Conceptual Foundations of Cost-Benefit Analysis

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BGVW Chapter 2 and 3

Questions

▸ What are the roles of cost-benefit analysis?

▸ Can the cost-benefit analysis (CBA) be applied to noneconomic activities such as environment and safety?

▸ What are the assumptions necessary for the applicability of the CBA?

▸ Is it true that the CBA is not effective for actual policy choice because it cannot be applied to problems involving equity issues?

▸ Should the utilities of children or criminals be included in the CBA? If not, how should they be treated?

▸ How to treat preferences that are considered to be socially undesirable (e.g., tobacco, marijuana, etc.)?

▸ Can a CBA criteria be used as a minimum requirement for the adoption of a project?

Outline

▸ The role of cost-benefit analysis

▸ Consumer surplus: benefit evaluation in monetary unit

   ▸ Rationality → Consistent Ranking (Indifference curves, Ordinal utility function) → Utility function in monetary unit

   ▸ Money-Metric Utility Function

   ▸ Equivalent Variation

▸ Marshallian Consumer Surplus as an approximation

▸ Social choice and cost-benefit analysis

▸ Irrational behavior and socially undesirable preferences

▸ How to use cost-benefit analysis

Basic steps of cost-benefit analysis

- ▸ Understand the problems and construct a framework for analysis
- ▸ Formulate policy alternatives to evaluate
  - ▸ Without: Do nothing new
  - ▸ With: New policies (stop nuclear plants, construct Maglev railway line, join TPP, Carbon Tax, etc.)
- ▸ Forecast impacts of each alternatives
  - ▸ Production & consumption, external costs and benefits, risks of accidents, national security risks, etc.
- ▸ Cost-Benefit Analysis
  - ▸ Evaluate the net benefits of 'With' relative to 'Without' in monetary terms
- ▸ Evaluate the reliability of your benefit estimates (Sensitivity analysis)

▸

The role of cost-benefit analysis

▸ **Communicate social benefits and costs using a pecuniary measure**

  ▸ Monetary values are easier to understand than utility units

  ▸ When it is difficult to quantify or when quantifying yields bad side effects, cost effectiveness analysis or qualitative cost-benefit analysis is used.

▸ **Provides a comprehensive framework to present the total picture of benefits and costs including those which are difficult to measure in monetary unit. (Examples)**

  ▸ cost-benefit analysis --- can help overcome many of the problems we face in assessing risks. --- it promotes a better understanding of the actual consequences of regulation. When availability bias makes people excessively concerned with trivial risks, cost-benefit analysis is a useful corrective. When the public is becoming fearful of an imaginary danger, but neglecting real dangers in daily life, an effort to tabulate the costs and benefits can overcome both panic and neglect. When regulation actually increases the very risks that it is designed to reduce, an understanding of health-health tradeoffs can be a valuable corrective. (Sunstein 2004, p.291)

Benefit and cost items

▸ ## Nuclear power
  - ▸ Benefits to consumers (Consumer surplus)
  - ▸ Profits of producers (Producer surplus)
  - ▸ Safety
  - ▸ Energy security
  - ▸ Environmental impacts
  - ▸ Nuclear non-prolification
  - ▸ Quasi-option value
  - ▸ Social acceptance

▸ ## Transportation investment
  - ▸ User benefits
  - ▸ Taxes and tolls
  - ▸ Environment (air pollution, global warming, noise, etc.)
  - ▸ Accidents
 - ▸ Aesthetics: Scenery, etc.
  - ▸ Regional development

Benefit measurement in monetary unit

▶ **Assumptions necessary for cost-benefit analysis (evaluation in monetary unit): Rational behavior**

 ▶ Rationality means that a consumer can rank all alternatives consistently → Indifference curves (and utility functions) to represent ranking → For given prices, the minimum expenditure necessary for an indifference curve yields a measure of welfare in monetary unit (Money-metric utility function) (Next slide)

▶ **Assumptions other than rationality are not necessary.** Can be applied to non-economic impacts.

