# SOCIAL CHOICE

Lecture 2

14.42/14.420

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# II. Social Choice

- A. Introduction and examples
  - Two basic questions in environmental economics are:
    - What is the right balance between environmental protection and use? (we focus on this question for the next few lectures)
    - How do we induce economic agents to use the environment in a fashion that we have determined is desirable?
  - Some specific questions:
    - How much land should be set aside to protect endangered species of plants and animals?
    - What level of air pollution should be acceptable?
  - The key issue in all of these questions is that they are societal decisions. They reflect many individuals' preferences, some of whom care deeply about the environment and some who don't care at all.
    - How can we translate diverse individual preferences regarding the environment into a group or societal choice?
    - We need to find a way to translate every individual's opinion, regardless of how strange it may seem, into the appropriate environmental policy.

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- Agenda for Today:
  - Examples of social choices
  - Classifying individual preferences
    - Different types of individual utility functions
  - Aggregating individual preferences to group decisions
    - Different types of social welfare functions
  - Arrow's Impossibility Theorem
    - There is no perfect way of voting
  - Sustainability

  - **Question: Why are these "social choices" instead of "individual choices"?**
    - i.e. why is this topic not in micro/consumer theory?

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- 3 examples:
  - Air Pollution in Santiago, Chile
    - Severe air pollution; diesel bases are a big problem.
    - **Question: should we force bus owners to pay for emission control?**
    - Reduction in diesel will raise cost of transport. This will hurt the poor but not the rich, who don't care about the cost of public transportation.
    - A simple vote (the hallmark of the democratic process) will leave things as they are.
    - A Willingness-to-Pay (WTP) approach will weight preferences of the rich much more heavily because they own more resources.
    - Which approach is better? How should we handle such distributional issues?

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- 3 examples (contd.):
  - California Gnatcatcher:
    - Bird lives in Southern California *and* is an endangered species.
    - It likes coastal areas of S. California, but so do humans.
    - **Question: Should we set aside coastal land where development is prohibited?**
    - Protection requires lots of land that could otherwise be used to build oceanfront condos or beach volleyball courts.
    - Who pays for this?
    - How to decide? If by vote, who should vote? The world, the country, the state, just southern California, future generations?
    - What moral issues are involved?

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- 3 examples (contd.)
  - 3 Gorges Dam, China
    - Benefits of the reservoir created by the dam:
      - Electricity production
      - Flood control
      - Only “temporary” – until the dam silts up
    - Costs:
      - Destroys ancient cities and inundates spectacular canyons.
      - Irreversible consequences (the possibility that the dam will fail).
    - **Question: Should we have built the dam?**
    - This example demonstrates the problem of potential gains today vs. losses in the distant future. How should future generations be figured into this?

Let’s keep these examples in mind as we continue.

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- B. Individual Preferences regarding environmental protection:
  - There are many different views on what is *right* or *moral* regarding the environment. Here are 3 broad categories of preferences:
    - 1) Biocentrism: Stresses the intrinsic (rather than instrumental value) of the environment and places the biological world (primarily nonhumans) at the center of its value system.

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2) Sustainability: This means many things to many people.

- The concept can be traced to Aldo Leopold's "Land Ethic." He argued that it is the health of ecosystems that is of paramount importance: an environmental policy is right if it preserves the integrity of an ecosystem and wrong if it does not.
  - "Conservation is a state of harmony between men and land."

- The World Commission on Environment and Development (the "Brundtland Commission") defines sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

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- 3) Anthropocentrism:
  - The environment has only 1 purpose: To provide material gratification to humans.

→Key difference with Utilitarianism is that Utilitariansim emphasizes the well-being people attain from the environment, whether it be materialistic or spiritual, instrumental, or intrinsic.

→Strictest definition of Anthropocentrism is that it only places instrumental values on the environment. For example, if the CA Gnatcatcher is that if it is of no use to humans, then it has no value.

→Utilitarianism would allow for individual values, no matter the source of the value (e.g., warm and fuzzy feelings from their existence is ok).

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- C. Utility Functions
  - N People in Society (i=1, . . . , N)
  - x is a composite material good
  - $X=(x_1, x_2, \ldots, x_N)$ is the set of individual consumption vectors
  - e is environmental quality, same for all agents
  - $u_i(x_i,e)$ is individual i's utility function (a function of material goods and environmental quality)
  - The standard microeconomic view is that individuals will be willing to trade off between x and e based on preferences/utility functions.
  - Note: Allow any Preferences over the Environment (e.g., biocentrists or selfish materialists)
  - Indifference Curves
    - Indifference Curves example: Forest land vs. material goods
    - What do anthropocentric vs. biocentric indifference curves look like?

