Chapter 17 Cost-Effective Analysis (CEA)

Cost-Effective Analysis (CEA) is a widely used alternative to CBA, especially health and defense policy. CEA compares (mutually exclusive) alternatives in terms of the ratio of their costs and a single quantified, but not monetized, effectiveness measure.

Three common constraints to doing CBA

- 1. Unwilling or unable to monetize the most important policy impact
- 2. A particular effectiveness measure does not capture all of the social benefits of each alternative, others are difficult to monetize.
- 3. To deal with intermediate goods whose linkage to preferences is not clear.

Cost-Utility Analysis (CUA) for the evaluation of health policies.

Cost-Effectiveness Ratios

Costs are measured in monetary terms.

Effectiveness may be measured in units such as lives saved, tons of carbon monoxide reduction, children vaccinated.

Two ways: *Cost-Effectiveness ratio* (CE ratio) more commonly used *Effectiveness-Cost ratio* (EC ratio) Increment CE ratio: *i* (with), *j* (without) policy alternatives

$$CE_{ij} = \frac{C}{E} = \frac{C_i - C_j}{E_i - E_j}$$

Identical Program Budgets

TABLE 17-2 Cost-Effectiveness Analysis with Fixed (Identical) Costs					
	Alternatives				
Cost and Effectiveness	A	B	C		
Cost measure (budget cost)	\$10M	\$10M	\$10M		
Effectiveness measure (number of lives saved)	5	10	15		
CE ratio (cost per life saved)	\$2.0M	\$1.0M	\$0.67M ^a		
EC ratio (lives saved per million dollars)	0.5 life	1.0 life	1.5 lives ^a		

^a CE ratio or EC ratio of the most cost-effective alternative.

Imposing Constraints to deal with Scale Differences

TABLE 17-3 The Problem with the CE Ratio When Scale Differs				
	Alternatives			
Cost and Effectiveness	A	В		
Cost measure (budget cost)	\$1M	\$100M		
Effectiveness measure (number of lives saved) CE ratio (cost per life saved) EC ratio (lives saved per million dollars)	4 \$250,000 ^a 4.0 lives ^a	200 \$500,000 2.0 lives		

" CE ratio or EC ratio of the most cost-effective alternative.

 $\begin{array}{lll} Min \ C_i & Min \ CE_i & Max \ E_i & Min \ CE_i \\ s.t. \ E_i \geq \overline{E} & s.t. \ E_i \geq \overline{E} & s.t. \ C_i \leq \overline{C} & s.t. \ C_i \leq \overline{C} \end{array}$

- \overline{E} : Minimum acceptable level of effectiveness
- \overline{C} : Maximum acceptable level of cost

Illustration of the Different CE Rules

TABLE	17-4	Cost-Effect	iveness Analy	vsis with Const	raints		
		of the most cos		<i>E</i> ≥ 50		<i>C</i> ≤ 250	
Projects (1)	Lives Saved (2)	Budget Cost (\$M) (3)	CE Ratio (cost per life saved) (\$M/life saved) (4)	Budget Cost of Projects That Save at Least 50 Lives (5)	CE Ratio of Projects That Save at Least 50 Lives (6)	Lives Saved of Projects That Cost No More than \$250M (7)	CE Ratio of Projects That Cost No More than \$250M (8)
А	100	250	2.5	250	2.5 ^a	100 ^a	2.5
В	20	44	2.2	addaura any san		20	2.2
С	100	300	3.0	300	3.0	201012_1010	-
D	50	300	6.0	300	6.0	igh is <u>ce</u> uch i	-
E	10	20	2.0 ^a	skin 14 is th	etel-e, li	10	2.0 ^a
F	100	900	9.0	900	9.0		_
G	60	210	3.5	210	3.5	60	3.5
Н	50	200	4.0	200 ^a	4.0	50	4.0
Ι	40	100	2.5	And Land	and Yin we	40	2.5
J	45	110	2.4	ATC-TOT VI	bneyed a	45	2.4

^a CE ratio, budget cost, or effectiveness of the most preferred alternative

Chapter 19 How Accurate is CBA?

Major Steps in CBA in Chapter 1 "Highway Example"

1. Specify the set of alternative projects

Road Surface, Routing, Size (Lane), Tolls, Wild Animal Friendliness, Timing

2. Decide whose benefits and costs count

Global, National, Provincial, Local...

3. Catalogue the impacts and select measurement indicators

Time saving, Operation cost saving, Horizon Value, Safety Benefit, Toll Revenue, New Users, Alternative Road Benefits, Construction cost, Maintenance cost, etc.

4. Predicts the impacts quantitatively over the life of the projects
Number of vehicle-trips, Vehicle operation cost, number of accidents avoided, number of lives saved, etc.

5. Monetize all impacts

Based on the concept of WTP

- Observed Behavior: Direct Estimation & Indirect Market Method (HPM, TCM)
- Contingent Valuation Method (Stated Preference)
- 6. Discount benefits and costs to obtain present values
- 7. Compute the net present value of each alternative

Discount rate, NPV, IRR, CBR

8.Perform sensitivity analysis9. Make a recommendation

Sources of Errors in CBA Studies

1.Omission Errors: to exclude some impact category completely. by "uncertainty of the fundamental scientific relationship"

2. Forecasting Errors: to arise due to the difficulty of predicting technological change, cognitive biases, changing project specifications, etc.

by "uncertainty" and "Over optimism: underweight low-probability *bad* events and overweight low-probability *good* events".

3. Measurement Errors: impacts are often observed, recorded or interpreted inaccurately.

4. Valuation Errors: Difficulty of accurate monetary estimates of the social value.

Others: Political and bureaucratic actors not only directly underestimate costs and overestimate benefits of their favored alternative, they also overestimate the costs and underestimate the benefits of alternatives the do not favor.

Distribution of Net Benefits over Time



Choosing among Projects (in Chapter 2)

Net Present Value
$$NPV = \sum_{t=0}^{t=n} \frac{B_t - C_t}{(1+i)^t} = \sum_{t=0}^{t=n} \frac{B_t}{(1+i)^t} - \sum_{t=0}^{t=n} \frac{C_t}{(1+i)^t} = PVB - PVC$$

Cost Benefit Ratio $CBR = \sum_{t=0}^{t=n} \frac{B_t}{(1+i)^t} / \sum_{t=0}^{t=n} \frac{C_t}{(1+i)^t} = PVB / PVC$

TABLE 2-1	Choosing Among Projects: Net Benefits versus Benefit-Cost Ratios				
	Costs (millions of dollars)	Benefits (millions of dollars)	Net Benefits (millions of dollars)	Benefits/Costs	
No project	0	0	0	_	
Project A	1	10	9	10	
Project B	10	30	20	3	
Project C	4	8	4	2	
Project D	3	5	2	1.7	
Projects C and	D 7	21	14	3	
Project E	10	8	-2	0.8	

(1) No constraints: Choose A, B, and combination C and D (net benefits equal \$43 million).

(2) All projects mutually exclusive: Choose B (net benefits equal \$20 million).

(3) Total costs cannot exceed \$10 million: Choose A and combination C and D (net benefits equal \$23 million).