 ▶ Example: choice of safety levels

  ▶ x_2: safety, x_1: consumption

Indifference curves and utility in monetary unit

- ▸ Consistent preferences
  → indifference curves
  → Utility measured in monetary unit
- ▸ I^0 : Utility of $x^0 = (x_1^0, x_2^0)$ in monetary unit
- ▸ I^1 : Utility of $x^1 = (x_1^1, x_2^1)$ in monetary unit
- ▸ I^0 and I^1 can be used as the utility levels
- ▸ This can be done for any arbitrary (positive) prices
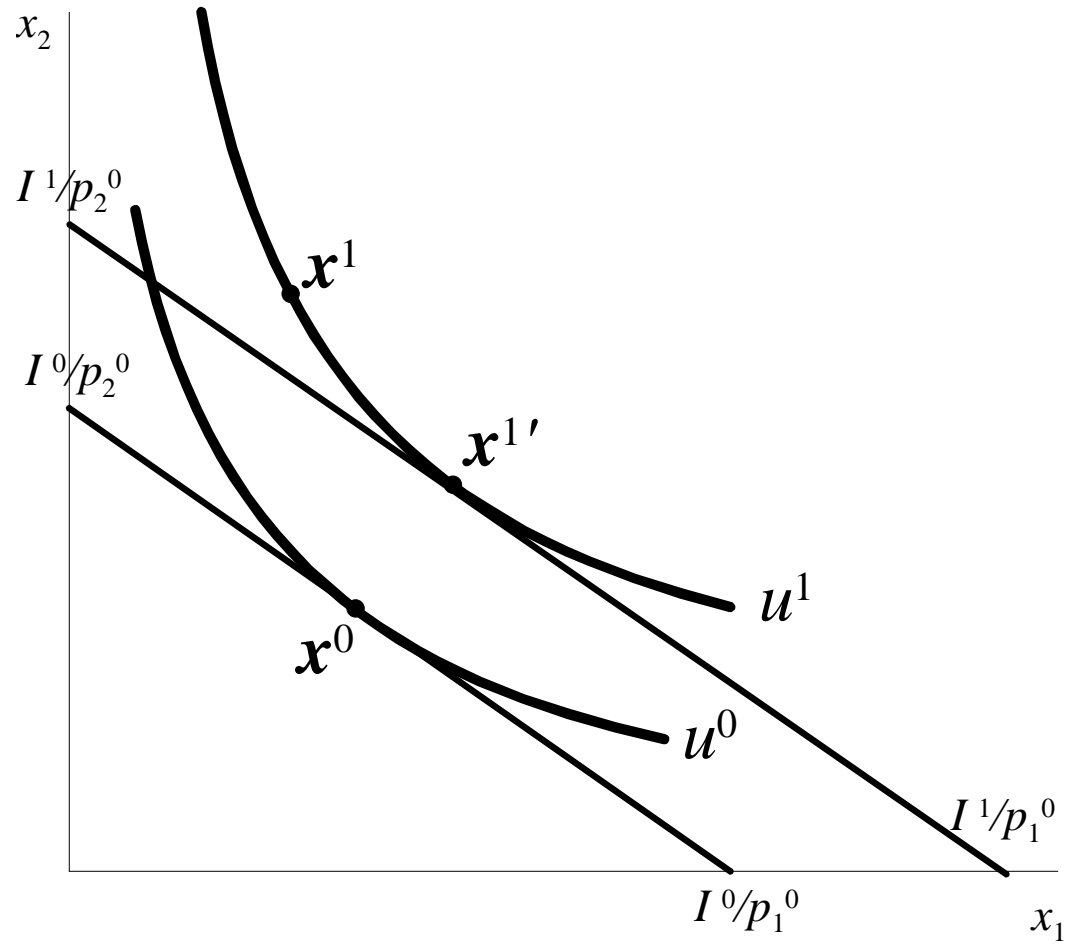
Value judgment in the use of CBA