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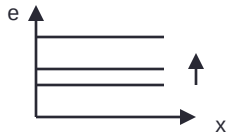
- Some utility functions (stylized examples)
  - “Pure Biocentrism”: the agent will never trade x for e.
    - Indifference curves look like:

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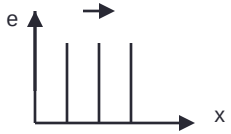

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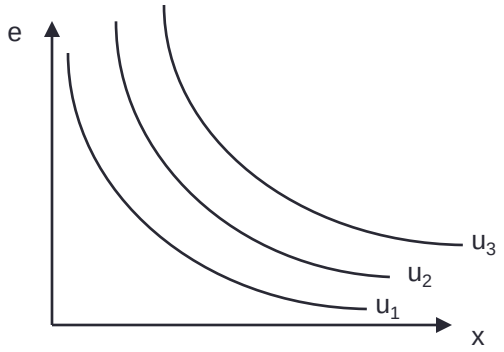
- Some “Middle Ground”:




  - $u_1 < u_2 < u_3$
  - At relatively low levels of x, the agent is willing to give up a lot of e to get some more x, and at high levels of x, the agent is willing to give up a lot of e to get more of x.
  - More of everything is always better.
  - How might these change at higher levels of utility?

  - What might in individual preference for “sustainability” look like?

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- b) **Social Choice Mechanisms**
  - Consider two bundles:
    - $a' = (X', e') = (x_1', \ldots, x_N', e')$
    - $a'' = (X'', e'') = (x_1'', \ldots, x_N'', e'')$
  - Also consider the corresponding utility functions $u_i'$ and $u_i''$ associated with these.
  - We know how individuals value these bundles, but how should society value them? This is the fundamental question of social choice—how can we aggregate individual preferences into social or group preferences?

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- Examples of Social Choice Mechanisms:
  - i) Pareto Criterion (Unanimous Voting)—If all individuals prefer one alternative to another then so should society.

    - Definition: For any two bundles a' and a'', a' is Pareto Preferred to a'' if for all individuals i, $u_i(a') \geq u_i(a'')$, and for at least one individual i*, $u_{i*}(a') > u_{i*}(a'')$

    - Do you think this is a **sensible** criterion?
    - Is this **useful**?

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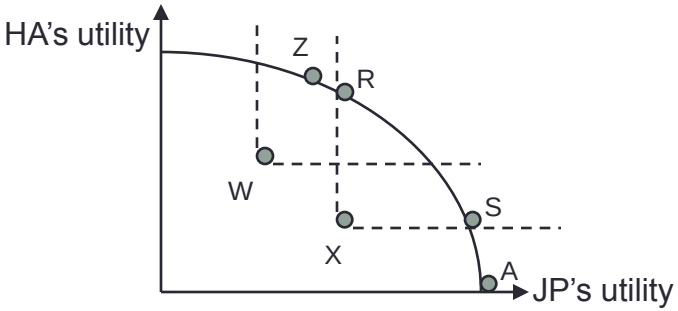
- Pareto Criterion Example (JP and HA)




- Above, Z is Pareto Preferred to W but not to X. S is Pareto Preferred to X
- Problems: Frequently, 2 alternatives cannot be compared. The Pareto Criterion is silent about a choice between A and Z or between X and Z (!). Use of the Pareto Criterion tends to paralyze government and support the status quo.

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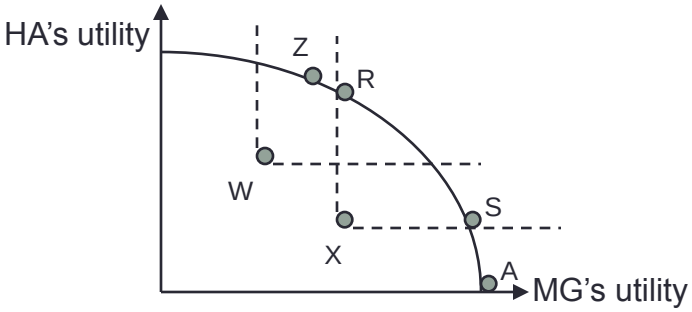
- Kaldor-Hicks Efficiency




- Can HA transfer money to JP so that she will be willing to go to Z?
- Is this fair?
  - Bill Gates example
- What problems?

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- ii) Potential Pareto Improvement
  - An obvious problem with the Pareto Criterion is that there is no way to get from X to Z—even a very small loss for one person could sink the potential for very large gains for the other. The Potential Pareto Improvement overcomes this by allowing transfers between agents.
  - Let y be a vector of individual incomes (any tradable good), and z be a vector of transfer payments.
  - Definition: If there exists a vector of transfers, z, that sum to 0, such that (a',y-z) is Pareto preferred to (a'',y), then a' is a Potential Pareto Improvement over a''.
  - On the previous graph, Z is a potential Pareto Improvement over X as long as HA can remain better off (at Z, compared to X) after compensating JP for her utility loss (due to the move from X to Z). If we consider money on the axes (instead of utility), R is the outcome that will most likely emerge if Z is a Potential Pareto Improvement on X.

