Cost-Benefit Analysis, Budget Impact Analysis and other Approaches

Marcelo Coca Perraillon

University of Colorado
Anschutz Medical Campus

Cost-Effectiveness Analysis
HSMP 6609
2016
We will talk about cost-benefit analysis and other type of studies that are part of economic evaluations

How do we transform outcomes (benefits) into money?

1. Human capital
2. Revealed preferences
3. Stated preferences (contingent valuation)

What’s the connection between CEA/CUA and cost-benefit? Are they really that different?

Budget impact analysis (BIA)

Cost of illness (COI)

Return on investment (ROI)
What is cost-benefit analysis

- In CBA, the benefits of an intervention are measured in monetary units.
- The summary measure is no longer ICER but rather **Net Social Benefits**

\[ NSB_i = B_i - C_i \]

where \( i \) is an intervention and \( B \) and \( C \) are its benefits and costs, respectively.

- The decision rule is that the intervention should be implemented if \( B_i > C_i \).
- Typically, benefits and costs are measured over time so we need to do the usual discounting of flows.
Net social benefit

\[ NSB_i = \sum_{t=0}^{n-1} \frac{B_{it} - C_{it}}{(1+r)^t} = \sum_{t=0}^{n-1} \frac{B_{it}}{(1+r)^t} - \sum_{t=0}^{n-1} \frac{C_{it}}{(1+r)^t} \]

- In other words, the difference between the present value of benefits and costs
- You could express it in terms of the ratio \( \frac{B_i}{C_i} \). If ratio > 1, we should implement project
- All the issues about perspective, time horizon, and relevance of costs for the decision are still valid
- We need to focus on two issues: 1) How to transform benefits into money and 2) And when should we do CBA instead of CEA/CUA?
Valuing outcomes

- Three methods
  1. Human capital
  2. Stated preferences (aka willingness to pay, WTP)
  3. Revealed preferences

- We have been talking about these terms during the semester

- They are about to take some slightly different meanings as they apply to *valuing outcomes*
One way to think of the benefits of an intervention is that it adds more time in better health.

More healthy time allows a person to work more.

Therefore, one way to **value** the benefits of an intervention is to calculate the **market value of the time** in better health.

We have seen this idea before: that’s how we can value productivity changes.

In the case of CBA, we can extend this idea to value **all the effects** of an intervention.
A vaccination program prevents medical costs associated with the condition.

It could lead to disability ("unproductive" time) and early death (can’t work).

We saw that we can value the unproductive time using wages.

We can extend the idea to value life: calculate average lifetime earnings of participants and come up with the reduction in earnings had the program not been implemented.

In other words, average lifetime earnings gained because of the intervention.

Textbook has an example on rubella vaccination.
Problems with the human capital approach

- We already talked about the problems of the human capital approach when we discussed productivity changes
  1. Wage rates may not be a good reflection of the value of earnings
  2. Ethical concerns about using wage rates (remember the homework about the VA intervention)

- Besides these practical criticisms, the human capital approach is problematic in theory

- In theory, we would like to know what resources would people be willing to sacrifice to implement a program

- Note that when using wages to measure productivity changes, this issue was not relevant
Why not ask people questions to measure the maximum they would be \textbf{willing to pay} for the programs?

There is theory behind the questions; it’s related to demand curves in economics.

Each consumer has a demand curve (resulting from utility maximization).

A demand curve shows the amount of a product a consumer would buy at different prices.

It also shows how much consumers \textbf{value} a good.

Market demand is the aggregation of consumers’ demand curves.
Stated preferences (contingent valuation)

- Why can we measure value from demand curves?
- Example: I like morel mushrooms so (in some occasions) I would pay up to $30 for a pound. When you can actually find them, they are about $14 per pound
- So I gained $16 in “value.” Economists call this consumer surplus
- Same idea in contingent valuation. We would like to know the max people would be willing to pay (WTP) for an intervention so we can compare it to the cost of the intervention
- One way of thinking about contingent valuation is that it is an attempt to create a market for the intervention and figuring out if value is greater than costs
Your textbook has an example of contingent valuation on the value of life.

“Suppose you buy a new car... You can choose an option that reduces the risk of death in case death in case of an accident. The next few questions will ask about how much extra you would be prepared to pay for some different type of safety features. You must bear in mind how much you personally can afford.”

Car without added safety feature: 10 in 100,000 risk of death. With feature, 5 in 100,000, so a reduction of 5 in 100,000.

