Cost-benefit analysis with social welfare functions (CBA-SWF): exposition and defense

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6 November 2019

CBA: a sketch

- $i = 0, \dots, 99$ indexes age, $j = 0, \dots, J$ indexes health state
- Period utility is a function of
  - Probability of being alive $s_j(i) \in [0,1]$
  - Health utility $q_j(i) \in [0,1]$
  - (Goods and services) consumption $c_j(i)$
  - Non-market time $l_j(i)$ which in turn consists of unpaid work and on leisure. Unpaid work includes activities like housekeeping, caregiving, volunteering.
  - Typically assume health and consumption/leisure are natural complements
- Lifetime utility is expected PDV of period utility
- Budget constraints:
  - Lifetime or period consumption cannot exceed lifetime or period income
  - Income depends on earnings and transfers, both of which can depend on disability status
  - Financial constraints: borrowing, annuitization of consumption, disability insurance
- Individual takes health as given chooses consumption and non-market time to maximize lifetime utility subject to budget constraint.

How to use this as valuation framework

- Solving the model gives optimal age- and health-state specific consumption and non-market time as a function of lifetime mortality and morbidity risks. This solution will be associated with optimized lifetime utility U^{old}.
- A health technology like a vaccine will change the trajectories of these lifetime mortality and morbidity risks, which in turn will change optimal consumption and non-market time, which in turn raises optimal lifetime utility to some new level U^{new}.
- The private willingness-to-pay (WTP) for the technology is the wealth reduction that, if it took place after the health technology has been implemented, would bring utility back down from U^{new} to U^{old}.

Distinguishing features

- Utility driven:
  - All values derived from individual preferences/utility functions
    - Most important value is individual's WTP for health
    - Valuation formulas derived from utility functions (typically more complex than formulas from CUA, reflecting complexity of health-wealth interactions)
- Each unit of mortality or morbidity risk reduction can have distinctive economic effects and so will not have uniform economic value
  - The "a QALY is a QALY is a QALY" assumption will not hold
- Imposes fewer simplifying assumptions than CUA
  - Allows for more general interactions between health and economic variables, and so better able to capture value

Two high-level questions

- Two high-level questions set the stage for economic evaluation
  - Q1: Which perspective: health payer versus societal
  - Q2: Conditional on having chosen the societal perspective, should we adopt
    - Societal perspective/extended CUA
    - Cost-benefit analysis
- I assume first question resolved in favor of the societal perspective
  - If not, there's no point to this debate since ECUA/CBA are irrelevant within payer's perspective.
  - The issue is therefore whether ECUA or CBA is a better *within* the societal perspective.

Justification for societal perspective

- But it is still helpful to recall the fundamental (normative) reason in favor of the societal perspective:
  - In a *representative government* or *accountable health system*, it is the *taxpayer or premium-payer* NOT the policymaker that is the sovereign authority or source of value.
    - In the language of principal-agent theory: taxpayers and premium payers are the *principal* (the ones whose interests are foundational) and finance ministers and health payers are (mere) *agents* (whose responsibility is to promote the interests of the principal).
  - Absent justifications for paternalism, payers should promote taxpayer/premium-payer values and not replace those values with the payers' own.
    - Some extra-welfarists claim that taxpayers/premium payers may fail to appreciate the special nature of health, and that certain (socially legitimate) policymakers better understand that nature, justifying paternalism.
      - Response: As an empirical matter, individuals tend to value health *more* than policymakers, who also systematically ignore critical contributions that health make to overall well-being. This suggests to me that it is simply false that policymakers have a better understanding. Paternalism seems to me unjustified.
      - Literature suggests policymaker WTP per QALY (as reflected in the ICER of the marginal funded health technology) is about ½ per capita GDP. CBA suggests that individual WTP is at least twice per capita GDP: the value of a statistical life year should be *at least* as large as the value of the paid work, unpaid work, and leisure time that the life year enables.

Why CBA?

- The fundamental reason for preferring CBA versus ECEA is:
  - Health interacts with economic aspects of a person's life in myriad complex ways.
    - Need to disaggregate health into mortality and morbidity aspects since these two aspects have distinct economic effects.
      - Morbidity affects productivity (e.g. the hourly wage), while mortality risks affect savings behavior.
    - Health interacts with multiple economic quantities: productivity, earnings, unpaid work, consumption, leisure.
      - Health affects not just the levels of these quantities but also their stability: the risk protection benefits of health involve their contribution to stabilizing these various economic quantities.
      - The value of health is affected by various aspects of the economic environment:
        - The ability to borrow, to annuitize consumption, to purchase disability insurance
        - Transfers: social security, disability benefits, private financial support from friends and family.
      - These dynamics vary over the lifecycle:
        - Contributions of health to human capital more important in children, contribution to (concurrent) market productivity more important in working age, while contributions to unpaid work and leisure more important in elderly.
  - Need value framework that is grounded in individual (not policymaker) preferences and that fully incorporates the complex lifecycle interactions between health and economics.

Why CBA?

