

**a broad outline of the course so far**

Microeconomic Foundations:

- Social choice: Ultimately, a government should aim to somehow aggregate citizens' preferences over both goods and bads.
  - Possible individual preferences over the environment: biocentrism, anthropocentrism, sustainability.
  - Arrow's Impossibility Theorem—the nonexistence of a social welfare function that satisfies some basic fairness/consistency criteria.
  - Even though a perfect social choice function is unavailable, there are some alternative criteria that can be used to make collective decisions:
    - Pareto Criterion—Unanimity
    - Potential Pareto Improvement—pareto improvement with transfers
    - Compensation Principle—potential pareto improvement without transfers.
  - For the rest of the course, we are primarily concerned with efficiency—how to achieve it when the market doesn't naturally arrive at it.
- Efficiency of Markets:
  - Efficiency under exchange—an Edgeworth Box illustration (tangency of indifference curves)
  - Efficiency with production—tangency of the PPF and consumer's indifference curve
  - Definition of efficiency—an allocation is efficient if there is no allocation that is pareto preferred to it. In particular, with markets it is defined by the following conditions:
    - MRT's equalized across firms
    - MRS's equalized across consumers
    - MRT's and MRS's both equalized to the price ratios
  - Definition of Equilibrium
  - First Welfare Theorem, and necessary assumptions
  - Second Welfare Theorem, and necessary assumptions
  - Efficiency across time periods
- Cost-Benefit Analysis:
  - Consumer and Producer surplus under supply and demand (without externalities)
  - Methods for measuring costs and benefits:
    - WTP/WTA
    - Indirect Methods:
      - Averting Behaviour (Substitutability)
      - Weak Complementarity Approach
      - Hedonic Methods
      - Contingent Valuation
  - Critiques of cost-benefit analysis

Why the environment violates assumptions for free-market efficiency, and what we can do about it:

- Key deviations: externalities, poorly-defined property rights, transaction costs. So now the free-market equilibrium need no longer be efficient.
- Public Goods
  - Definition of public goods/bads as nonrival and nonexcludable
  - Aggregating demand for public goods (sum demand vertically)
  - Private provision of public goods might lead to inefficient outcomes (when individuals make isolated decisions about purchases)—the free-rider problem
  - When to provide a public good—when aggregate marginal benefit exceeds marginal cost
  - Lindahl Pricing can generate efficient production, but is too infeasible in practice.
  - Public goods involve externalities—equilibrium price system in a free-market does not take full effect of externalities into account (laundry-steel mill example)
- Property Rights
  - Coase Theorem: Efficiency can be achieved by assigning property rights over public goods (and allowing other agents to compensate the holder of these rights)
  - The Coase Theorem requires several assumptions. In particular, the “no transaction costs” assumption is problematic and rarely satisfied in practice.
- Government Intervention to achieve efficiency (Command and Control versus Incentive Mechanisms):
  - Command and Control: pros and cons
  - Incentive Mechanisms
    - General pros and cons
    - Pollution Fees (Pigovian fees or subsidies)
      - Without fees, firms will pollute as long as there are marginal savings from polluting. The government sets fees so that, at the new equilibrium, societal marginal damage from pollution equals firms’ aggregate marginal savings (horizontal summation of individual MS curves) from pollution.
      - Since the fee is fixed, the equimarginal principle is satisfied. If the fee is correct, then  $MS=MD$  is also satisfied.
      - Alternatively, subsidies can also achieve efficiency, but with potential problems (effectively assigns property rights to firms; the subsidy must come from somewhere; long-run over-production)
    - Marketable Permits—the government sets the maximum allowed level of pollution, and then allows firms to trade for these rights.

- Forcing firms to assume full liability
  - Fullerton and Kinnaman: Empirical paper about the pros and cons of a Pigovian fee
- Extensions:
  - Space
    - Assume a linear relationship between emissions from source and pollution at receptor. The transfer coefficient is the rate at which a change in emissions at a source affects pollution at a receptor.
    - Efficiency requires that MD of total pollution be equal to individual firms' MS scaled by the relevant transfer coefficients.
    - Optimal Pigovian fees now differ across firms. If the government must use a single fee, it chooses the fee that minimizes the total dead weight loss.
    - Marketable Permits are often easier to implement:
      - Ambient Pollution permits
      - Emission permits
      - Trading equilibria are similar to before, except that they now take transfer coefficients into account.
  - Time
    - We must take time into account when there are stock pollutants.
    - Efficiency requires that firms' marginal savings from pollution equal the aggregated (over time) marginal costs from an additional unit of pollution today (discounted by the relevant time discount factor and the persistence of pollution).
    - Another issue related to time: temporal variability
  - Unknown Control Costs
    - We assume that the government is aware of the MD curve but unsure about the firm's MS curve (marginal savings from pollution).
    - Firms have an incentive to lie:
      - Under a permit system, a firm wants to pretend it has a high MS curve.
      - Under a fee system, a firm wants to pretend it has a low MS curve.
    - It is possible to use a system of fees and rewards that encourage high MS firms to tell the truth while discouraging low MS firms from lying and claiming to be high MS too (two constraint example)
    - Alternatively, the government can choose either taxes or permits so as to minimize the total expected welfare loss (but not eliminate it).
      - Weitzman proposition: under uncertainty, permits are preferred if MD relatively more steeply sloped than MS; and fees are preferred in the opposite case.