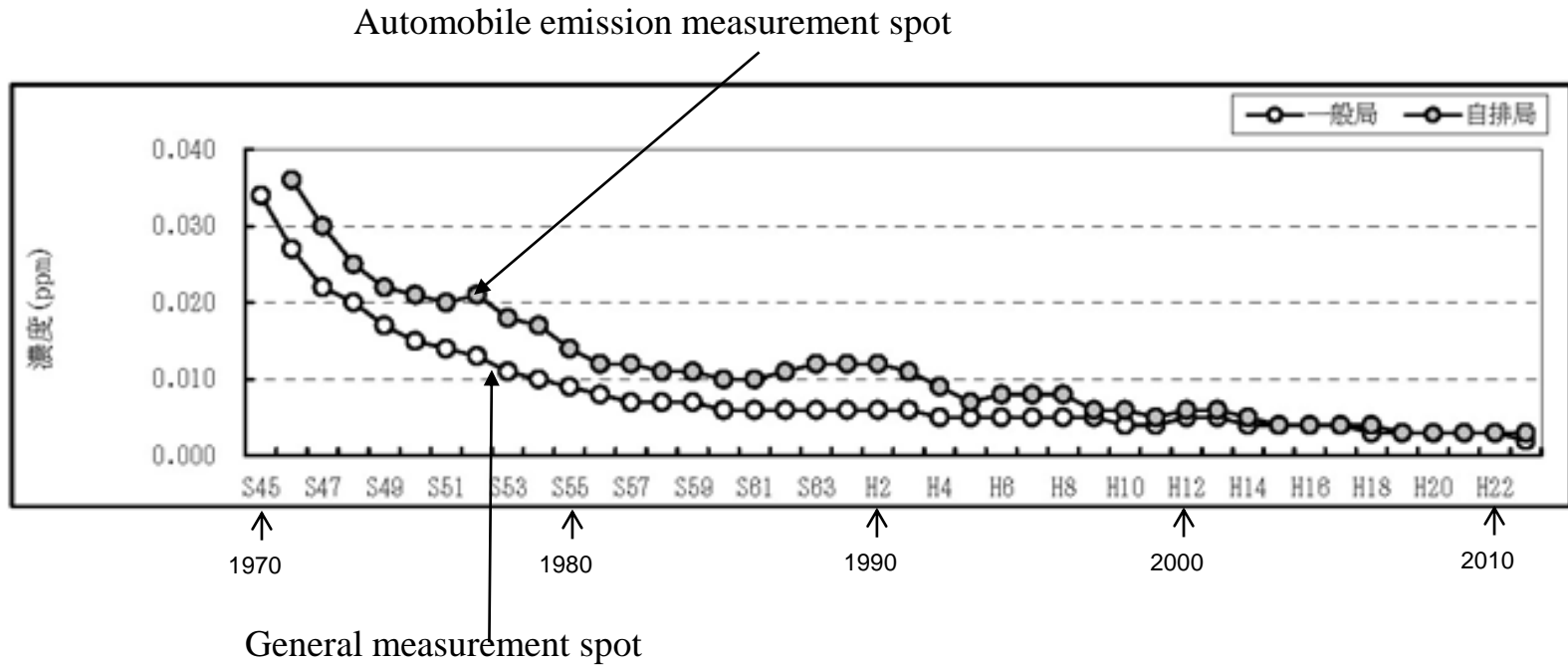
a. Ambient standards

- Ambient standards cannot be enforced directly.
- What can be enforced is the various emissions that lead to ambient quality levels.
- Ambient standards are normally expressed in terms of average concentration levels.
- Eg. The upper limit of the concentration of SO₂ in Japan is 0.04ppm/d (day average), and this is mandated.

Remarks

- There is no direct control method to attain ambient standards.
- This means that the authority must try to use several indirect methods to attain the standards.
- Thus, in some cases of pollution control, it is hard to attain ambient standards.

