CENG 6108 Construction Economics

Public Sector Decision Making

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1. Decisions for Public Projects
2. Benefit – Cost Ratio

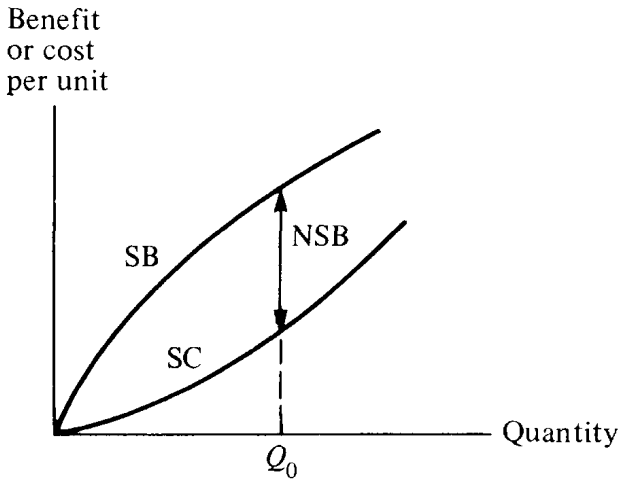
Introduction:

- Evaluation of public investment projects involves various social and political issues and interactions among economic, social, and political concerns.
- Fiscal Policy Objectives for Public Sector: Major functions
  - Allocation Function:
    - The process by which total resource use is divided between private and public goods, and by which the mix of public goods is chose.
    - Objective is to achieve economic efficiency, i.e., maximize the improvement of social welfare available under the prevailing income distribution.
  - Distribution Function:
    - Redistribution of wealth: 1) a tax scheme combining progressive income taxes for high-income households with a subsidy to low-income households, 2) publicly financed programs which benefit low-income households, 3) taxes on luxury goods and subsides of other goods which are used chiefly by low-income consumers.
  - Stabilization Function: High employment and price stability.

Introduction:

- Public Projects vs. Public Production
- Public Projects refers to government investments in goods and services in the public sector.
  - Public projects may be undertaken by private firms and paid for by the government, or carried out directly under public management.
- Public Production: Goods mainly produced by public enterprises.
- Economic efficiency is measured by the maximization of the net social benefit (NSB)

$$NSB = Social\ Benefits\ (SB) - Social\ Costs\ (SC)$$



Benefit – Cost Ratio:

- Benefit-cost ratio is commonly used in public projects.
  - Who will benefit from a project (the users)
  - Who will pay for a project (the sponsor)
- For example for a highway expansion project:
  - Costs to the Sponsor: Construction costs, Operating and Maintenance costs, Administrative costs.
  - Savings to the Sponsor: Increased tax revenues due to higher land values
  - Social Benefits: Reduced travel time for business and recreational users; Increased safety; and Reduced vehicle operating costs for business and recreational users.
  - Social Costs: Increased noise and air pollution; Disruption to the local environment; Disruption to traffic flows or business transactions during construction; and Loss of business elsewhere due to traffic rerouting one to the new highway.
  - Benefits and Costs are directly or indirectly attributed to the project.

Benefit – Cost Ratio:

- Benefit-cost ratios can be based on either the present worth or the annual worths of benefits and costs of projects:

$$BCR = \frac{PW\ (users'benefits)}{PW\ (sponsors'costs)}$$

- Modified benefit-cost ratio is also commonly used:

$$BCRM = \frac{PW\ (users'benefits) - PW\ (sponsors'operating\ costs)}{PW\ (sponsors'costs)}$$

- So, for independent projects: $BCRM > 1\ or\ BCR > 1$
- Mutually exclusive projects: using incremental analysis
- Let X and Y represent two mutually exclusive projects

$$BCR(X - Y) = \frac{B_X - B_Y}{C_X - C_Y}$$

- $BCR(X - Y) > 1$, chose X ; $BCR(X - Y) < 1$, chose Y ; $BCR(X - Y) = 1$, chose the project with the greater present worth of benefits.

MARR in the Public Sector:

- For example, public projects in Canada are evaluated using various MARRs.
- Sensitivity analysis is recommended, using 10% bas the base case and vary it in the range of 8% to 12%.