- **Consumer sovereignty**
  - Respect consumers' preferences
  - How about a criminal's preferences? A children's preference?
  - Socially undesirable preferences?
  - Are consumers rational?
- **Equity issues if a simple sum is used**
  - The social values of one yen are the same for all individuals
  - No need to use a simple sum
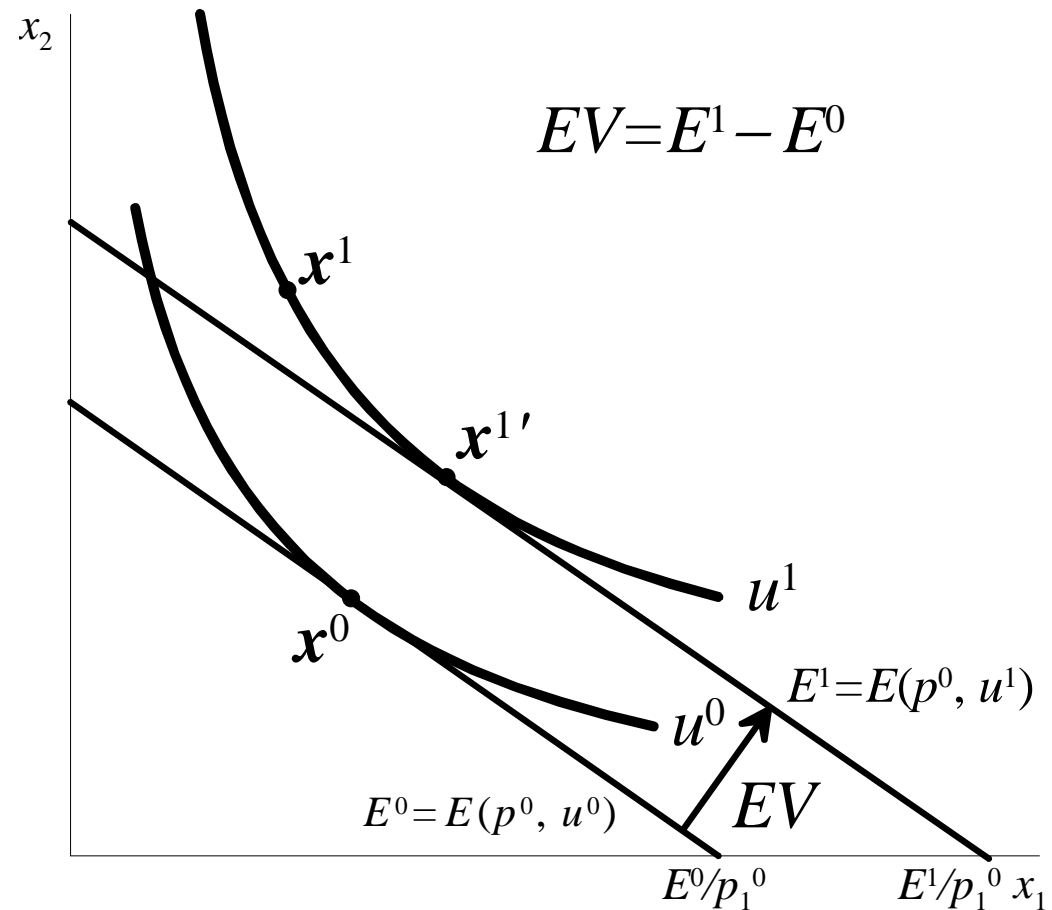   - Example: Different weights for different income groups

Money-Metric Utility Function (Skip)

▸ Utility function：$u(x)$

▸ Expenditure function：$E(p,u)$

  ▸ Minimize income ($I = p_1x_1+p_2x_2$) necessary to achieve utility level u at prices p

▸ Expenditure function as a utility function in monetary unit: $U(x)=E(p,u(x))$

▸ Impact of a policy: x^0, p^0, $u^0=U(x^0) \Rightarrow x^1$, p^1, $u^1=U(x^1)$

▸ EV(Equivalent Variation）: $E(p^0,u(x))$

▸ CV(Compensating Variation）: $E(p^1,u(x))$

Indifference curves and EV

▸ A move from x^0 to x^1, with price p^0 to p^1

▸ EV is the increase in expenditure necessary to achieve the utility level at x^1, at price p^0.

▸ CV uses the price at the With equilibrium p^1.

x_2

$$EV = E^1 - E^0$$

x^1

$x^{1\prime}$

u^1

x^0

u^0

$E^1 = E(p^0, u^1)$

$E^0 = E(p^0, u^0)$

EV

E^0/p_1^0 E^1/p_1^0 x_1

Consumer surplus

▶ Marshallian consumer surplus: Area to the left of a Marshallian demand function (income and other prices fixed)

▶ Weaknesses of Marshallian consumer surplus

▷ Not a money-metric utility function

▷ Quasi-linear utility function: coincide with EV and CV

$$U(z,Q) = z + u(Q)$$

▷ Path dependence: Not unique

▶ Most of practical applications use the Marshallian measure

▷ Errors caused by the use of Marshallian measure is small compared with forecast errors