Concentration of SO₂



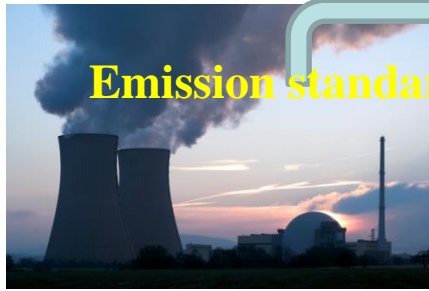
b. Emission standards

- Emission standards are directly applied to potential pollution sources.
- The distinction between ambient standards and emission standards is very important.
- There is linkage between emission levels of pollution sources and ambient quality, although the linkage is not always clearly determined.

b. Emission standards (cont.)

- Actually, the linkage is very complicated, depending upon meteorological factors, geographical factors, and so on.
- It is also affected by human decisions.
- Emissions standards are **performance standards**.

Ambient and emission standards



The relationships represented by the arrows are often vague in reality. They are affected by quite a few factors.

Remarks

- Theoretically, direct control on emission sources is made relatively without difficulty.
- If the authority were omnipotent, it could attain ambient standards by using direct control on emission sources.
- Yet, there are various types of uncertainty, so that such method is not feasible.

c. Technology standards

- Technologies, techniques or practices are sometimes specified, and firms are required to adopt them.
- This type of standard includes what are called design standards or engineering standards.
- Three standards are sometimes used in combination.

Remarks

- If a certain type of technology is specified by the authority, potential dischargers of pollutants do not have incentives to develop new technology which may be cheaper and more efficient. Nowadays, we cannot find good examples of technology standards.

Remarks (cont.)

- If incentives for developing new technology which is environmentally more friendly and less costly are killed, dynamic efficiency is damaged, so that dead weight loss occurs in a long-run.
- Nowadays, imposing technology standards, the government tends to recommend firms to adopt the best available technology (BAT) for improving environmental quality.

