

A Partial Review of Seven Jurisdictional Guidelines for Cost-Benefit Analysis

Presentation to Australian Conference of Economists
July 2019, Melbourne

Peter Abelson
pabelson@appliedeconomics.com.au

Contents

This paper reviews 7 guidelines to CBA with respect to 8 major cost-benefit issues drawing on latest edition of CBA textbook (Boardman et al, 5E, 2018) for guidance.

Jurisdictions: Infrastructure Australia, NSW Treasury, Victorian Department of Treasury and Finance, UK Treasury, European Commission, US Environmental Protection Agency, and New Zealand Treasury.

Eight issues: standing, core valuation principles, scope of CBA, changes in real values over time, the marginal excess tax burden, social discount rate, use of benefit-cost ratios, and treatment of risk.

Two more introductory remarks

- The Editor of the much-cited UK Treasury (2018) Green Book (*Central Government Guidance on Appraisal and Evaluation*), has pointed out to me (in email) that this is intended as a “guide for public officials”, not as a “textbook on techniques such as CBA” which are to be found separately in “the academic arena”.
- This leads to related issue: should a jurisdictional guide provide complex technical advice? Including complex issues may discourage use of CBA and result in inconsistent reports. Where differences on issues have minor effects, simple or no explanation may be preferred. Or explanation could be provided in annexes.

Layout of Paper

For each of the 8 topics, the paper describes (succinctly):

- The key issue(s),
- The Boardman text position(s)
- The relevant positions of the guidelines, and
- Draws conclusions.

The final section concludes.

Standing

- **Problem:** Standing may be global, national, provincial or local.
- **Boardman** position: “Analysts should ideally conduct CBA from the national perspective... Adopting the subnational perspective makes CBA a less valuable decision rule for public policy”.
- If “major impacts” spill over national borders, CBA should be done from the global, as well as, national perspective.
- Analysts may conduct parallel sub-national CBA in response to interests of narrower groups of stakeholders.
- Boardman does not define “major impacts”.

Agency	Positions on Standing
Boardman	National standing + global or sub-national if needed.
UK	National (no mention global). Sub-national is a distributional issue (Annex 3).
EC	Local, regional, national, “even EU”. Wider standing essential with env. Impacts.
USEPA	National. Report beyond border effects separately. Cites OMB Circular A-4.
NZ	National. Government responsible to country. Especially present generation.
IA	National. “Australian community as a whole”; global not mentioned.
Victoria	“All welfare costs and benefits to society” (not defined). In practice state.
NSW	NSW state. Should consider inter-state impacts (Box 2.6). No mention national.
This paper	Standing as per jurisdiction + global or national if significant impacts.

Standing: Conclusions

Most jurisdictions adopt their community as standing. EC main exception.

Paper broadly agrees Boardman approach.

- But neither Boardman nor Guidelines describe complex implications of alternative standings.
- Paper: should not do national projects with negative global NPV or state projects with negative national NPV. Not equitable or efficient.
- The issue of standing and how to apply the principle needs fuller discussion in most of the guidelines.

Core Valuation Principles

Problems

- (i) What is underlying starting position? CV or EV?
- (ii) How to value individual losses from this position?

Related issue: Strictly CV or EV involves Hicksian demand curves holding real income constant. With observed (Maschallian) demand curves, real income changes.

Boardman: changes in consumer surplus, as measured by (Marshallian) demand curves, “are usually reasonable approximations of WTP to obtain or avoid effects of policy changes”. Income effects are usually small “and can be safely ignored”. Bias may occur where income changes are significant as with large changes in housing or wage rates.

Economic theory suggests WTP values close to WTA values for market goods, but stated choice surveys suggest WTA values may be five times WTP values.

Conclusion: may sometimes be appropriate to include WTA values but with “social budget constraints to increase likelihood respondents will provide an economic response”.

Agency	Positions on valuation principles
Boardman	CV. Generally, observed (Marshallian) WTP values. WTA sometimes appropriate.
UK	Chapter 6 discusses valuations. But core valuation principles nowhere discussed.
EC	CV / EV discussed (p.321). CV and WTP recommended. WTA possible (323-3)
USEPA	Recommends Marshallian WTP. Detailed CV / EV discussion. May be WTA. 7-8,9
NZ	CV implicit in do-nothing Base Case. WTA mentioned only in passing.
IA	Both approaches described informally. WTA mentioned, not clearly prescribed.
Victoria	CV implicit. Base case = existing policy. WTA mentioned only briefly once (p.14).
NSW	CV implicit. WTP values (implicitly Marshallian). WTA mentioned; not specified.
This paper	Adopt explicit CV and explicit WTA. EV alternative should be explained.

