The Economics of Climate Change

C 175 - Christian Traeger

Part 3: Policy Instruments

continued

Cap and Trade

Lecture 11

Review: Command and Control (Standards)

- Without unrealistic amount of information marginal abatement costs are not equalized over firms
- CAC does not meet requirement of static efficiency
- CAC is not dynamically efficient either
- Very effective: Reaches ecological targets accurately (unless industry grows…)
- Politically attractive: firms like standards because cheaper than taxes

Review: Pigovian Taxes

- Cost efficient as it equalizes marginal abatement costs across firms
- Dynamically efficient as well
- Ecological accuracy: If uncertainty about MAC then problematic
- Political feasibility:
  With taxation, large transfers of money: if target is to reduce emissions by 10%, still taxes are paid over 90% of initial amount
  –> firms are hostile to taxes
- So what about not punishing the bad but helping the good?

Subsidies

- Subsidy is negative tax.
- Is subsidizing 'good behavior' efficient? (emission reductions, or particular technologies like solar panels, windmills)
- Only somewhat efficient because:
  - Have to be financed through distorting taxes
  - Also hard to stop once started…
- Political feasibility: yes!! Firms love subsidies!
- In case of subsidy on particular technology: dynamically inefficient
  - Does government know which technology is best?
  - Hampers technology competition

Tradable Pollution Permits
(or marketable emission permits or 'cap and trade')

- Permits (licenses) to control externalities:
  - Legislate that externalities can only be generated if a license (e.g. emission permit) is held.
  - Licenses up to a given (optimal?) quantity are issued.
  - Trading of licenses ensures equalization of marginal abatement cost over firms.

- Combines CAC and market aspects:
  - Quantity objective (limit or *cap*) => Command and Control
  - Price mechanism (*trade*) => Economic instrument

- Practical implementation
  - Step 1: Regulator determines optimal aggregate amount of emissions
  - Step 2: Institution of exchange is set up.
  - Step 3: Market is initialized through an initial allocation of emission permits
  - Step 4: Trading in permits is opened.

Tradable Permits, Cost Efficiency

- Regulator sets aggregate emissions E^*
- Each market participant, in general firms, receives emission rights E_i ($\Sigma E_i = E^*$)
- Choice for each firm i:
  - Reduce emissions to the level covered by the number of awarded permits
  - Reduce emissions less than covered by the number of awarded permits AND buy additional permits
  - Reduce emissions even further than the original award AND sell the permits which are not required to cover emissions
- Denote actual emissions of firm i by e_i
- Polluter requires e_i units of permits, valued on the permit market at equilibrium price σ.
- If polluter i holds E_i permits, then its total cost of production is

  $TC_i = C_i(e_i) + \sigma\ (e_i - E_i)$

Tradable Permits, Cost Efficiency

- Total cost of production for polluter *i*: $TC_i = C_i(e_i) + \sigma\,(e_i - E_i)$
- Profit maximization gives:

$$MAC(e_i) = -C_i'(e_i) = \sigma$$

marginal abatement costs = price of permits

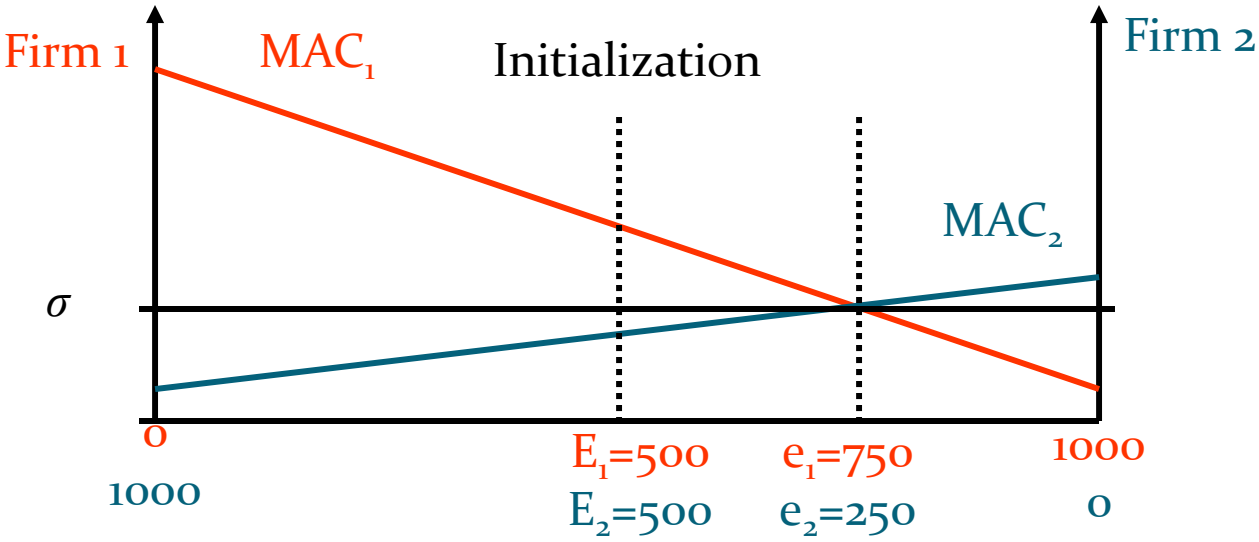
- Same reasoning for polluter *j*
  => *marginal abatement costs equalized over polluters*
- In equilibrium we have market clearance, i.e. price σ such that

$$\sum e_i = \sum E_i = E^*$$

permit demand = permit supply

Tradable Permits, Cost Efficiency, Example

- Regulator gives out allowances for E^*=1000 Gt of CO2, equally distributed to two firms
- Each firm will choose a level of emissions to minimize total cost $MAC(e_i) = -C_i'(e_i) = \sigma$
- Since MAC of firm 1 are higher than the market price (respectively the MAC of firm 2) at endowments E_i, firm 1 will buy e_1-E_1=250 permits from firm 2



Merits of Tradable Pollution Permits

- Corrects the pollution externality (through the creation of market)
- Enables control of total emissions (through allocation of permits)
- Equates each firms MAC to common traded price
  - Least cost abater sells, high cost abater buys.
  - Effect: Lowest cost forms of abatement used first
- Maintains freedom of choice of abatement technology, recognizes heterogeneity within and across industries
- Is robust to the initial allocation of permits
- Informational requirements:
  - Very low for achieving certain reduction target
  - High for achieving social optimum where marginal cost=marginal benefits
- In summary: combines advantages of CAC with allocation capacity of a market
  - Standard fixed
  - Common scarcity price

Tradable Permits, judged by our criteria:

- Scientific/Ecological accuracy: Yes
- Static cost-effectiveness: Yes
  - given no transaction cost, no market power
- Dynamic cost-effectiveness: Yes
  - gives incentives to reduce abatement cost for each firm
  - regulator can reduce total emission endowments over time
- Political acceptability (by polluters)?

Tradable Permits, political acceptability, auctioning vs. grandfathering

Different option for allocating permits:

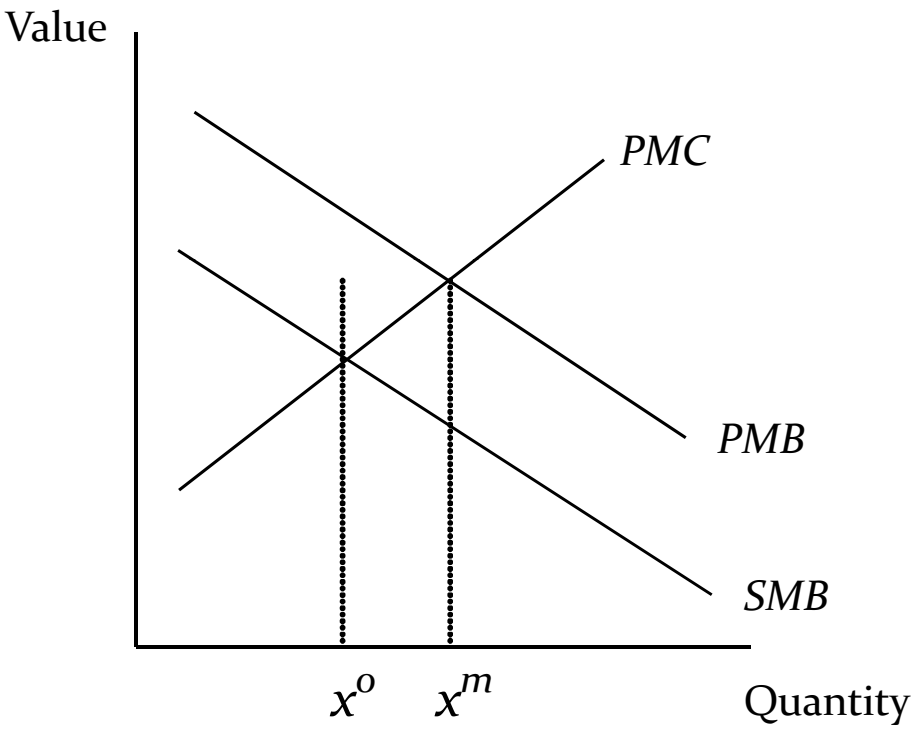
- All sources get the same number of emission permits for free
- All sources get a certain percentage of their original emissions (grandfathering)
- Emission permits are auctioned off => firms have to bear additional costs! Auction revenues could be used to reduce other taxes…
- **These different allocation methods imply different costs for firms!!!**