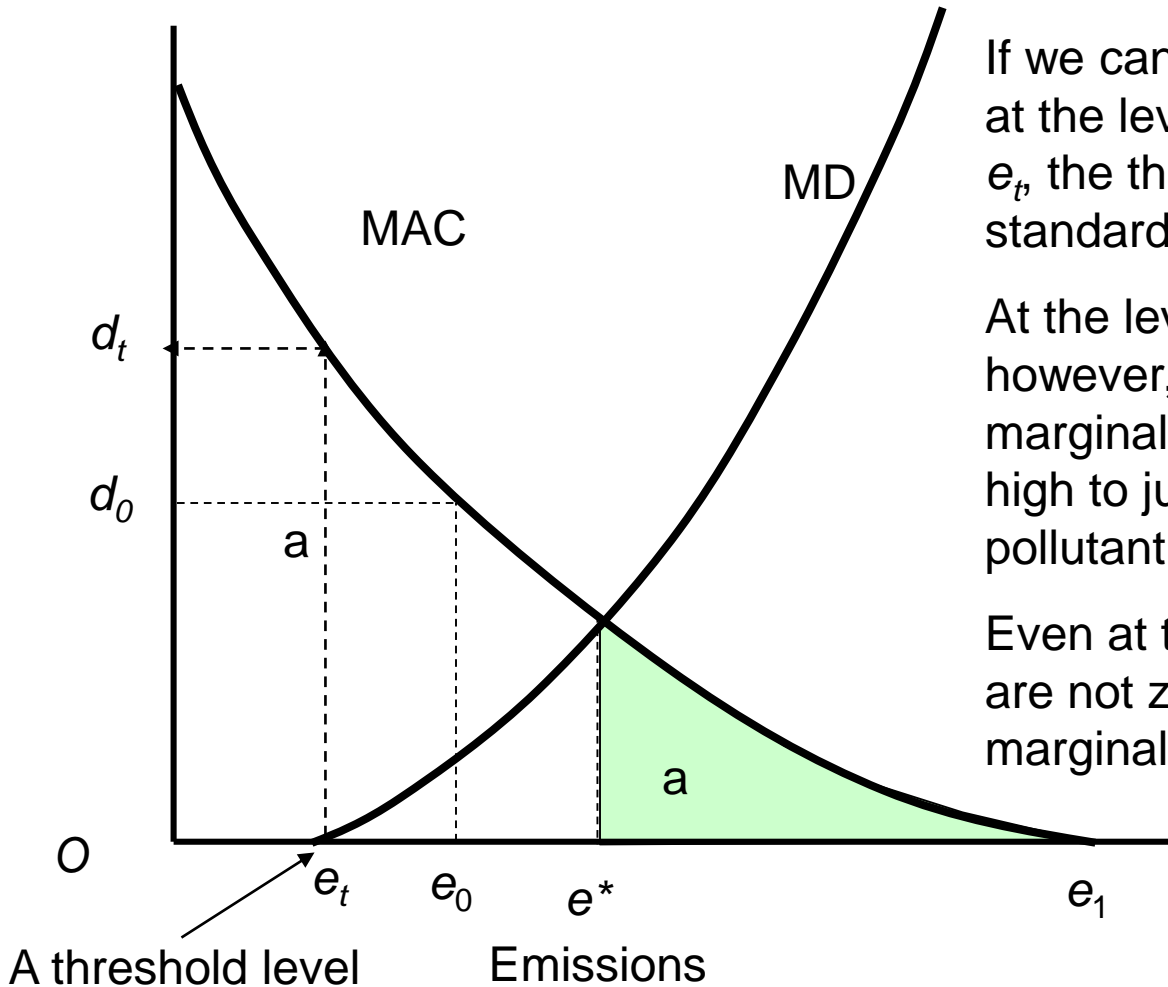
2. Economics of standards

- Standards are established in the authoritative political processes or administrative processes.
- How do authorities determine the standards?
- Only damages are taken into account or damage-abatement costs balance are taken into account, too?
- Sometimes, only damages are taken into account when standards are set.
- Thus, the social costs may not be minimized.

Zero-risk standards

- Standards are sometime set at the level where there is no risk.
- If there is a threshold level of emission which does not bring about any risk, such standards setting is possible.
- Yet, for many pollutants, there is no threshold level.
- Thus, zero-risk standards are impossible and nonsense in many cases.

Explanation by means of a figure



If we can set the emission standard at the level which is not larger than e_t , the threshold level, the no-risk standard is possible.

At the level of the threshold level, e_t , however, the corresponding marginal abatement cost (d_t) is too high to justify the reduction of pollutant emission.

Even at the level e_0 where damages are not zero but small enough, the marginal abatement cost is still high.

