COST-BENEFIT COST-EFFECTIVENESS ANALYSIS—NIH Overview

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What are CBA and CEA?

- Cost-Benefit Analysis
  - A method by which one attempts to quantify in monetary terms the impacts of a policy.
  - Net Benefits = $Benefits – $Costs
- Cost-Effectiveness Analysis
  - Compares policy alternatives, based on ratio of their costs to a single quantified (but not monetized) effectiveness measure (or benefit).
  - CE Ratio = $Cost/Unit of Effectiveness

A Long and Storied History

- "When difficult cases occur, they are difficult, chiefly because...all of the reasons pro and con are not present to the mind at the same time...To get over this, my way is to divide half a sheet of paper by a line into two columns; *writing over the one Pro, and over the other Con...*When I have got them all together in one view, *I endeavor to estimate their respective weights*....thus proceeding I find at length where the balance lies."

B Franklin, 19 September 1772

CB/CE Evaluation Points

- Prospective Analysis (*Ex Ante*)
  - Do the benefits of a proposed program or project outweigh the costs?
  - How does it compare to the alternatives, including no action?
- Current (Snap-shot, *In Medias Res*) Analysis
  - Do the benefits of an existing program or project exceed the costs? Alternatives?
- Retrospective Analysis (*Ex Post*)
  - Was the project successful?

Comparison of Approaches

Approach	Cost-Benefit	Cost-Effective
Analytical question	Which alternative yields the highest level of benefits to costs.	Which alternative yields the highest level of effectiveness/costs
Measurement of Costs	Total costs, including opportunity cost to whomever	Total costs, including opportunity cost to whomever
Measurement of Benefits	Total benefits to whomever, measured in $	Benefits measured in terms of units of effectiveness
Decision Criteria	Efficiency: B/C ratio or net benefits	Effectiveness: units/$ or $/units

Strengths and Weaknesses of each approach

- Cost-Benefit Analysis:
  - Comparative project worth
  - Ability to calculate ROI
  - But: hard to put dollar values on everything
- Cost-Effectiveness Analysis:
  - Easy to use; relates dollars to objectives
  - Compare projects with same objectives
  - But: hard to evaluate multiple objective projects

Financial vs. Social/Economic Return

- Private sector analysis is concerned with financial return.
  - Efficiency = Profit Maximization = Revenues-Expenditures
- Public sector analysis is broader than financial return.
  - Maximize Social Welfare
  - Make everyone in society as well-off as possible.
  - Kaldor-Hicks criterion: If gains to winners outweigh costs to losers.
    - Winners could (theoretically) fully compensate losers.
  - Also concerned with distributional *equity*--who wins and loses and other concepts of public value.

CB: Value and Limitations

"The literature on project appraisal commonly gives the impression that the goal is to produce a number or set of numbers that tells whether the project is good or bad. In reality, it is not the numbers themselves that are important but rather the appreciation of the project's relative strengths and weaknesses that are gained in the course of appraising it. The numbers are simply an instrument of discipline..." *Guide to Practical Project Appraisal,* United Nations 1978.

Steps in Cost-Benefit Analysis

1. Specify set of alternative projects
2. Decide on perspective (who has standing)
3. Identify & categorize impacts
4. Monetize costs & benefits
5. Discount to obtain present value
6. Compute net benefits (benefits-costs)
7. Perform sensitivity analysis
8. Make a recommendation (apply decision rule)

1. Specify set of alternative projects/policies

- Specify the set of alternative policies/projects:
  - Status quo: State of affairs without policy (holding all else equal)
  - Policy change: before/after or with/without
- Can compare 2 policies, then:
  - Policy A vs. Status Quo → Net Benefits of Policy A
  - Policy B vs. Status Quo → Net Benefits of Policy B
  - Compare Net Benefits of A vs. Net Benefits of B

2. Decide on Perspective

- Global Perspective: Everyone in the world.
  - Theoretically best, but often impractical.
  - Multi-national perspective for trade
- National Perspective: Everyone in a particular country.
  - Justification: Shared culture, laws, effects outside border likely to be small for many policies.
- Sub-national Perspective: Everyone in a particular state, city, etc.
  - Problem: Spillovers!
- Institutional Perspective: Everyone affiliated with organization.
  - Used for financial CBA.

3. Identify & Categorize Costs & Benefits

- Question: What benefits & costs is the project expected to produce?
  - Marginal (or incremental) CHANGES in costs/benefits over the Status Quo

- Examples of Benefits:
  - Lives saved (additional)
  - Reduced illness/disease
  - Traffic congestion reduced
  - Profits increased
  - Additional jobs created

Step 3 (cont.)

Categorization of Costs/Benefits

- Real vs. transfers
- Tangible vs. intangible
- Direct vs. indirect

Step 3 (cont.)

Real vs. Transfers

- Transfer: An offsetting reallocation of resources between members of society.
  - Show up as cost to one group and benefit to another—cancel out.
  - Larger geographic scope (perspective), the more costs/benefits are transfers.
- Real Cost/Benefit: Result in net gains or losses. Effect bottom line net benefits.
  - Time, life are always real.

Step 3 (cont.)

Tangible vs. Intangible

- Tangible: Easily identified and measured.
  - E.g. Value of capital, supplies, wages.
- Intangible: Difficult to identify and measure
  - “Sense of community”, value of preserving wilderness, student confidence, a view of a lake.
- Some cross-over: Lives saved by a policy is tangible, but hard to measure in dollar terms.
- Sunk Costs?

Step 3 (cont.)

