ECN 275/375 Environmental and natural resource economics 8: Pollution control – instruments (3) Perman *et al.* Ch 7

Reading guide

Read whole chapter for an overview (last sections typica overiew stuff. Focus on sec. 7.2 and 7.3.

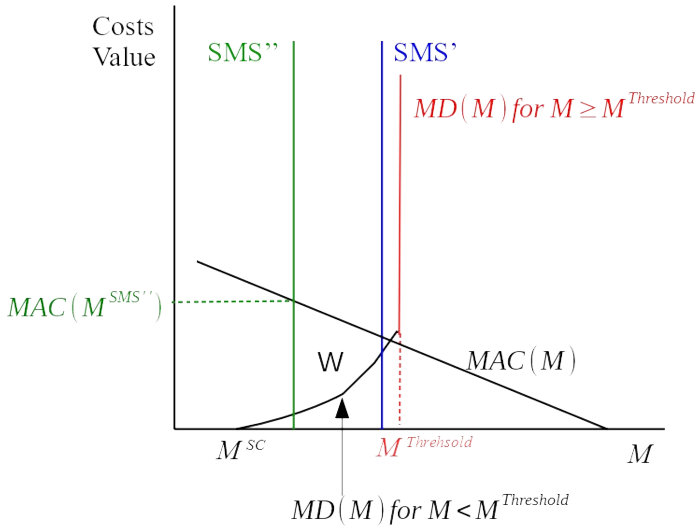
ECN 275/375 focuses on 2 kinds of uncertainty/imperfect information:

1. Marginal damages of reduced emissions (section 7.2)
2. Marginal abatement costs of reducing emissions (section 7.3)
3. Emissions costly or technically difficult to measure (section 7.4 through transaction costs)

1. Uncertainty on the benefit side

Two main types of uncertainty

- **MD-function (demand for env. improvements) not known**. Main reason: The natural science/ biological foundations not known → difficult to place the MD function
  - Policy responses: set some maximum allowed emission ttarget where one believes marginal damages are approximately equal to marginal abatement costs, i.e., expected marginal damages equal to marginal abatement costs $E[MD(M')] = MAC(\sum_{i=1}^{I} m_i')$, where $M' = \sum_{i=1}^{I} m_i'$. Cost effectiveness ($MAC_i(m_i') = MAC_j(m_j') \forall i, j \in \{I\}$) must hold → policies that promote cost effectiveness (emission taxes, tradable emission permits) put in place.



- **MD-function changes character (switches to some other functional form at some threshold)**. This effect is most notable when there are stock effects: the dynamics of the recipient change as stocks of the pollutant (or organisms associated with the pollutant) increase. Threshold effects usually imply that at some point (the threshold) the MD-function becomes vertical. Main problem with thresholds – one does not know where the threshold is located. Example: excess nutrient loading to a lake causes algae blooms, and when the algae dies, it works as if extra nutrients are added – in Norway: lake Vansjø outside Moss a well known case.
  - Policy response: **safe minimum standard (SMS)** – set an aggregate emission quota (permit level) less than the threshold so there is reasonable certainty the unknown threshold is not exceeded. Problems: (i) Setting a too restrictive SMS (too far to the left -like SMS") → marginal abatement costs ($MAC(M^{SMS''})$), and welfare losses (area W) grow large. (ii) With unknown location of $M^{Threshold}$, not set a too high SMS → higher risk of extreme damages (SMS' is getting awfully close to the threshold). Remark: SMS discussion in section 7.2 is shallow (does not go very far).

2. Uncertainty on the abatement cost side

Read for an overview – sections 7.3.2 and 7.3.3

Perman *et al.* Section 7.3

Performance of tradable permits and taxes under cost uncertainty (section 7.3.1)

Figure 7.1 important for understanding

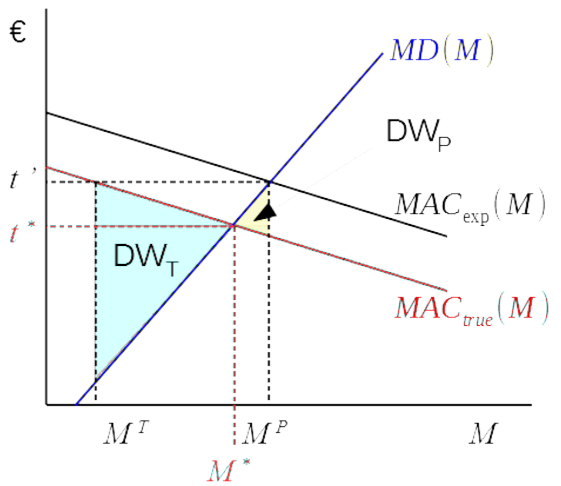
Permits → total emissions do not exceed the targeted permit level (if proper monitoring and enforcement strategies are in place), but costs can be excessive

Taxes → if aggregate MACs are under or over estimated the targeted emission level M^* in figure 7.1 can be to low or too high