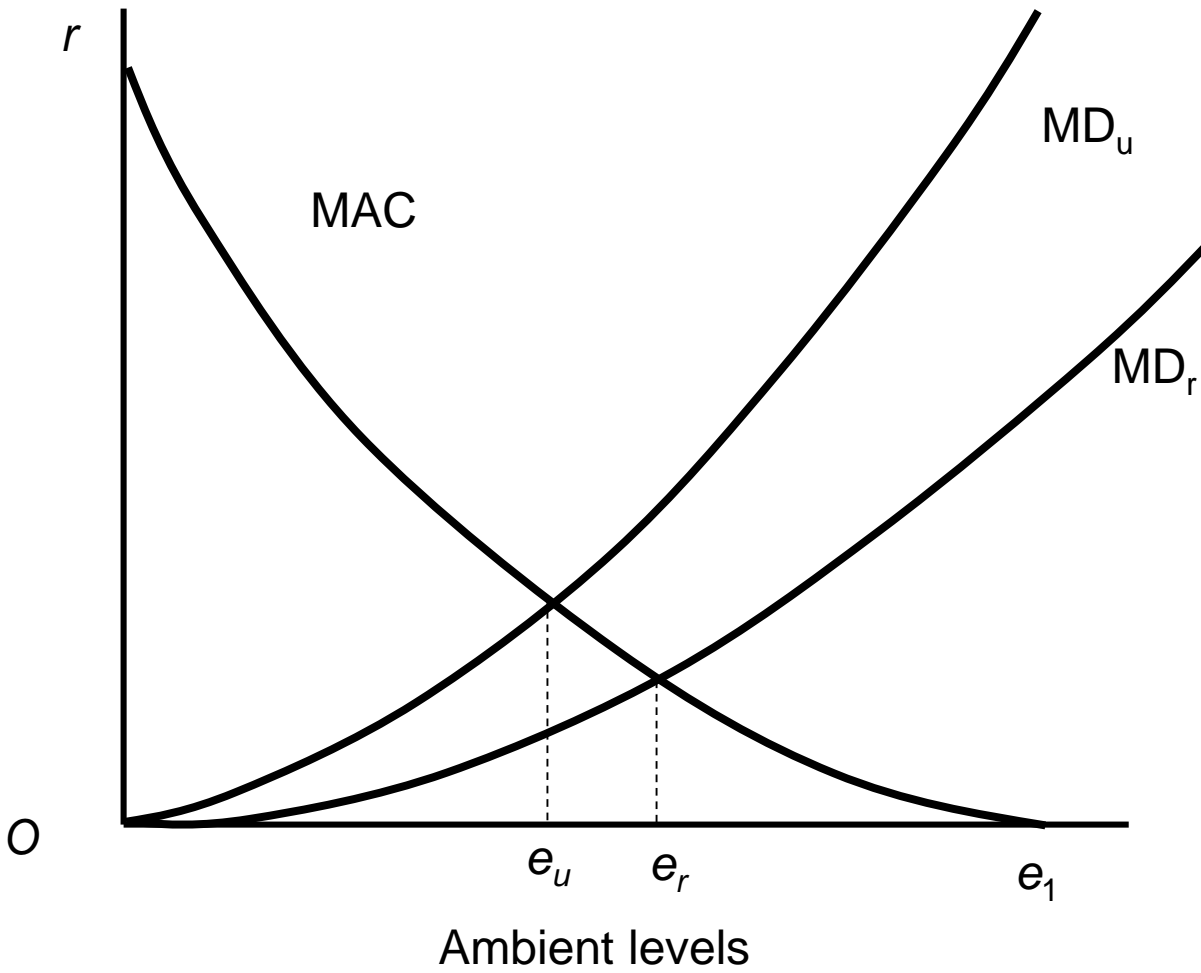
Discussion

- Some people insist on a zero-risk solution.
- Do you find any justification for such insistence?
- Do you think that they are just irrational, insisting that way?
- Is there a case in which a zero-risk approach is admissible?

Uniformity of standards

- Should environmental standards be applied uniformly to all actors?
- The circumstances are different region to region, time to time, and so on.
- Hence, uniformly applied standards mean serious misallocation of the resources.
- Yet, differentiation of standards is very costly, and almost impossible, sometimes for political reasons.

Explanation by means of a figure



An urban area which is densely populated may be more seriously damaged by pollutants than a rural area. Thus, the marginal damage curve of the urban area is located above that corresponding to the rural area.

The efficient emission levels of the urban area and the rural area are e_u and e_r , respectively. Yet, the differentiation of the standards sometimes requires very high administrative costs.

Viewpoint of fairness

- In the last slide, it is mentioned that differentiation of ambient levels in the two areas is difficult due to high administrative costs.
- Apart from this, one may oppose such differentiation on the ground that it is against fairness.
- Here too, one may not avoid the discussion of fairness.

Discussion

- How do you feel differentiation of ambient levels in the two areas? Do you think it is unfair and should not be allowed?