▷ Bias is small for a good with a small share of income（Willig, AER 1976）
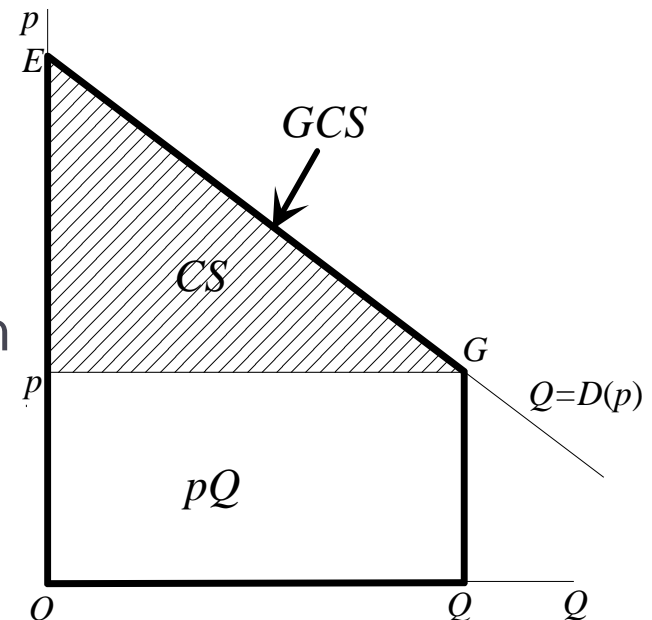
Marshallian consumer surplus and CV, EV (Skip)

▸ **The benefit of a change from b to a**

  ▸ BGVW, Ch.3, Appendix 3A

  ▸ CV: The area to the left of Hicksian demand curve with utility level fixed at the pre-project level, U_1

  ▸ Marshallian: The area to the left of the Marshallian demand curve (with income fixed)
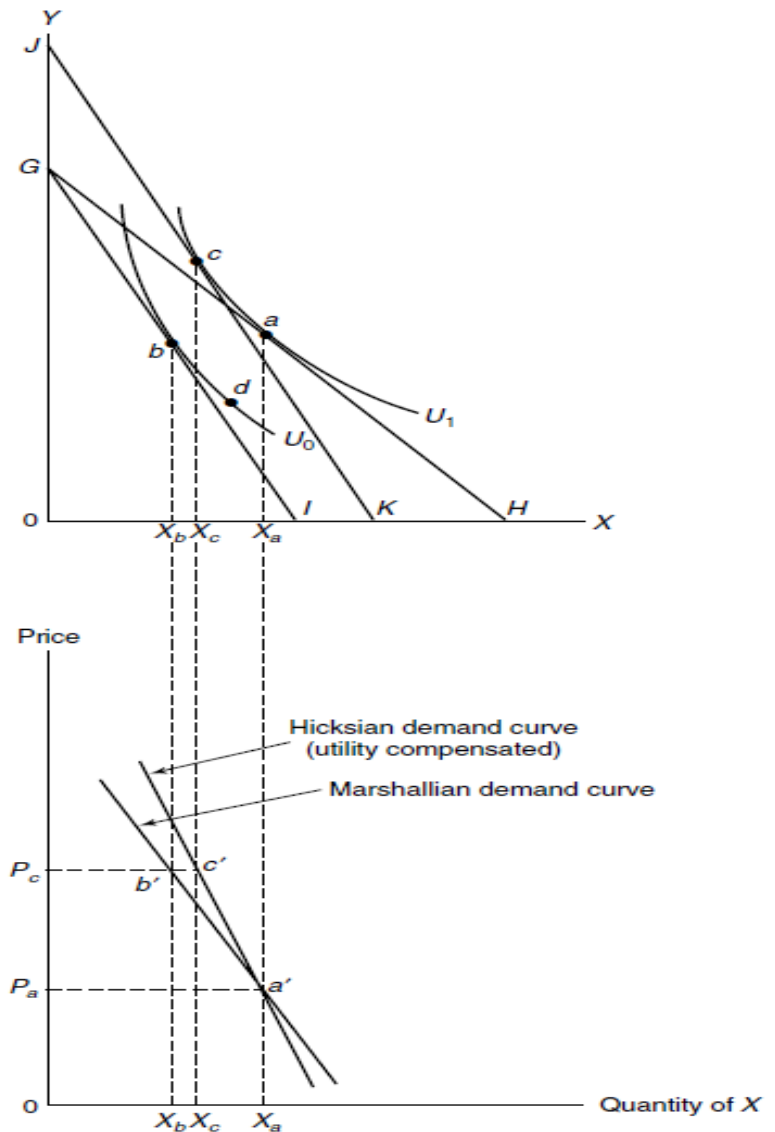
Willingness to Pay and Opportunity Cost

▸ Willingness to Pay (WTP): The payment that one would have to make or receive under the policy so one would be indifferent between the status quo and the policy with the payments.