- CBA is a utility-based framework that allows explicitly modeling all the above.
  - Utility-based:
    - Grounded in individual preferences and therefore reflects fundamental principle of societal perspective. All difficult trade-offs (most importantly health v. wealth) are driven by individual as opposed to policymaker preferences.
    - Axiomatic approach can help make sure that preferences/values are filtered so as to eliminate various sorts of instrumental irrationalities (non-transitivity, erroneous processing of risks, various cognitive biases and heuristics)
      - Contra stated preference/contingent valuation approaches
  - Comprehensive and imposes fewer restrictive simplifying assumptions
    - CBA typically does not yield the result that a QALY is a QALY is a QALY. Since different "units" of mortality and morbidity risk have different economic consequences, their economic values will not be as uniform as those implied by CUA. QALYs typically not meaningful in CBA.
    - Brings into play knowledge from non-health aspects of life: human capital formation, labor markets, financial markets, tax-and-transfer systems, work-life balance, non-health- and non-market-based measures of well-being.
  - Contributes to uniformity in valuation across different sectors/ministries which promotes coherent/efficient decision-making
    - Health technologies have economic effects. But highway construction and anti-poverty programs have health consequences. Rational government-wide decision-making requires uniform health-wealth valuations across all these policies. E/CUA imposes too many simplifications on the non-health aspects of life/society, while CBA explicitly models all of them, making it better suited as a uniform valuation system.
    - CBA seems revolutionary within health but is much more standard everywhere else in policy. Easier for MoF to understand.
  - Typically suggest higher monetary value of health than traditional CUA
    - Payers should appreciate the contribution CBA can make to strengthening their case in budget negotiations with MoF, potentially resulting in higher payer budgets.

Sketch of a sophisticated version of CBA called a health-augmented lifecycle model (HALM)

- $i = 0, \dots, 99$ indexes age, $j = 0, \dots, J$ indexes health state
- Health utilities and state probabilities $q_j(i), s_j(i) \in [0,1]$
- Health-augmented period utility (PU): $v_j(i) = q_j(i) * u\left(c_j(i), l_j(i)\right)$
  - Individual ultimately cares about two kinds of consumption: goods and services $c_j(i)$ and non-market time $l_j(i)$. Non-market time is the sum of time spent on unpaid work and on leisure. Unpaid work includes activities like housekeeping, caregiving, volunteering.
  - health utility and composite consumption are natural complements (mutual enhancers)
- u is typically strictly concave, implying diminishing marginal utility of income as well as aversion to consumption risk.
- Lifetime utility is expected PDV of PU: $U = \sum_{i=0}^{100} \sum_{j=0}^{J} \frac{s_j(i) * q_j(i) * u\left(c_j(i), l_j(i)\right)}{(1+\rho)^i}$

Budget constraint

- Benchmark 1: Perfect capital markets (can borrow, can annuitize consumption, can access disability insurance)
  - $A(a) + \sum_{i=a}^{100} \sum_{j=0}^{J} \frac{s_j(i) * [y_j(i) - c(i)]}{(1+r)^{i-a}} = 0$
  - $y_j(i) = w_j(i)\left[T - l_j(i)\right] + \tau_j(i)$
- Benchmark 2: Imperfect capital markets (no borrowing, no annuitization, no disability insurance)
  - $A_j(i+1) = (1+r) * \left[A_j(i) + y_j(i) - c_j(i)\right]$
  - $A_j(i+1) \geq 0$

Extending CBA with Social Welfare Functions

- Problem with CBA is insensitivity to distributional issues.
- To extend CBA to allow for distributional considerations, use strictly concave social welfare function f and choose policy to maximize
$$W = f(U_A) + f(U_B)$$
- Social WTP: Uniform wealth reduction to bring W^{post} back down to W^{pre}
- Note that his formulation allows distributional considerations to enter in two distinct ways (neither of which is allowed in CBA):
  - Since utility u is strictly concave in consumption, we allow for diminishing marginal utility of income (dollar means less to Bill Gates than it does to poor person)
  - Since f is strictly concave in utility, we allow for priority to the worse off

LC-SWF versus CUA-SWF

- Lifetime utility of person A: $U_A = \sum_{i=0}^{100} \sum_{j=0}^{J} \frac{s_j(i) * q_j(i) * u(c_j(i))}{(1+\rho)^i}$
  - If $c_j(i) = \bar{c}_A$ for all i, j, then $U_A = u(\bar{c}_A) * QALY_A$
- Person B: $c_j(i) = \bar{c}_B$, then $U_B = u(\bar{c}_B) * QALY_B$
- If $W = f(U_A) + f(U_B)$, f is concave, $f(X * Y) = f(X) * f(Y)$, and $\bar{c}_A = \bar{c}_B = \bar{c}$ then:
$$W = f(U_A) + f(U_B) = f(\bar{c}) * (f(QALY_A) + f(QALY_B))$$
- Conclusion: LC-SWF simplifies to CUA-SWF if consumption is invariant across age, health state, and people. This is clearly false.

Recap

- True societal perspective grounded in taxpayer/premium-payer values and not policymaker values.
- HALM-SWF provides a utility-based valuation approach that allows explicit modeling of complex causal interactions between health and economic quantities in a way that is distributionally sensitive.
- CBA typically implies significant underspending on health
- HALM-SWF simplifies to CUA-SWF only under empirically false conditions.
- CBA is more general than CUA, and so will be able to capture socio-economic value in a way that is (i) empirically superior, (ii) more respectful of individual preferences, and (iii) sensitive to distributional issues.