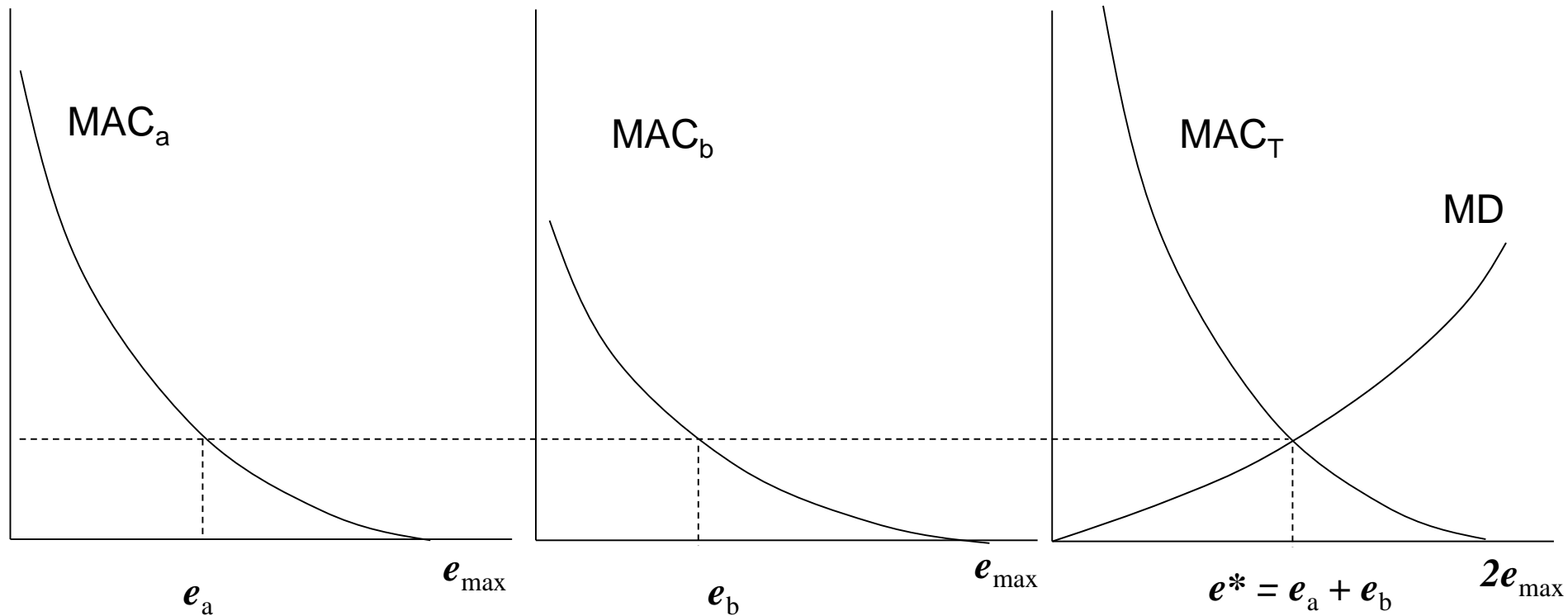
Standards and the equi-marginal principle

- Efficient reduction of pollutants from plural firms requires **equi-marginal principle**.
- The efficient reduction means that *the marginal abatement costs of different firms must be equal to one another*.
- A major problems with standards is that there is almost always an overwhelming tendency for authorities to apply the same standards to all sources.

Difficulty of differentiation of standards

- Why don't authorities differentiate standards which are applied to pollution sources?
- To do so, authorities have to know the shapes of the MAC curves for all the different sources.
- It is very costly to obtain the information to implement the equi-marginal principle in a command-and-control setting.
- This is a big problem!

Aggregated marginal abatement costs and equi-marginal principle



3. Standards and incentive

- When we try to evaluate any policy approach, we have to consider its effects on the incentives of the firms subject to regulation.
- There are short-run incentive effects and long-run ones.
- The short-run effects are often different from the long-run ones which have various dynamic implications.