The Weitzman proposition: prices vs quantities

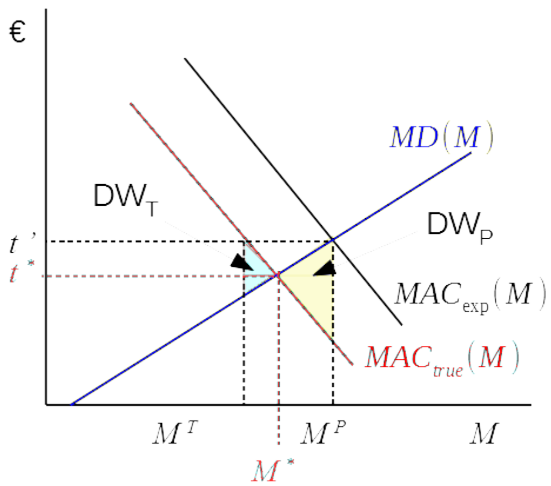
Figures 7.3-7.6 important for understanding – or following graphs:

In (1) Permits – MD steeper than MAC



Permits: "precision" matters more than costs

(1) Taxes – MD less steep than MAC



Taxes: cost matters more than "precision"

Both figures: $\{t^*, M^*\}$ denotes the optimal equilibrium where $MD(M)$ crosses $MACtrue(M)$. The sizes of the welfare losses depend on the relative slopes of the MD- and MAC-curves.

- The tax t' is set firs at the perceived optimal level where $MD(M)$ crosses $MACexp(M)$ → M^T and welfare losses DW_T (pink areas).
- The permit M^P is set first at the perceived optimal level where $MD(M)$ crosses $MACexp(M)$ → t' and welfare losses DW_P (light blue areas).

The Weitzman prices vs. quantity proposition:

> When marginal damages are steeper than marginal abatement costs, and there uncertainty about marginal abatement costs, use quantity based instruments (permits). In the converse situation, use price based instruments (taxes).

Rationale:

- When the MD-curve is steeper than the MAC-curve, not exceeding the emission target is more important than costs (see fig. 7.1) → more important to control emission levels than costs → permits.
- Conversely, when the MAC-curve is steeper than the MD-curve, controlling costs more important than controlling emissions → taxes.

3. Emissions are technically difficult and costly to measure

Transaction costs include the costs of acquiring necessary information, monitoring and enforcement (lecture 7 for details), and running/revising environmental programs. Some of these issues are realted to the RAM-criteria (lecture 5), in particular informational viability (necessary) and informational efficiency (desirable and needed for welfare maximization. Moreover, from the RAM- and general regulation literature, incentives should be targeted towards the problem to be solved.

What if emissions cannot be measured or it is so costly to measure emissions that the expected benefits from using an emissions based instrument (emission tax or tradable emission permits) costs exceed the welfare losses of using an emission based instruments due to high transaction costs?

1. **Input based regulations:** Point instruments to input factors strongly linked to the environmental issue. Examples: (i) burning fossil fuels is strongly linked towards emissions (carbon balance) → fuel tax. (ii) tax on nitrogen fertilizers or potassium (fosfor) in agriculture to reduce nutrient leakage and hence eutrophication.
2. **Processes based regulations:** Certain technologies and their use in the production may cause or aggravate environmental problems. (Perman ch. 6 (p. 189) on BAT and BATNEEC). Examples: (i) energy efficient building codes (ENØK) to reduce energy use. (ii) the move from conventional tillage (fall ploughing) to reduced or no tillage in agriculture to reduce erosion.

Additional topics associated with environmental policy

Some central topics not discussed that much in the chapters in the ECN 275/375 readings of Perman *et al.*:

- **Rebound effect:** environmental (or other) policies aim to reduce environmental impacts of an action. At the same time the costs (prices) of these actions decline, which then increases demand. The overall environmental impact is hence reduced. Example: more fuel efficient (or electric) cars, lower the cost of car use, which may offset the per kilometer emissions. (see Perman *et al.* p. 164, 266, 274-6)
- **Shifting externalities:** How policies may reduce externalities on one party, but lead to increased externalities onto other parties (not discussed in Perman *et al*.). Efficiency and fairness issues with such shifts/switches.
- **Adaptation** as a mitigation strategy: Making victims of pollution adapt to the problem. (see Perman *et al* p. 70-71). Example: improving air quality to the level where nobody feels any discomfort from pollution can be to costly. People with astma and other respiratory problems undertake preventive measures (not being outside when airpollution is bad, wear gasmasks or other devices that remove the last

Exercises

Go to the exercises section on the course web page.

… discussion questions next page

Discussion topics

Norway has exstensive electric vehicle (EV) policies in place, with high subsidies (reduced taxes) on aquiring an EV compared to a fossil driven vehichle (FV)

1. What are the main problems with current Norwegian policies to switch from FVs to EVs?
2. What other policies could have sped up the transition from FVs to EVs? What are the main problems with such alternate policies?

What are the main difficulties with safe minimum standards (SMS), and how should one deal with these difficulties?