Political feasibility often achieved by **grandfathering** of permits
(U.S. SO2 trading, EU carbon emissions trading system)

Equivalence: Pollution Tax and Pollution Permit

(N.B.: This only holds under perfect information)

- Example: correction of a *negative* consumption externality
- Social marginal benefit (*SMB*) is below Private marginal benefit (*PMB*)
- If an amount of permits equal to x^o is given out, efficient outcome with $SMB = PMC$ is achieved
- Permit price p is equal to Pigouvian tax t.



- N.B.: Licenses have no information advantage over taxes: same information needed to determine optimal amount of externality

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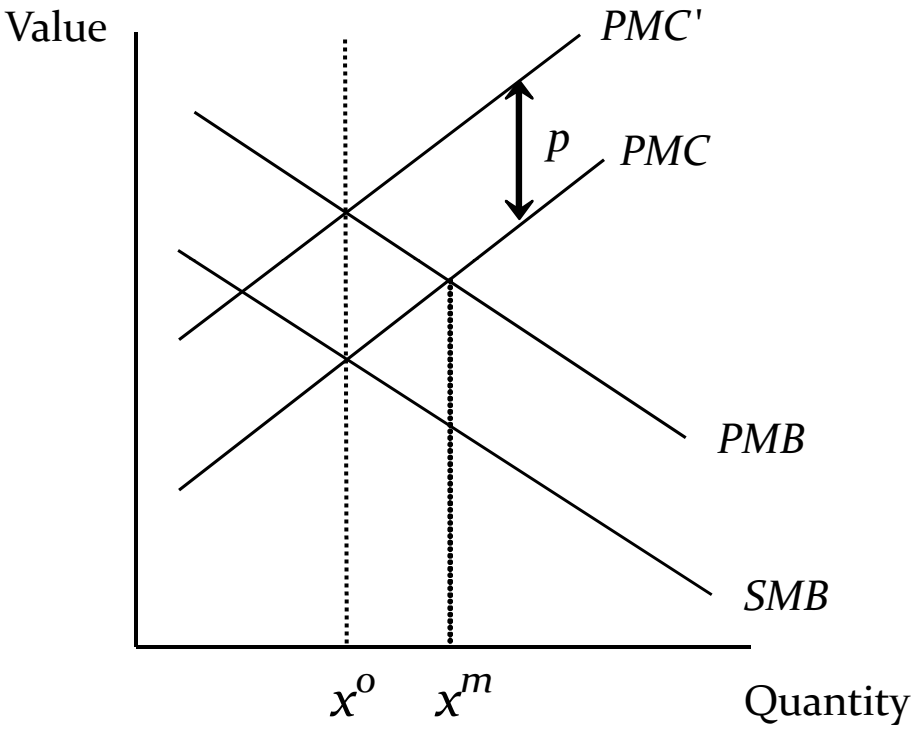

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Cap and Trade vs Taxes
Lecture 12