Average willingness to pay for feature: $200
So people would be willing to pay additional $200 for a reduction of 5 deaths in 100,000:

\[
\frac{100}{\left(\frac{5}{100,000}\right)} = \$2,000,000 \text{ per life}
\]

This is per life saved you are dividing $\frac{\text{deathssaved}}{\text{deathssaved}}$

When reading your textbook, keep in mind that this is an example on valuing life

WTP is used to value other outcomes (see infertility example on page 226)
Global versus restricted WTP

- Two views on what WTP should be measuring
- A restrictive perspective is that WTP methods should only be used to measure health benefits, for which there are no money valuations.
- In this view, productivity gains of a program should not be measured using WTP.
- On the other hand, WTP could value every aspect of an intervention because we would like to mimic a market in which the intervention could be “sold.” This is the global perspective.
Global versus restricted WTP

- How questions are framed determines the type of valuation
- When people value an intervention, their WTP amount may take into account future health care costs and productivity gains, which could be already be included in the study
- We saw this problem of double (or triple) counting before when talking about measuring preferences over health states
- To avoid these problems, the wording of the questions should include clear instructions
Problems with WTP

- There are many problems with stated preferences
  1. Many ways to ask questions; comparability is difficult
  2. Who should answer the question? Society or the participants?
  3. WTP depends on income; it raises ethical concerns
  4. Perhaps the biggest one: talk is cheap!

- We want to know what people would pay, not what they say they would pay

- Economists (particularly in the US) are always very skeptical about asking people about hypotheticals

- So revealed preferences would be better
Revealed preferences

- Revealed preferences uses actual choices to figure out valuations
- Revealed preferences are limited to valuations of benefits that are **salient**
- For this reason, revealed preferences studies are often used to value life and not other intermediate outcomes
It all started with Adam Smith in 1776 (so to speak):

The wages of labour vary with the easy or hardship, the cleanliness or dirtiness, the honourableness or dishonourableness of the employment.

In other words, for people to do a job, wages need to compensate for risk

**General approach**: use data on wages and risks while controlling for worker and job characteristics

There many studies that have use this type of analysis (sometimes called **hedonic pricing** or **hedonic valuation**)
Problems with revealed preferences

- Valuations vary widely and are context (e.g. unemployment, sample) and job specific
- Hard to differentiate one aspect of the job versus another. Wage depends on risk, but also on comfort
- Is the higher wage of truck drivers due to the risk of death or due to the hours and the fact that truck drivers don’t see their families very often?
- Wage is not the only compensation; some truck companies may offer generous disability benefits that are not reflected in wages
- Competing risks. The risk of mortality is relatively low, but there is also the risk of injury. Not possible to disentangle both effects from data on wages
When applied to valuing life, the result is called the **value of a statistical life**

See Viscusi and Aldy (2003) for a comprehensive review

Wide range of estimates. Range of about $3 to $7 million (this is also mentioned in Cutler, 2004)

By the way, as you probably suspect, WTP estimates are a lot **higher than value of statistical life estimates** (talk is cheap)
Big picture: what is the state of CBA?

- Given the difficulties of valuing outcomes, CBA is not often used in economic evaluations.
- This true for **final outcomes** like death, even more complicated to value **intermediate outcomes** like blood pressure decreases, cases detected, depression reductions.
- Ethical concerns.
Big picture: what is the state of CBA?

- “The major disadvantage of the benefit-cost framework is the requirement that human lives and quality of life be valued in monetary units. Many decision-makers find this difficulty or unethical or do not trust analyses that depend upon such valuations. (Weinstein and Fienberg, 1980)

- “To be trained in medicine, nursing or one of the other sharp end disciplines and then be faced with some hard-nosed cold-blooded economist placing money values on human life and suffering is anathema to many. (Mooney, 1992)

- [Cost-benefit analysis is] an approach whose difficulty lies in its intrinsic favoring of programs and diseases of the affluent over those of the poor (Gold et al, 1996)
On the other hand, is CBA that different from the CEA/CUA approach?

Remember, we compare ICERs to some threshold (or ICERs of other interventions), which traditionally is measured in terms of years of life gained or quality-adjusted life years (QALY)

But the threshold is the maximum WTP per unit of life or QALY.

To many economists, the difference between CBA and CEA/CUA is that CBA makes this valuation explicit.

Regardless, CBA is not often used in health care and many of the studies that claim to use CBA do not value benefits (see Box 7.2 on page 213).
Switching gears: Budget impact analysis

Suppose that there is a new intervention that is considered cost-effective. Its ICER compared to traditional care is about $35,000 per QALY.

The recommendation is to implement the intervention.

The next logical question should be: can we afford it?
Budget impact analysis

- Remember, to get ICERs we compare the new intervention to something else
- ICER is the ratio of incremental costs to incremental benefits
- Nowhere in the calculation of costs we took into account the actual number of people that would be affected by the program
Budget impact analysis

Definition 1: BIA measures expected changes in the expenditure of health care system after the adoption of a new technology (or intervention or drug, etc).

Definition 2: An economic assessment that estimates the financial consequences of a new technology (or intervention or drug, etc).