Project Type	Government Level	MARR	Suggested Range of Values
Benefit-Cost Analysis Guide	Federal	10%	8% - 12%
Pharmaceutical	Provincial	5%	0% - 3%
Land and resource management planning	Provincial (British Columbia)	8%	6% - 10%
Agricultural	Provincial (Alberta)	13%	-
Assessment of damages in personal injury and fatal accident litigation	Provincial (British Columbia and others)	2.5-3.5%	-

Benefit – Cost Ratio:

- Example:
- There are periodic floods in the spring and drought conditions in the summer that cause losses in a 15,000-square-kilometer river basin located between two regions (A and B) that has a population of 50,000 people. The area is mostly farmland, but there are several towns. Several flood control and irrigation alternative are being considered:
  1. Dam the river to provide floor control, irrigation, and recreation.
  2. Dam the river to provide floor control and irrigation without recreation.
  3. Control flooding with a joint regional water control project on the river.
  4. Develop alternative land uses that would not be affected by flooding.
- The constraints faced by the government are the following:
  - The project must not reduce arable land.
  - Joint regional state projects are subject to delays caused by legal and political obstacles.
  - Damming of the river in the side of region A will cause damage to wildlife refuges.
  - The target date for completion is three years.

Benefit – Cost Ratio:

- Taking into account the constraints, alternative 3 and 4 above can be eliminated, leaving two:
  I. Construct a dam for floor control, irrigation, and recreation.
  II. Construct a dam for floor control and irrigation only.
- The following assumption have been made:
  1. An earthen dam will have a 50 year useful life.
  2. Population and demand for recreation facilities will grow by 3.25% per year.
  3. A three-year planning and construction period is reasonable for the dam.
  4. Operating and maintenance costs for the dam will be constant in real dollars.
  5. Recreational facilities will be constructed in year 2.
  6. It will be necessary to replace the recreational facilities every 10 years. This will occur in years 12, 22, 32, and 42. Replacement costs will be constant in real dollars.
  7. Operating and maintenance costs for the three recreational facilities will be constant in real dollars.
  8. The real dollar opportunity cost of funds used for this project is estimated to be in the rage of 5% to 15%.

Benefit – Cost Ratio:

- The benefits and costs of the two projects are:

Estimated Average Benefits of the Two Projects

Year	Flood Damage Reduction	Irrigation Benefits	Recreation Benefits
0	0	0	0
1	0	0	0
2	0	0	0
3	182,510	200,000	27,600
4	182,510	200,000	27,600
⋮	⋮	⋮	⋮
52	182, 510	200,000	27,600

Estimated Average Costs of the Two Projects

Year	Dam Construction	Operating and Maintenance Dam	Recreation Construction	Operating and Maintenance Recreation
0	300,000	0	0	0
1	750,000	0	0	0
2	1,500,000	0	50,000	0
3	0	30,000	0	15,000
4	0	30,000	0	15,000
⋮	⋮	⋮	⋮	⋮
11	0	30,000	0	15,000
12	0	30,000	20,000	15,000
13	0	30,000	0	15,000
⋮	⋮	⋮	⋮	⋮
21	0	30,000	0	15,000
22	0	30,000	20,000	15,000
23	0	30,000	0	15,000
⋮	⋮	⋮	⋮	⋮

Estimated Average Costs of the Two Projects (continued)

Year	Dam Construction	Operating and Maintenance Dam	Recreation Construction	Operating and Maintenance Recreation
31	0	30,000	0	15,000
32	0	30,000	20,000	15,000
33	0	30,000	0	15,000
⋮	⋮	⋮	⋮	⋮
41	0	30,000	0	15,000
42	0	30,000	20,000	15,000
43	0	30,000	0	15,000
⋮	⋮	⋮	⋮	⋮
52	0	30,000	0	15,000

Benefit – Cost Ratio:

- Determine the following:
  a) What is the present worth of building the dam only? What is the benefit-cost ratio? What is the modified benefit-cost ratio? Use 10% as the MARR.
  b) What is the present worth of building the dam plus the recreational facilities? Use 10% as the MARR.
  c) What is the benefit-cost ratio for building the dam and recreation facilities together? What is the modified benefit-cost ratio?
  d) What project, 1 or 2, is preferred, on the basis of your benefit-cost analysis? Use 10% as the MARR.

References:

- Au, T., Au, Thomas P. (1992). *Engineering economics for capital investment analysis*. Second edition. Prentice Hall, New Jersey.
- Treasury Board of Canada (2007). Canadian Cost-Benefit Analysis Guide Regulatory Proposals.
- Fraser, N.M., Jewkes, E., Bernhardt, I., Tajima, M. (2006). *Engineering Economics in Canada*. 3rd edition, Prentice Hall.