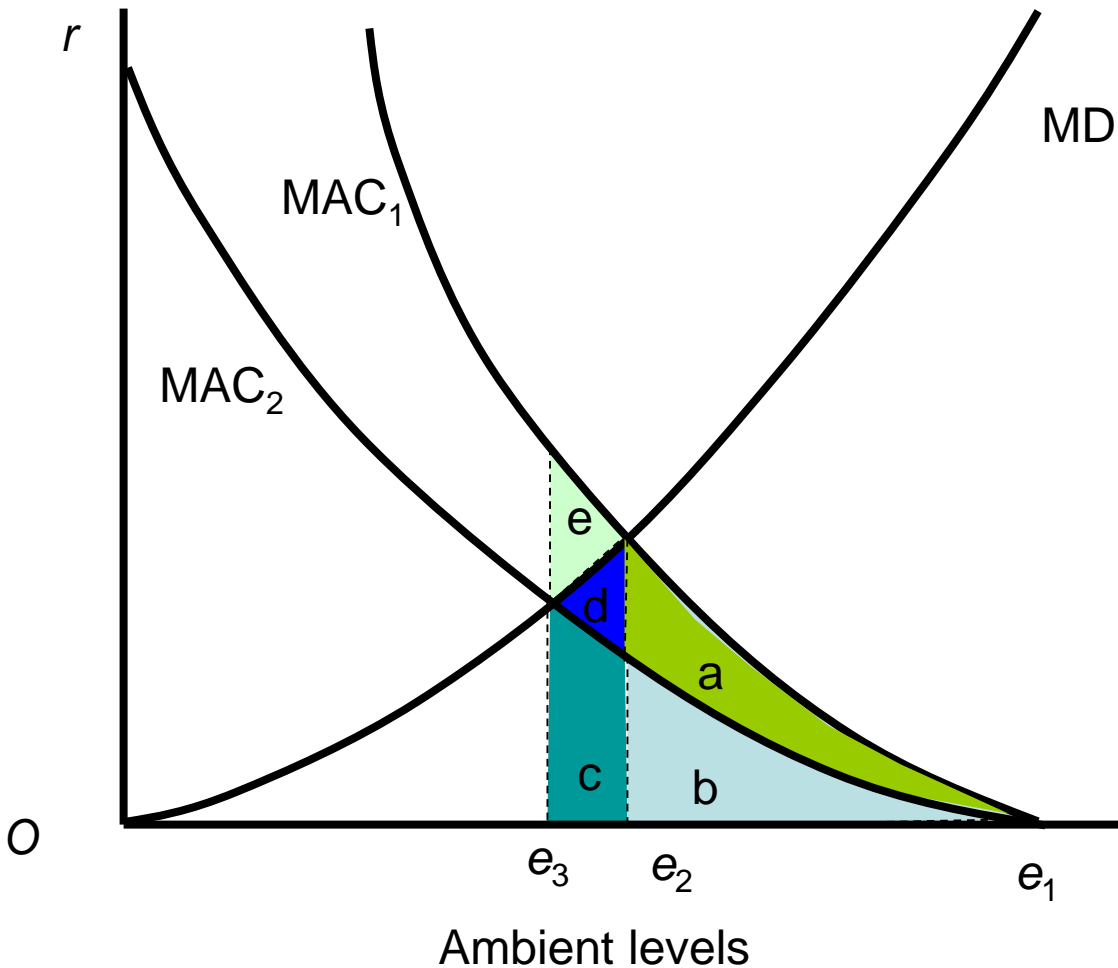
Short-run effects

- In a short-run, the question is whether the policy creates incentive for sources to reduce emissions to efficient levels and in cost-effective ways.
- The command-and-control approach has a serious defects in this regard.
- What matters is whether the target given by the standards is met or not.
- As for technology standards, they take flexibility away from polluters, because there is no incentive to choose a better technology.

Long-run effects

- In a long-run, what matters is that policies produce strong incentives to search for the kinds of technical and managerial changes that will make it less costly to achieve reductions in emissions.
- Basically, there is no such incentive for technology standards.
- Emission standards may have incentives in this regard.

