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Valuation of CO_2 Emissions in Cost-benefit Analysis of Transportation Projects: Report from Japan

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Government's Manuals of CBA for Transportation Projects in Japan

- Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan has published CBA manuals of transportation projects including road, rail, air, and water transportation.
- All manuals are available on line at the website of Ministry of Internal Affairs and Communications.

CBA manuals of transportation projects in Japan

Type of project	Title	Latest updated
Airport	Cost-effectiveness Analysis Manual of Airport Development Projects Version 4	March 2008
Rail	Project Evaluation Manual of Rail Projects	July 2012
Road	Cost-benefit Analysis Manual	November 2010
Seaport	Cost-effectiveness Analysis Manual of Port Development Projects	June 2011

CBA Manuals vs. Technical Guidance

- CBA manuals of transportation projects are independently made by different bureaus under the MLIT.
  - They reflect the different characteristics of transportation facilities/services.
- "Technical Guidance of Cost-benefit Analysis for Public Project Evaluation" (TG) presents general recommendations to all CBA manuals of transportation projects.
  - The latest TG was published in June 2009 by MLIT.
  - Note each CBA manual is not obliged to follow the TG.

Basic Method shown in TG

- Evaluation indexes:
  - Three indexes: Net Present Value (NPV), Cost-benefit Ratio (CBR), and Economic Internal Rate of Return (EIRR)
- Social discount rate: 4 percent
- Evaluation period:
  - Appropriate period should be used by type of projects.
    - Air: 50 years
    - Rail: 30 years or 50 years
    - Road: 50 years
    - Sea Port: 20 to 50 years

Notes on Social Discount Rate: Comments in TG

- *Although there are two approaches to setting the social discount rate (SDR): capital cost approach and social time preference approach, it is difficult to determine the SDR with social time preference approach in practice.*
- *TG recommends the SDR estimated from market interest rate based on the capital cost approach.*
- *It estimated SDR to be approximately 4% using the past data of Japanese Government Bond Yield.*

Japanese Government Bond Yield from 1980s to 2000s

Period	JGB 10 year Yield (Nominal, average)	JGB 10 year Yield (Real, average)
1991 to 1995	4.09%	3.91%
1986 to 1995	4.78%	3.85%
1993 to 2002	2.23%	3.10%
1983 to 2002	3.95%	3.52%

Source: MLIT (2009)

Evaluation of Environmental Impacts Recommended by TG

- TG raises negative impacts of transportation projects on environment such as air quality, water quality, noise, vibration, soil quality, biodiversity, etc.
- It recommends alternative cost method, hedonic method, contingency valuation method (CVM), and travel cost method (TCM) for valuing the environmental impacts.
- It also recommends the valuation of CO_2 emissions.
  - 10,600 JPY per t-C (2006 year value)
  - This is estimated with damage cost approach

Benefit Estimation in Each Manual

	Components of benefit	Estimation methods
Airport	Saving of travel time, saving of travel cost, improvement of travel time reliability, increase of service frequency, noise	Consumer surplus approach, abatement cost approach (noise)
Rail	Saving of travel time, saving of travel cost, improvement of transfer at stations, reduction of in-vehicle congestion, increase of service frequency, NOx, noise, CO_2	Consumer surplus approach, CVM, abatement cost approach (NOx, noise), TG method (CO_2)
Road	Saving of travel time, saving of travel cost, improvement of traffic safety	Consumer surplus approach
Seaport	Saving of travel time, saving of travel cost	Consumer surplus approach

- Valuation of changes in CO_2 emissions is incorporated into benefit estimation only in the CBA manual of rail projects.

Discussions about Valuation of CO_2 Emissions in Japan

Revision of General Guideline of CBA

- Working Group (WG) of Government Committee on Project Evaluation Method was set up in October 2008 for revision of TG.
- To prepare this discussion, Study Team started discussions about the revisions of TG from January 2007 to June 2008.
- WG finally recommended the results to Government Committee in March 2009.
- The revised TG was published in June 2009.