It is usually done in addition to a CEA/CUA study.

The relevant question for a BIA study is the affordability of the program.
Definition 1: BIA measures expected changes in the expenditure of health care system after the adoption of a new technology (or intervention or drug, etc).

Definition 2: An economic assessment that estimates the financial consequences of a new technology (or intervention or drug, etc).

It is usually done in addition to a CEA/CUA study.

The relevant question for a BIA study is the affordability of the program.
Key components of BIA

- **Perspective**: A payer perspective (but the payer could be the government)

- **Time horizon**: Usually shorter than CEA/CUA (1-3 years)

- **BIA** does incorporate the **number of people affected by the intervention** (this is a crucial element)

  Not so easy to measure: need to come up with estimates of uptake, insurance restrictions, and other features of the health care system.

  Hard to estimate how the new intervention will change current practice

- **Discounting**: Usually not (but could take into account inflation)

- **Sensitivity analysis**: Of course, always important
BIA studies are becoming more common, particularly for expensive treatments

Affordability is an important economic evaluation question

... and now for something completely different: cost of illness studies
Cost of illness studies

- Cost analysis estimates the cost of an **intervention**
- Cost of illness measures the costs of a **disease**
- They attempt to estimate the amount of money that could be saved if a disease were to be cured
- In other words, the impact of an illness on budgets
- You have probably heard about cost of illness studies in the media: the burden of Y in the US is $X and that’s why it is important to pay attention to Y
- It’s the favorite first line in a grant or an article (along with “XY has changed in the last N years” or some variant of that sentence; N is usually 10 or 20 years)
- COI studies help decision makers prioritize expenditures
Cost of illness studies

- In terms of methods, we have covered most of the important elements already
- The perspective, the cost items to include, and discounting are the same as in any cost study
- Like BIA, COI has to take into account the prevalence/incidence of the disease
- Incidentally, while reviewing COI I found a nice table on costs and perspective from Segel (2006)
### Costs by perspective

#### Table 1. Costs Included in Cost-of-Illness Studies, by Perspective

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Medical Costs</th>
<th>Morbidity Costs</th>
<th>Mortality Costs</th>
<th>Transportation/Nonmedical Costs</th>
<th>Transfer Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Societal</td>
<td>All costs</td>
<td>All costs</td>
<td>All costs</td>
<td>All costs</td>
<td>—</td>
</tr>
<tr>
<td>Health care system</td>
<td>All costs</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Third-party payer</td>
<td>Covered costs</td>
<td>—</td>
<td>Covered costs</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Businesses</td>
<td>Covered costs (self-insured)</td>
<td>Lost productivity (presenteeism/absenteeism)</td>
<td>Lost productivity</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Government</td>
<td>Covered (Medicare, Medicaid)</td>
<td>—</td>
<td>—</td>
<td>Criminal justice costs</td>
<td>Attributable to illness</td>
</tr>
<tr>
<td>Participants and families</td>
<td>Out-of-pocket costs</td>
<td>Lost wages/ Household production</td>
<td>Lost wages/ Household production</td>
<td>Out-of-pocket costs</td>
<td>Amount received</td>
</tr>
</tbody>
</table>

Note: Adapted from Luce et al.\textsuperscript{8,27,34}
So what is different or unusual about COI?

The most difficult part of COI studies is to estimate the costs that are due to the condition under study.

How can we separate the costs of obesity when so many other problems are associated with obesity (like diabetes and high-blood pressure)?

The methodological challenges of COI studies are about disentangling costs.
Once again, we have covered most of the important issues you need to know to do a ROI.

Don’t mean to be funny here but an ROI study is just CBA with a different formula.

\[ ROI = \frac{B-C}{C}, \]

where B are benefits and C are costs or the investment needed to achieve the benefits.

Sometimes expressed as (net returns) / (investments).

ROI could be negative (investment greater than costs).

What do you do with this information? You can compare it to other interventions.

The key here is that to get B you still need to translated benefits into money.
CBA is like CEA or CUA but benefits need to be explicitly translated into money.

In CEA/CUA, the translation is implicit because we usually compare ICERs to a threshold.

CEA/CUA do not answer the affordability question.

BIA does address affordability and a key part of BIA is to determine the number of people that will use the intervention.

COI uses the same principles we have learned this semester but it’s about a disease, not an intervention or drug or technology.

ROI is really a different formula for CBA.
Where we are in the class?

- We have covered all the most important ideas you need to understand in economic evaluations.
- You need to remember that the **perspective**, **time horizon**, and **relevance** of costs for the decision are the most important considerations.
- We have calculated ICERs using different outcomes.
- After Spring break, we will use other methods to calculate ICER.
- These methods are used to 1) go from intermediate outcomes to final outcomes and 2) to take into account uncertainty.