Lecture 4: Economic instruments (1) - the importance of incentives

- Objectives
  - how incentives work (emission taxes & tradable permits :: advantages, differences)
  - non-standard settings :: instrument choice

Eirik Romstad
School of Economics and Business
Norwegian University of Life Sciences
http://www.nmbu.no/hh/

Outline

- Incentive compatibility
- Incentives extended
  - unintended impacts
  - non-standard settings (heterogeneity in marginal damages (MEC))
- The "standard" economist choices:
  - Emission taxes and tradable emission permits
- Static efficiency (dynamic efficiency discussed in lecture 7)

Incentive compatibility

- Definition:
  to make agents behave the way the regulator wants

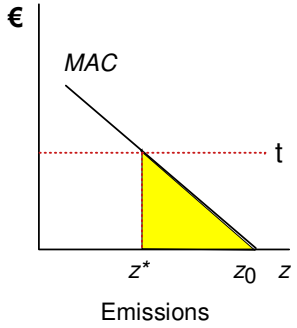
- What does the regulator want
  - maximize social welfare (Max *SW*)
  - efficiency: $MAC_i(z_i^*) = MEC(z^*)$ for all i
  - cost effectiveness: $MAC_i(z_i^*) = MAC_j(z_j^*)$ for all i,j

- Max *SW* subset efficiency subset cost effectivness

- No such thing as a "free lunch":
  also incentive compatibility has its costs

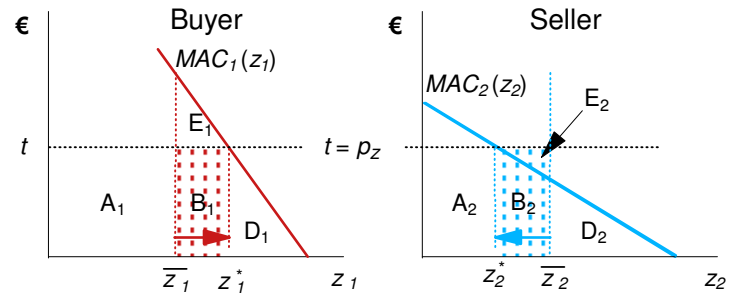
... incentive compatibility (2)

- case: tax on emissions
  - optimal emission level: z*
  - marginal abatement costs in optimum: $MAC(z^*) = t$
  - total abatement costs:
    TC= $\int_{z^*}^{z_0} MAC(z)\,dz$
    = area under MAC from z* to z_0



The agent's choice of emission level reveals his/her marginal abatement costs at this level

Taxes or tradable permits (1)



Costs to society	Taxes	Tradable permits	Fixed permits
Firm 1 (Buyer)	D_1	D_1	$D_1 + B_1 + E_1$
Firm 2 (Seller)	$D_2 + B_2$	$D_2 + B_2$	D_2
Total	$D_1 + D_2 + B_2$	$D_1 + D_2 + B_2$	$D_1 + B_1 + E_1 + D_2$

... taxes or tradable permits (2)

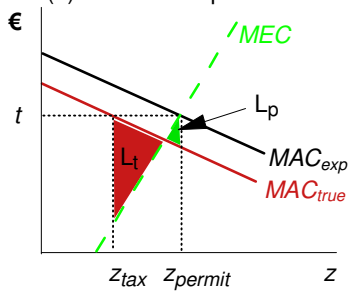
- Emission taxes and tradable permits yield the same outcomes wrt.:
  - optimal emissions per firm (and hence the optimal aggregate emission level)
  - social costs (and hence net benefits)
  - as both satisfy the equi-marginal principle
- both generally better than command-and-control
- Differences:
  - cost savings to firms (cfr. figure on last slide) equals A_1 for buyers and $A_2 + E_2$ (= difference between revenues from selling permits less additional cleaning costs)
  - uncertainty about firms' MACs (Weitzman proposition)
  - information provided to regulator by the scheme

... differences taxes & TPs (2)

- Assume that the regulator does not know the true abatement cost, but knows their relative slope relative to the marginal damages. Possible situations:
  - expected marg. abatement costs less steep than marg. damages
  - expected marg. abatement costs steeper than marg. damages
- Weitzman prop. - "Prices vs. quantities" - Definition: When marginal damages are steeper than marginal abatement costs, and uncertainty about marginal abatement costs, use quantity based instruments (permits). In the converse situation, use price based instruments (taxes).

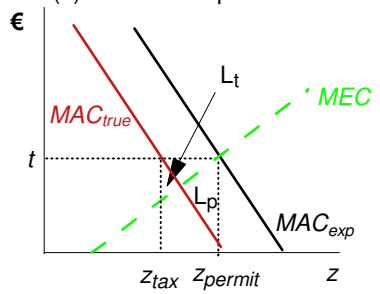
... differences taxes & TPs (2B)

(1) *MEC* is steeper than *MAC*



(1) *MEC* (*MD*) steeper than *MAC*: use permits (precision matters more than costs)

(2) *MAC* is steeper than *MEC*



(2) *MAC* steeper than *MEC* (*MD*): use taxes (costs matter more than precision)

... differences taxes & TPs (3)