Valuation Principles: Conclusions

- Most guidelines implicitly adopt CV position and value benefits (consumer surpluses) using Marshallian (WTP) demand curves. This is practical.
- Guidelines could be clearer about value judgments by reference, probably in annex, to CV and EV and the implications for rights to health services, environmental goods and so on. These are important value judgements. Clarity could help to reduce misunderstandings on these issues
- More practical issue: lack of guidance on application and estimation of WTA values. For small changes in income (say up to \$100), differences between WTP and WTA amounts are likely to be minor and can be ignored. However, losses are sometimes high, e.g. household disruptions from major transport infrastructure projects.
- While recognizing the practical issues in estimating WTA values, in our view, this is an area for more consideration.

Project Scope

Main issues are:

- (i) What are related markets and when to include benefits from them.
- (ii) If, and when, to include second-round income (multiplier) effects.

Boardman: generally appropriate to include related market effects (called “secondary benefits”) when markets are non-competitive. or distorted. The text does not discuss wider economic benefits.

Text does not support including second-round (multiplier) flow-on effects in CBA, except for distributional analysis.

Agency	Positions on Project Scope
Boardman	Allow when related markets are distorted. Do not use multipliers.
UK	Indirect productivity benefits possible. Demand-based multipliers not be adopted.
EC	Use shadow prices reflect indirect benefits. Don't double count related markets.
USEPA	Growth impacts not predictable (9-9). Don't double count pass-through effects.
NZ	Yes, if related markets distorted, but usually small. Do not use multipliers.
IA	Significant extra economic benefits possible. ^a CGE / multipliers limited (pp. 83-4).
Victoria	Scope not discussed. Wider economic benefits are possible. ^a Avoid multipliers.
NSW	Allow for distorted related markets; exclude wider benefits ^a and multipliers
This paper	Allow for market distortions in related markets (conservatively). No multipliers.

Project Scope: Conclusions

- There is fair agreement between Boardman positions and guidelines on project scope, with high agreement on non-use of multipliers.
- There is also general agreement on treatment of impacts in related markets. However, this is a tricky practical area and these issues could usefully be addressed more explicitly in several guidelines.
- The main differences relate to wider economic benefits. Boardman does not address these, presumably implying unimportance, but the UK guideline supports WEBs as do the Australian guidelines more tentatively. The writer's view (Abelson, 2019) is that WEBs should be treated very cautiously.

Changes in Real Values over Time

- **Issue:** All CBAs forecast values in constant prices. However, real (relative) values may change over time. For example, a resource, or environmental asset, may be expected to become scarcer or more plentiful over the life of a project, with relative values rising or falling accordingly over time.
- **Boardman** has a clear view on this. “Relative prices may change. Analysts should always consider this possibility, especially for long-lived projects. Fortunately, *there is no conceptual difficulty* in handling relative price changes” (my italics).

Agency	Positions on Real Values over Time
Boardman	CBA should allow for changes in real values over time.
UK	Not discussed but note position on STPR (Table 6 below).
EC	Not discussed
USEPA	Not discussed directly. Hard to predict tech. changes & varying responses.
NZ	Best assume constant but allow change if evidence (inc. value of life).
IA	Not discussed
Victoria	Not discussed
NSW	Not discussed
This paper	Assume constant. Introduce real changes if evidence in sensitivity tests.

Real Values over Time: Conclusions

- Issue not discussed in any Australian guide, EC or UK guide. Discussed implicitly in USEPA guide. NZ guide accepts allowing for relative price changes in principle but recommends apply with great caution.
- Some guides have implicit real value changes in variations in SDR /life
- Paper agrees with Boardman that issue of real (relative) values over time should be explicitly considered. For example, arguably the value of business travel time savings would rise with real earnings.
- But, as NZ and USEPA note, this is a complex forecasting matter.
- If changes in real values are adopted, they be adopted consistently and centrally and not by analysts on individual projects.

The Marginal Excess Tax Burden (METB)

- **The issue:** should the marginal cost of public funds include an allowance for METB associated with distortions of labour supply, savings or consumption?
- If METB is included, what value should be allowed?
- **Boardman** recommends METB should be included in CBA.
- Drawing on several estimates of METB in US, text estimates average METB = 0.23 (US 23 cents in the dollar) for federal projects based on income tax financing. For local government projects financed by property tax, METB = 0.17.

Agency**Positions on METB****Boardman**

Should allow for METB. In federal use METB = 0.23. Local government = 0.17.

UK

Not discussed

EC

Not discussed

USEPA

Not discussed

NZ

Include at 20%

IA

Not discussed

Victoria

Allow 8 cents per \$ marginal tax raised; not for fixed tax revenue or Comm. Grants.