   ▸ The algebraic sum of the WTP values is the appropriate measure of the net benefits of the impacts of a policy. If and only if the aggregate net benefits of the policy (as measured by WTP of affected individuals) are positive, then there exists a set of contributions and payments that make a Pareto improvement over the status quo.

▸ Opportunity Cost: The value of an input in its best alternative use

Cost-benefit criterion and Pareto efficiency (Skip)

▶ How to justify the simple cost-benefit criterion?
  ▶ Simple sums of benefits in monetary unit
  ▶ The compensation principle was proposed as a theoretical justification. (May not be important in practical application as seen later.)
  ▶ The cost-benefit criterion corresponds to the compensation (potential Pareto) criterion

▶ Pareto efficiency criterion: Everyone is made better off.
  ▶ Any policy makes some people worse off. Difficult to compensate them.

▶ Potential Pareto criterion （Kaldor-Hicks criterion）
  ▶ Kaldor compensation principle: Pareto improvement is possible with hypothetical compensation.
  ▶ Hicks: It is not possible to make everyone better off even with hypothetical redistribution.

▶ Cost-benefit criterion
  ▶ The net benefit measured in monetary units is positive.
  ▶ The cost-benefit criterion corresponds to the potential Pareto criterion
    ▶ A necessary condition for the Kaldor (weak) test is passed: Sum of CVs > 0
    ▶ A sufficient condition for the Hicks (weak) test is passed: Sum of EVs > 0

Social choice and the CBA

▸ ## Practical use of CBA

  ▸ "if government agencies should employ cost-benefit analysis, then they should do so because it is a beneficial tool, not because the sum-of-compensating-variations test or any related test has basic moral weight." (Adler and Posner 2000, p.2)

▸ ## Equity

  ▸ Incidence of benefits and costs must be examined case by case.

  ▸ Equity between groups (regions, firm sizes, etc.) does not guarantee equity between individuals

    ▸ Groups with political power tend to advocate equity

▸ ## Limits to consumer sovereignty

  ▸ Socially undesirable preferences

Adler, M.D. and E.A. Posner, Cost-Benefit Analysis - Legal, Economic, and Philosophical Perspectives, University of Chicago Press, 2000.

Irrational behavior

- **Behavioral economics, economic psychology**
  - People often behave irrationally
  - Systematic patterns in irrational behavior
- **Appropriate policies when people are not rational?**
  - No consensus yet
  - Nudge, Richard H. Thaler and Cass R. Sunstein, 2009.
    - Nudge: maintaining freedom of choice, induce better choice by a design of a choice architecture
  - Sunstein, C.R., Risk and Reason, 2004.
    - Use the framework of CBA to foster rational choice

Standing

▸ Jurisdictional Definition of Society: National, local, or global

▸ Jurisdictional Membership: Whose utility should be counted? How about illegal aliens, citizens abroad, legal non-citizens, etc.?

▸ Exclusion of Socially Unacceptable Preferences: This uses prohibitions to legal rights as a guide about prevailing social values and whether certain preferences should have standing. There is also difficulty in deciding on standing when dealing with preferences from foreign cultures (and their views on the roles of women, for example).

▸ Inclusion of the Preferences of Future Generations: This should be included, but it is difficult to measure the WTP of future generations. We can use the value (WTP) of people now as a proxy (very few policies affect only the future).

How to use CBA

▸ **Recognize the weaknesses of CBA**

▸ **But, an effective communication tool in practice**

  ▸ "cost-benefit analysis seems thoroughly entrenched in the federal bureaucracy" (p.5, Adler and Posner, 2000.)

▸ **How to use CBA**

  ▸ Avoid a mechanical use of CBA

  ▸ Distribution of benefits and costs should be considered when necessary

  ▸ Recognize the errors and biases of estimates

Quick Questions #1

▸ Comment on the following statements.

▸ CBA is not applicable to non-economic activities such as environment and safety because they cannot be monetized.

▸ The utilities of children and criminals should not be included in CBA. How should they be treated?

▸ CBA is not effective for actual policy choice because it cannot be applied to equity issues.