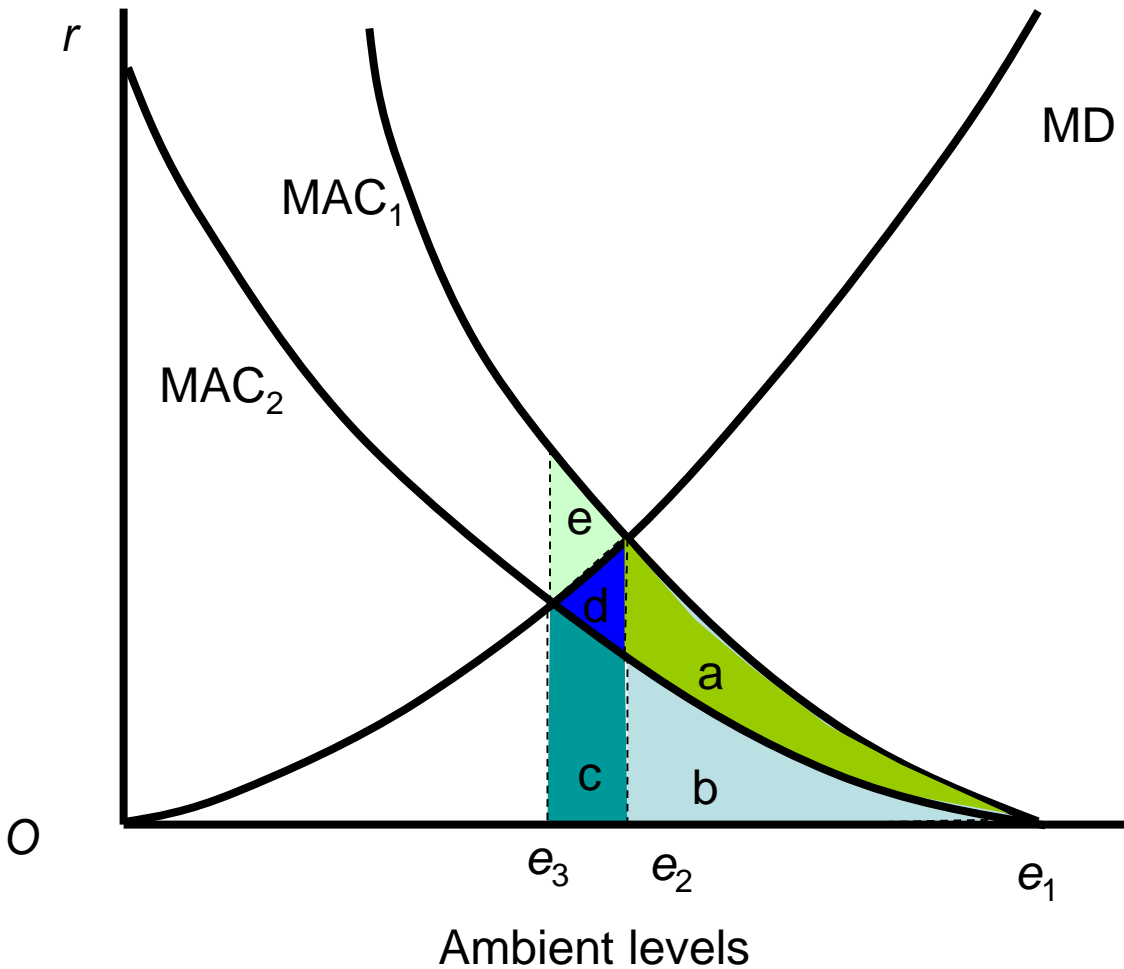
Explanation by means of a figure



Suppose that the standard is set at e_2 . Then, firms have incentives to innovate the abatement technology and shift MAC down. At e_2 , they save the cost represented by the area a.

If the authorities change the standard from e_2 to e_3 , the net cost reduction is expressed by the area (a – c). If the firms expect that there is net cost reduction, they try to innovate the abatement technology. If net cost reduction is not expected, there is no incentive for such innovation.