NSW

Not in central case. May be included in sensitivity test downside.

This paper

Inclusion of METB not supported.

METB Conclusions

Follow Boardman, ignore METB or search for a compromise?

- In comprehensive guides, it is appropriate to recognize METB is a real cost. However, there are several reasons NOT to use METB multipliers.
- First, taxes are generally fixed independently of projects. Thus, cost of project is opportunity cost of forgone project(s), not marginal tax raised. As argued below, this should be recognised in choice of SDR. Where tax is fixed, inappropriate to add METB.
- Second, revenues may offset taxes, with net tax less than gross tax. This would need to be accounted for, which would be challenging.
- Third,, including METB on project by project basis would raise serious practical issues of consistency between projects.
- In perfect economy, where public funds are raised until marginal rate of return on public projects equals marginal return on private investments and both equal optimal social time preference rate (see Section 7), METB should be accounted for. But this is not economy most of us experience.

The Social Discount Rate

Two main concepts: social opportunity cost of capital (SOC) and social time preference rate (STPR).

- Two main versions of SOC: forward return on alternative investment (ROI) and weighted cost of capital (WCOC) based investment and consumption forgone.
- STPR values benefits and costs based on social values of consumption over time.
- SOC based on ROI = around 6-7% p.a. while STPR = around 2.5-3.5%.
- Shadow price of capital (SPC) approach. Estimate shadow price by discounting returns on investment forgone by STPR. Then apply STPR to forecast project net benefits based on shadow price of the capital. Where funds would have been fully invested, this gives similar outcomes (positive or negative) to use of ROI.

Boardman: SPC approach appropriate, but not practical (depends on how projects are funded). They recommend:

- STPR: 3.5% from year 0 to 50, and declining rates reaching 0% in year 300.
- Sensitivity testing with alternative discount rates.

Agency	Positions on Social Discount Rate
Boardman	SPC correct method, not practical. Recommends STPR = 3.5% + slow fall (p.258)
UK	STPR = 3.5 with 1.5 for life and health values. Decline after 30 years. (Annex A6)
EC	STPR. 5% for cohesion states and 3% for member states.
USEPA	SPC method. Or STPR (2.5% to 5%) based on foregone consumption.
NZ	SOC = 6% default = ROI approach. Varies with β in CAPM / WACC.
IA	SOC implicit. 7% in line with other Australian practice.
Victoria	Claim SOC. Recommends 7%, but 4% for hard to quantify benefits.
NSW	SOC = ROI = 7%
This paper	ROI based on return on alternative foregone: market WACC (inc. market risk)

SDR Conclusions

- North / South divide. North adopts STPR. South adopts ROI.
- Some jurisdictions (UK, NZ, Victoria) recommend varying SDRs for different situations. UK for health and life; NZ for β in CAPM formula; Victoria for “hard to monetise values”.
- Paper agrees Boardman views on SPC approach; good principle, hard in practice.
- Given this, following Abelson and Dalton (2018), paper recommends SDR based on forward-looking ROI principle rather than on the backward looking WCOC.
- Selecting projects with lower STPR is inefficient and does not optimise welfare growth. Selecting efficient projects with higher rates of return can benefit future generations as well as present ones.
- Paper also cautious about adopting different SDRs for different projects or any of arguments in Guidelines for this.

Benefit-Cost Ratios

Common definition: $BCR = PV(B) / PV(I+C)$ (1)

- where PV = present value, B = benefits, I = capex, C = all other costs.

Alternative definition: $BCR = PV(B-C) / PV(I)$ (2)

Boardman implies Eq (1); does not discuss Eq. (2).

“This is one area where there is a right answer and wrong answers. The appropriate criterion to use is the NPV rule ...The other rules (including the IRR) sometimes give incorrect answers; the NPV rule does not.”

BCR is biased towards small projects and may be manipulated by classifying some costs as negative benefits (classification issue).

“We recommend that analysts avoid using benefit-cost ratios to rank policies and rely instead on net benefits”.

Agency	Positions on BCRs
Boardman	NPV appropriate. $BCR = PV(B)/PV(I+C)$ should not be used. Do not discuss other.
UK	Standard $BCR = PV(B)/PV(I+C)$ cited as an option - no qualifications.
EC	Standard BCR; cites bias / classification issues. Suggests OK if budget constraint.
USEPA	Cites standard BCR; notes ranking issue; not proposed in summary template.
NZ	$BCR = PV(B)/PV(I+C)$ provides understanding. But ranks projects incorrectly.
IA	Supports standard $BCR = PV(B)/PV(I+C)$ Use $NPVI = NPV/I$ if budget constraint.
Victoria	$BCR = PV(B)/PV(I+C)$ biases rankings. $BCR = PV(B-C)/PV(I)$ yes, when capital limited.
NSW	Adopts $BCR = PV(B) / PV(I+C)$ with no qualifications.
This paper	Agree Boardman with Victorian addition (or IA equivalent).