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- Is this unfair?
  - Bill Gates, Chile examples
  - Generalize to other rich-poor transfers
  - Compare to Summers/Pritchett memo.
    - What does this require?
- Problems:
  - Units/Quasilinearity
  - Politically feasible?
  - How to determine appropriate transfers?

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- **iii) Compensation Principle**
- If a transfer could be made to achieve unanimity on a choice between alternatives, then, according to the Compensation Principle, the preferred choice is socially desirable even if the transfers are not actually made.
  - This is very controversial but is frequently used in practice (e.g. Cost-Benefit analysis in Regulatory Impact Analyses)
  - Related phrases: Compensation Principle, Kaldor-Hicks Efficiency, Potential Pareto Improvemen

**iv) Voting**

- The basic problem with the Pareto Criterion is that it requires some form of unanimity. Voting/Majority Rule does not.
- What problems with voting?

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- Potential problems with voting:
  - Does not account for the intensity of preferences (no compensation possible).
  - Poorly informed voters?

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- c) Social Welfare Function
  - Definition: Assume there are N people, each with utility function $u_i(a)$. Let $W(u_1,\ldots,u_N)$ be a function that associates a single number with every distribution of utilities in society. If, when comparing any two consumption bundles a and b, $W[u_1(a),\ldots,u_N(a)] > W[u_1(b),\ldots,u_N(b)]$ is equivalent to a being socially preferred to b, then W is a Bergson-Samuelson Social Welfare Function (or, more simply, a Social Welfare Function).
  - Problems: In order to aggregate across individual utilities, the individual utilities, not consumption bundles, must be measured—a very difficult task.

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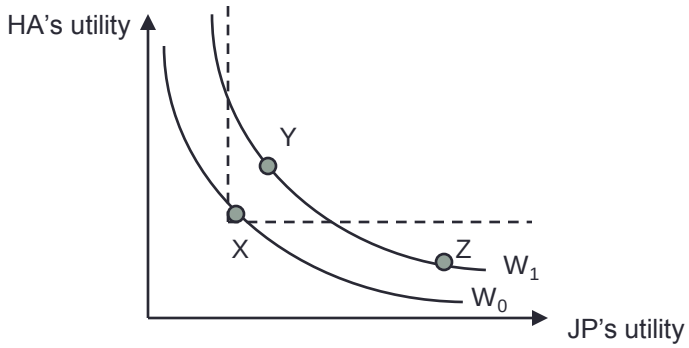
- For example, Social Indifference Curves (based on a Social Welfare Function) on the utilities of two agents, HA and JP, could look like the following:




- Y is Pareto Preferred to X and yields a higher social welfare. Z is not Pareto Preferred to X but it is on a higher social indifference curve (and is therefore socially preferred to X).

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- Some formal examples of Social Welfare Functions:
  - Benthamite Utilitarianism:
    - $W(u_1,\ldots,u_N) = \Sigma_i \theta_i u_i$, where $\theta_i \geq 0$ (the weights can, for example, be equal across individuals, or be proportional to income)
  - Egalitarian:
    - $W(u_1,\ldots,u_N) = \Sigma_i u_i - \lambda \Sigma_i [u_i - \min_i(u_i)]$
    - Here, we care about both total utility and inequality ($\lambda$ indicates the relative weight placed on equality)
  - Rawlsian:
    - $W(u_1,\ldots,u_N) = \min_i(u_i)$

    - What do these Social Indifference Curves look like?
    - What criticisms of utilitarianism?

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- C. Criticism of the Utilitarian Perspective:
  - Whose utility functions should be included as arguments in W (for example, future generations')?
  - Paternalism: What if people's "revealed preferences" are not their "hedonic preferences"?
  - Social preferences/peer effects: SUV example
  - Inequality makes people unhappy.
  - Economics likes to think of utility functions as immutable. If they aren't (for example, suppose education changes an individual's preferences about the environment), which utility function should we use?
    - How can these first examples be dealt with?
  - Should public policy be based only on individual preferences? Shouldn't it also be based on what is ethically *right*?
    - Who decides what is "right"?

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- d) Impossibility of Perfect Choice Mechanism: “Arrow’s Impossibility Theorem”
  - Is there a general way of aggregating individual ranked preferences into a reasonable social preference ordering?
    - Important: Ordinal, not cardinal, preferences
  - Kenneth Arrow argued that any “reasonable” mechanism should satisfy 6 basic axioms, and then proved that no such mechanism exists.