Discussions among Experts

- Study Team and WG invited eight experts from economists, civil engineers, and transportation researchers in Japan for discussing the necessary revision of TG.
  - One of the issues in WG is valuation of environmental impacts.
  - Earlier version of TG did not include the guidance of CO_2 value although it suggested the emissions trading price approach.

Discussions about Valuation of CO_2 Emissions in Japan

- The Study Team and WG examined three potential methods for valuing CO_2:
  - Damage cost approach
  - Abatement cost approach
  - Emissions trading price approach
- They reviewed the existing literature as well as current practices in other countries through literature review, interviews, and questionnaire surveys.
  - Austria, Denmark, Finland, France, Germany, Netherland, Sweden, Switzerland, UK, US, New Zealand
  - IPCC Report, HEATCO Report, academic studies/papers

Major Comments from ST/WG Members

- “The assumptions of abatement technologies and expected damages significantly influence the values.”
- “Emissions trading price highly depends on the market design and regulations. The emissions trading market has not been well matured. The market price could be seriously biased.”
- “Abatement cost approach should be excluded because abatement technologies cannot be clearly identified. The willingness-to-pay for reducing CO_2 should be reflected into the value.”
- “National value of CO_2 emissions may have some strong message to the public and international/domestic market.”
- “Simple reviews of past studies in other countries may be biased by currency exchange rate.”
- “The accuracy of estimating future damage cost may be quite low, thus the sensitivity analysis should be carried out in its application. “
- “Results including state-of-the-art studies should be used. The regular updating process is strongly recommended.”

Comparisons of Three Approaches

	Advantage	Disadvantage
Damage cost approach	• Easy to integrate findings of past research due to recent increase of meta-analysis on damage cost.	• Estimated values vary among studies depending on models used and assumptions of future damage
Abatement cost approach	• Possible to estimate the value being consistent with government's target of CO_2 reduction in the future	• Estimated values highly depend on the government's target of CO_2 reduction and the technology development in the future.
Emissions trading price approach	• Theoretically reasonable as the market price	• Emissions trading market has not been well developed, thus the trading price may not reflect the marginal cost.

Source: Document prepared for Study Team meeting in July 2007

Recommendations from WG

- Damage cost approach
- 10,600 JPY/t-C (2006 year value)
  - This value was estimated by referring to Tol (1999).
  - 1990 year value (60 US$/t-C) is first converted into 2006 year value using GDP deflator of US and then converted into JPY (2006 year value) using Purchasing Power Parities (PPPs) as of 2006.
- Sensitivity analysis
  - Minimum: 50 percent; Maximum: 200 percent

Conclusions

Summaries of Report from Japan

- Japanese Government has introduced the value of CO_2 emissions into Technical Guidance of CBA since 2009.
- It recommends the use of value of CO_2 based on damage cost approach estimated with the empirical evidences from past literature.

Discussions

- However, few manuals of CBA in transportation projects have introduced the value of CO_2 emissions into benefit estimation.
- Benefit stemming from reduction of CO_2 emissions in transportation project seems to account for very small percent out of total benefit.
- The low influence of CO_2-reduction benefit may lead to lower incentive of introducing it into CBA manual.

References

- Civil Aviation Bureau, MLIT (2008) *Cost-effectiveness Analysis Manual of Airport Development Projects Version 4*. (in Japanese)
- MLIT (2009) *Technical Guidance of Cost-benefit Analysis for Public Project Evaluation*. (in Japanese)
- Ports and Harbours Bureau, MLIT (2011) *Cost-effectiveness Analysis Manual of Port Development Projects*. (in Japanese)
- Railway Bureau, MLIT (2012) *Project Evaluation Manual of Rail Projects*. (in Japanese)
- Road Bureau, MLIT (2010) *Cost-benefit Analysis Manual*. (in Japanese)
- Tol, R.S.J. (1999) The Marginal Costs of Greenhouse Gas Emissions, *The Energy Journal* 20(1): 61-81.