Technology forcing



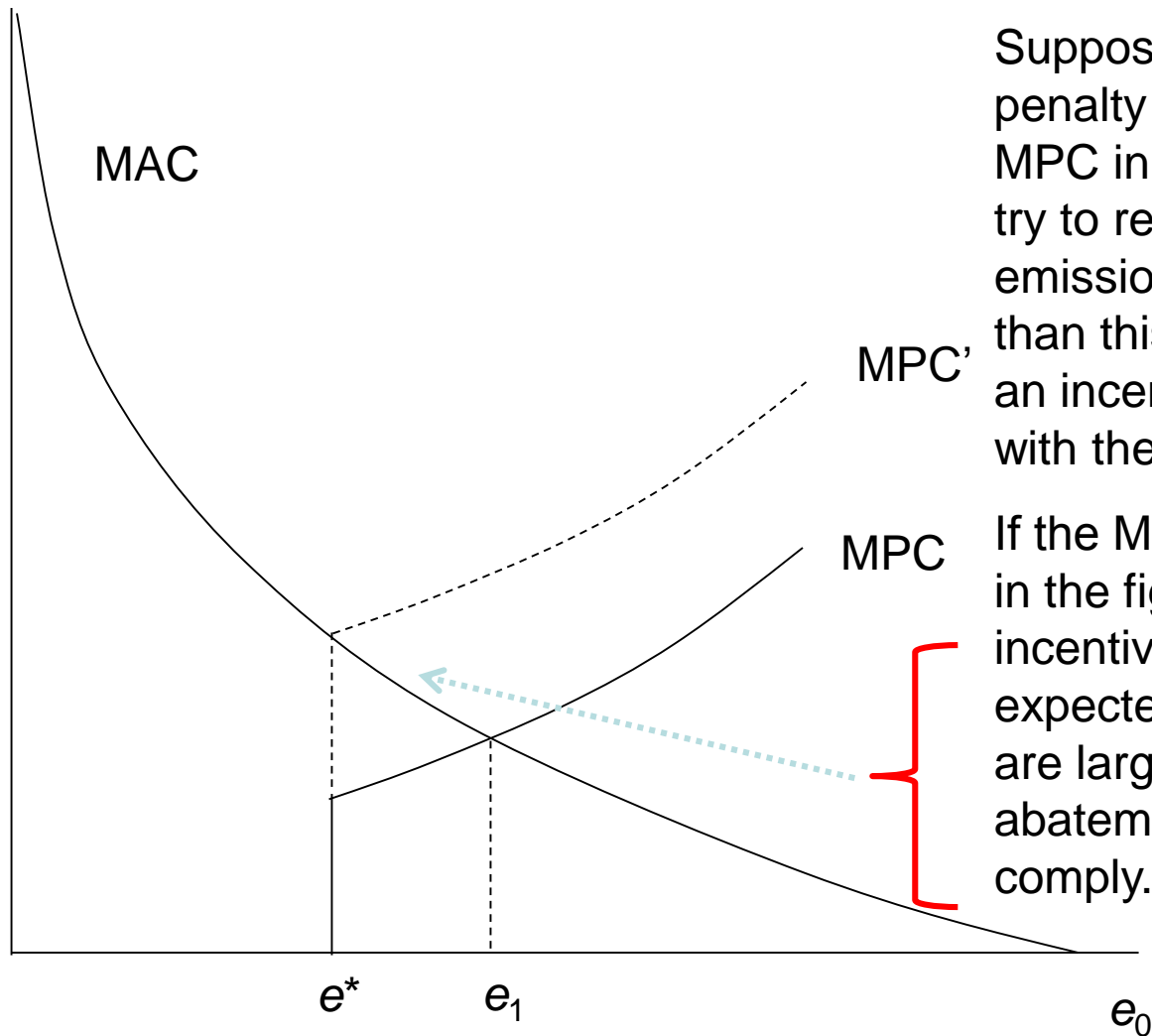
The authorities may set the standard at e_3 at the beginning, trying to induce innovation. If such policy is successful, the cost reduction is expressed by the area $(a + d + e)$.

Yet, the stronger the standard becomes, the more is there incentives to persuade the authorities to postpone the introduction of the standards. Then, the technology forcing fails.

4. The economics of enforcement

- Enforcement is indispensable for standards to be meaningful.
- Two factors are important for enforcement; monitoring and sanctioning as already mentioned.
- Monitoring technologies have developed rapidly. Actually, there is an apparatus which transmits the monitored information from would-be polluters to the authority in real time.
- Sufficiently heavy penalties coupled with precise monitoring technologies give incentives of compliance to potential polluters.

Explanation by means of a figure



Suppose that the marginal penalty function given as MPC in the figure. Then, firms try to reduce pollutant emission to e_1 , and not further than this. Thus, the firm has an incentive not to comply with the standard.

If the MPC curve is as MPC' in the figure, firms have an incentive of compliance. If the expected marginal penalties are larger than the marginal abatement costs, they do comply.

Standard setting and reality

- Stricter standards often imply high administrative costs, which hinder the introduction of such standards.
- Furthermore, it is often the case that standards are introduced by the government, although enforcement is made by prefectures or local governments.
- Hence, standards may possibly be introduced without paying any consideration to enforcement.
- In a real world, some flexibility is permitted when command-and-control policies with standards are adopted.

Why is a CAC policy adopted?

- Why is a CAC policy adopted despite the inefficiency?
- It is often easier to introduce a CAC policy than an incentive-based policy.
- To regulate emission of toxic or hazardous substances, a CAC policy is basically more effective. Just apply a zero-emission rule!
- Transactions costs are sometimes larger in an incentive-based policy than a CAC policy.