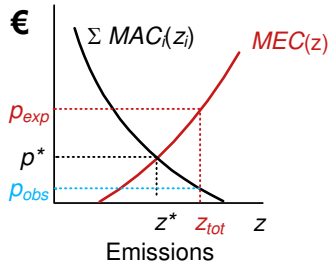
- The informational contents of taxes
  - the tax, t, is set,
  - the regulator can obtain information about each firm's emission level, z_i,
  - and hence also aggregate emissions, Z_{tot}
- The informational contents of tradable permits
  - the aggregate permit level, Z_{tot}, is set
  - each firm buys (sells) permits until its MAC equals the permit price
  - the regulator (and firms) observe the market price for permits

... differences taxes & TPs (3B)

- Firms are reluctant to reveal their true *MACs*
- A situation of *asymmetric information* where each firm knows its own MAC scheme, while other firms and the regulator only has an idea - (g)estimate
- Regulation - how to find optimal emission levels?
  - clue: make a scheme such that it is in the firms' own best interest to reveal their *MAC* schemes
  - must meet RAM criteria
    - participation constraint
    - informational viability and efficiency
    - incentive compatibilty

... differences taxes & TPs (3C)

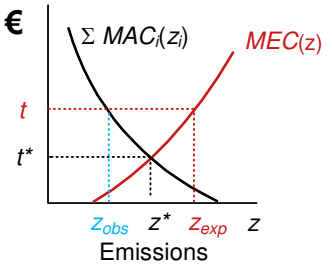
- Alt. 1: tradable permits
  - regulator sets agregate emission level, z_{tot}
  - if correct, expects p_{exp}
  - observes p_{obs}
  - deduces that z_{tot} is too large, and buys quotas back until $p_{obs} = p^*$



- Advantages
  - firms observe increased/decreased prices and adjust accordingly (don't know reason for price change)
  - meets RAM criteria

... differences taxes & TPs (3D)

- Alt. 2: taxes
  - regulator sets tax, t
  - if correct, expects z_{exp}
  - observes z_{obs}
  - deduces that t is too large, and reduces t until $z_{obs} = z_{exp}$



- Problems
  - firms reluctant to frequent adjustment of taxes (unpredictable business environment)
  - firms seek to manipulate the tax rate f.ex. by lobbying

Incentives - unintended impacts

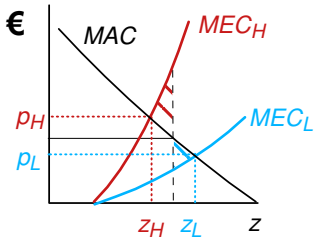
- Introducing an incentive
  ⇒ changing relative prices (costs)
- ... but this could happen in relation to other activities than those one wants agents to change
- historic example: former Soviet GOSPLAN targets
- current issue: incentives in the workplace
  - creating stronger incentives for some actions (like international publications in universities) may cause professors to spend less time on preparing for teaching

... incentives - unintended (2)

- Tinbergen: one instrument per objective
  - problem: many instruments may be needed [some fixed cost for every instrument
    ⇒ some objectives may become Pareto irellevant]
  - solution: prioritice objectives
- "university professor example"
  - reward international publications (improves theoretical quality)
  - reward teaching

Incentives - non-std setting

- Assume same MACs in two regions but separate MECs (MDs) low and high
- The optimal emission level (and permit prices) in the two regions differ



- The "law of one price"
  - leads to welfare losses if applied to regions with different marginal economic costs (damages)
  - limits the applicability of tradable permits and taxes

... incentives - non-std setting (2)

- Reasons for difficulties applying tradable permits and taxes when MECs differ between locations

- Tradable emission permits (TP)
  - have implicit incentives for evening out costs (meeting the equi-marginal principle) among firms within the trading region
  - solution: limit the trading regions to each location (watershed, region)
  - ... but that creates a new problem: thin markets (= few actors in the market
    ⇒ price taking behavior? so important for the efficiency gains of TP to be realized)

... incentives - non-std setting (3)

- Reasons for difficulties applying tradable permits and taxes when MECs differ between locations
- Taxes on inputs and tradable permits on inputs
  - hard to operate with geographically seperated markets where inputs are traded (max price difference = max tax difference = transport costs)
- Emission taxes
  - can be geographically seperated without any (major) incentive problems

Static efficiency

- Tradable emission permits and emission taxes provide incentives for reaching least cost solutions
- Static efficiency: $MAC\ (z_i^*) = MEC\ (Z^*)$ and $MAC\ (z_i^*)$ is least cost
  - the equi-marginal principle a necessary condition for overall static efficiency
  - the saved costs in the least cost solution vis-a-vis other solution can be used to make agents better off
- Dynamic cost effectiveness and efficiency

Summary (1)

- Incentive compatibility
  - make agents behave as the regulator wants
  - not without costs (if that was the case, behavior would already have changed)
  - the optimal emission level
- Incentives - beyond the textbook cases:
  - MECs differ between locations
  - attention on unintended side-effects
- Static efficiency
  - always evaluate at z_i^* - where equi-marginal principle must hold

... summary (2)

- Many factors need to be considered in the choice between (emission) taxes and tradable permits
  - thin markets / Weitzman prop / asymmetric info. / costs to regulated firms - relocation?
- Generally: tradable permits or taxes better than command-and-control
- Correcting for environmental problems when there are other imperfections in the market is "tricky"
  - Tinbergen: one instrument per problem
- Revenues from taxes or permit auctions shall generally be used where they improve social well being the most ... but implementation issues !!