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- Arrow's Impossibility Theorem:
  - Axioms about the Social Choice Mechanism:
    - A1. Completeness: we can compare all social alternatives.
    - A2. Unanimity: If everyone prefers a to b, then society prefers a to b.
    - A3. Non-dictatorship: No one should always get their way.
    - A4. Transitivity: If a is socially preferred to b and b is socially preferred to c, then a is socially preferred to c.
    - A5. Independence of Irrelevant Alternatives (IIA): Society's choice between a and b should depend only on how individuals rank a and b (and on no other information)
    - A6. Universality: Any individual ranking over alternatives is permissible.
  - Theorem: There does not exist a Social Choice Mechanism such that A1-A6 are satisfied.

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- Example: Majority rule. Choice ranked first by more than half the voters wins. What does this violate?
  - Remember: could be more than two options possible.
- Example: Plurality rule: Choice ranked first by the largest number of voters wins. What does this violate?
  - Ralph Nader
- Example: Majority voting on two alternatives at a time.
- Consider 3 agents: Abel, Boris, and Curt. Consider 3 potential levels of pollution: 1, 2, and 3. Preferences:
  - Abel: 1>2>3
  - Boris: 2>3>1
  - Curt: 3>1>2

  What does this violate?

  What do you notice about Curt's preferences?

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- Example: The problem with voting
  - “Rock-paper-scissors” cycling
  - This shows how voting can violate transitivity (1 is preferred to 2 by the majority rule, 2 is preferred to 3 by the majority rule, and 3 is preferred to 1 by the majority rule).
  - Choice depends on where voting stops – could be any outcome!
  - Possible solutions:
    1. Ordered options + “Single peaked preferences”
       1. Curt’s new preferences: 3>2>1
       2. Eliminates cyclicality
    2. Axioms all hold with only two options.

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- Arrow's Theorem is troubling because it implies that voting rules (with Ordinal preferences) cannot satisfy intuitive and appealing axioms.
- Possible solutions we've identified:
  - Restrictions on preferences or options
  - Use Cardinal utility (Kaldor-Hicks criterion)

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- Using Intensity of Preferences
- So far, we have ignored the possibility that some people really hate certain outcomes.
  - Allow log-rolling/vote-trading: This happens frequently in the U.S. Congress.
  - On the next slide, see the utility gain:
    - if each project is voted on individually, it will pass. Yet A and B are not desirable.
      - What do we mean by “not desirable”?
    - A trade between 1 and 5 over projects A and B can make both better off and serve society.
    - But trades over A and C are possible and thus could prevent passage of C.
      - This prevents a Potential Pareto Improvement (Kaldor-Hicks Improvement).

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| | A | B | C | Sum | A & B sum | A & C sum |
|---|---|---|---|---|---|---|
| 1 | -5 | 2 | 2 | -1 | 2 | 2 |
| 2 | -5 | 6 | 6 | | | |
| 3 | 3 | 2 | 10 | | | |
| 4 | 3 | -5 | -5 | | | |
| 5 | 3 | -7 | -7 | -11 | -7 | -7 |
| Sum | -1 | -2 | 6 | | | |

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- D. 3 Examples revisited:
  - 1) Air Pollution in Santiago:
    - Pareto criterion would cause the status quo to persist.
    - Compensation principle could lead to a change.
    - Majority rule?
      - If lots of poor people, unlikely to change policy because it cannot accommodate WTP.
    - So, outcomes depend crucially on individual preferences *and* on the social choice mechanism.

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- 2) California gnatcatcher:
  - Policy option: buy all coastal land and set it aside:
    - Financing options:
      - a) Tax wealthiest 10% of population.
      - b) Head tax on all citizens.
  - Pareto criterion: Nothing happens with either a or b because 100% will not support it.
  - Compensation principle: a and b are identical, since resources go from supporters to opponents.
  - Majority rule: Option a would pass, but b is ambiguous. But who should vote is unclear.
  - We see that outcomes vary with preferences and social choice mechanism.

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- 3) 3 Gorges Dam:
  - Assume: GDP growth benefits now, environmental costs in the future.
    - GDP growth could increase human capital over time.
    - Intertemporal Pareto Criterion: Passes if the increase in human capital will be so great as to compensate for loss of river.
  - Compensation: Cannot easily transfer resources across generations (particularly from future to present).
  - Majority Rule: Only present generation—it passes. Future generations—it fails.

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- Conclusions:
  - Economics can admit a wide array of individual preferences
  - Outcome depends on both individual preferences and social choice mechanism.
  - There is no perfect voting mechanism
  - Kaldor-Hicks criterion is appealing
    - Allows us to “separate” efficiency from equity.
    - Measuring strength of preferences is difficult.

# 14.42 / 14.420 Environmental Policy and Economics

Spring 2011