Direct vs. Indirect Costs

- **Direct costs (or effects in primary markets): Intended effects of the policy**.
  - Levin's "cost ingredients"
  - Personnel, capital, administration (Kee, Table 3)
    - Salaries to teachers, computer software, consultant for teacher training
- **Indirect costs (or effects in secondary markets): sometimes unintended**
  - Overhead, cost to third parties
    - Increased insurance (complement to activities of the program), maintenance (could be direct).
    - Lower crime rates.
  - Environmental degradation
- Not always clear (analyst must decide).

Step 3 (cont.)

Direct vs. Indirect Benefits

- **Direct benefits (or effects in primary markets): Intended effects of the policy**.
  - Closely related to the primary purpose(s) of the policy or program.
- **Indirect benefits (or effects in secondary markets): sometimes unintended.**
  - Spillover benefits:
    - New jobs created by program
    - Technological innovations (e.g., space program)

4. Monetizing Costs & Benefits

- Must be measured to all groups (with standing) no matter to whom they accrue
  - Not just the agency managing the program!
  - Financial and non-financial
- Theory: sum for all people/groups with standing:
  - Costs = Opportunity Costs (OC)
  - Benefits = Willingness-to-Pay (WTP)
- In EFFICIENT (non-distorted) markets:
  - Actual prices (reflect WTP and OC) and quantities
  - Government expenditure/revenue
- **Problem**: Not always possible to measure.

5. Discount to obtain PV

- Logic is simple: timing of costs and benefits matters because of time value of money
  - $1 received one year from now is worth less than $1 received today
  - Why? Because that $1 is unavailable to me for use or investment for one year
  - Note: This is not because of inflation!
- Discounting: Process of converting a stream of benefits or costs (in the future) to a single present value

Step 5 (cont.)

Net Present Value

- Which social discount rate to use?
  - Controversial, based on theoretical and ethical concerns, and rates of return on investment, etc.
  - The longer the project, the smaller the SDR.
  - Some organizations have standards:
    - OMB = 7%
    - GAO & CBO = 2-4%
    - EPA = 2-3%
    - Stern Report = .01%

6. Compute Net Benefits (NPV)

- Net Present Value
  - NPV = PV of benefits-PV of costs
  - positive=good

- Alternative: Benefit/Cost Ratio
  - PV of benefits/PV of costs
  - >1=good
  - Problem: Masks project scale!
    - Policy A:
      - NPV = 100-5 = 95
      - B/C ratio = 100/5 = 20
    - Policy B:
      - NPV = 500-100 = 400
      - B/C ratio = 500/100 = 5
    - With NPV Policy B is undertaken.
    - With B/C ratio Policy A is undertaken.
  - (Economists will argue that A is the better choice!)

7. Perform Sensitivity Analysis

- Sensitivity analysis is essential!
- Methods
  - Partial sensitivity analysis
    - Vary one important parameter at a time holding all else equal.
    - Pick the largest in magnitude, most uncertain, most controversial.
    - E.g. VSL of $1 mill. and recalculate with $10 mill
  - Breakeven values where NPV=0 (NPV benefits= NPV costs)
    - E.g. What would VSL have to be to be?
    - Special Case: What would discount rate have to be?
      - Internal Rate of Return (IRR or ERR for “Economic CBA”)
  - Extreme case (best-worst case) analysis
    - Vary every uncertain parameter at the same time to get best and worst outcomes.

8. Make a Recommendation

- Consider positive or negative NPV.
- If positive (and robust with sensitivity analysis):
  - At least enough benefits to (theoretically) fully compensate losers (Kaldor-Hicks efficiency).
  - However, benefits/costs may not be evenly distributed.
  - Might be concerned about the impacts on certain groups.

Step 8 (cont.)

Distributional Considerations

- Concerns about equity
  - May be concerned about various constituents, government, producers, consumers, etc.
    - Calculate & report NPV for each group separately.
  - Special case: low-income groups
    - Income equality important goal for govt (& many economists)
    - CBA may be biased against low-income groups.
      - WTP does not account for different incomes.
      - Each dollar is worth more to them (marginal utility of money).

Cost-Effectiveness Analysis

- Obtaining the maximum output for a given total cost; or
- Minimize the total cost of producing a given amount of output.
- Levels of Output: Levels of Cost
- It does not provide any information on how the output is valued by consumers.

Cost-Effectiveness Illustrations

- Lives Saved/healed/made more productive
  - highway safety
  - health programs
  - early intervention programs
- Prevention Programs
  - crime/recidivism
  - vaccination
  - environmental damage
- Education/Job Training
  - test scores
  - employment

CE Analysis is Most Useful

- When DM have decided on the output and you are trying to evaluate alternatives.
- When attempting to assign a value to the output or benefit is impossible (economically or politically).
- When the program does not produce multiple/dissimilar outputs or benefits.
- Is CE analysis the best for privatization options?

Issues in Cost-Effectiveness Analysis

- Distribution of benefits
- Multiple benefits
  - Can you create a “common denominator?”
- Accounting for uncertainty
- Recognizing your specific audience for the analysis

Some Difficult Issues in CE/CB Analysis

- Risk and uncertainty
- Equity concerns
- Labor costs
- Intangibles
- Criteria for selecting alternatives
- Regulatory analysis--health and safety
  - Can a value be placed on life or health?
- When multiple decision makers are involved, perspectives/issues may differ

Summation--The Value of CB/CE Analysis

- What it can do:
  - Provides a framework for analysis
  - Reveals assumptions
  - Focus on the key issues
  - Compare programs with different objectives to each other (C/B)
- What it cannot do:
  - Provide the appropriate perspective
  - Provide <u>the</u> answer
  - Quantify or put a dollar value on all intangibles
  - Compare programs with different objectives to each other (C/E)