BCR Conclusions

- Jurisdictions take various approaches. Several jurisdictions (EC, USEPA, NZ and Victoria) cite bias and / or classification errors in standard Equation (1).
- But reach different conclusions. EC suggest Eq. (1) is satisfactory with budget constraints. USEPA excludes BCR from its proposed reporting template. NZ says Eq. 1 provides useful intuitive understanding of outcomes, despite ranking problems. Only Victoria recommends Eq. 2 with capital constraints. On the other hand, UK and NSW guides support use of BCR in Eq. 1 without qualifications.
- This review agrees fully Boardman's criticisms of Eq. 1: biased towards small projects and subject to classification manipulation.
- However, BCR as in Eq.(2) is relevant to decision making under capital constraints when returns on agency's marginal projects exceed return elsewhere. Then, agency should select projects in order of present value per unit of constrained capital until capital is exhausted. Box 1 in paper illustrates this with simple first year constraint example.

Treatment of Risk and Uncertainty

Many issues: paper discusses use of expected values and option prices (OP).

- $OP = EUV + OV = WTP$ (4)
- Where EUV = expected use values; OV = option values = WTP for good / service.

Boardman: expected value analysis is appropriate to deal with uncertain range of costs of benefits. Implicitly, a risk neutral approach.

And provides conceptual support for OP. “Economists generally consider option price ... to be the theoretically correct measure of willingness to pay in circumstances of uncertainty or risk”.

However OP is too difficult: “In practice analysts usually do not convert net benefits to certainty equivalents or option prices. Specifically, they use expected values rather than option prices because the former can be estimated from observable behavior, while the latter requires contingent valuation surveys”.

Agency**Positions on Expected Values and Option Prices****Boardman**

Should use EVs. Option prices / values conceptually correct, but not practical.

UK

No discussion EVs or option values Discusses risk management inc. optimism bias.

EC

Recommends EVs and ENPV. Option values flagged, but not discussed (pp.323-4)

USEPA

V. little discussion (regs. focus); ideally show probabilities; describe uncertainties.

NZ

EV only implicit para 131. Mainly other concepts (e.g. real options) discussed.

IA

EV preferred for cost. Can use P50. EV for benefits and option price not discussed

Victoria

No discussion EVs or option values. Discusses real options & Monte Carlo analysis.

NSW

Recommends EVs. Option values not discussed. Discusses real options.

This paper

Paper agrees Boardman position.

Risk and Uncertainty Conclusions

- Most Guidelines discuss treatment of risk at length. But there is limited discussion of use of expected values and virtually none on option prices / values.
- Only guides to explicitly discuss and recommend use of EVs are EC and NSW.
- Our conclusions. We agree with Boardman that CBA should generally be based on expected values (and ENPVs). This risk neutral approach is efficient and appropriate for most public policy and project decisions. Occasionally, when projects have large impact on a community, government may choose safer project with lower ENPV. This should be an explicit approach in CBA guides along with guides on how to treat issues like contingency costs.
- Option values are more complex. In effect, they are included in WTP (option) prices obtained from stated preference surveys. They are not included in market prices or other revealed preference valuation methods.
- The usual implicit assumption is that where these differences exist, they are likely to be small and can be ignored. This paper cannot provide any better approach.

Conclusions

All Guidelines reviewed provide readable and high quality advice.

But several guidelines did not deal with some elements of these 8 issues:

Turning to the 8 sets of issues, the review found (inter alia) that:

- i. The application of standing generally needs more discussion. And jurisdictions should not adopt national projects with a negative global NPV or state projects with a negative national NPV.
- ii. The guidelines should address core (CV/EV) valuation principles (perhaps in Annex) and provide more guidance on when WTA values should be adopted and how estimated.
- iii. Most guidelines should give more guidance on inclusion or otherwise of impacts in related markets and how these impacts should be valued.
- iv. Changes in real values over time should be discussed but considered cautiously. If adopted, they should be adopted consistently with central guidance.

Conclusions (cont.)

- (v) The Guidelines should recognize possible METB but not adopt inclusion.
- (vi) The SOC discount rate based on ROI principle should be adopted.
- (vii) Guidelines should explain but not recommend standard BCR. Under capital constraints, alternative BCR with only capital (and perhaps public net recurrent costs) in denominator is useful.
- (viii) The Guidelines should give clearer guidance on use of expected values, including expected net present values, in CBA.

However, as some reviewers have noted: the challenge for the guidelines is to encourage consistent and correct use but not become academic manuals.