Costs II

Marcelo Coca Perraillon

University of Colorado
Anschutz Medical Campus

Cost-Effectiveness Analysis
HSMP 6609
2020

Outline

- Discounting
- Related and non-related costs
- Productivity losses
- Overhead costs
- Inflation

Department of Unicorn Extensions

- Last class I covered the conditions necessary for a **perfectly competitive market** (or baby micro 101)
- I told you those markets do not exist in nature. **They are unicorns**. However, it's a very useful framework to study **real** markets. The trick is to understand and extend the framework when an unrealistic simplification makes a difference
- This may sound odd: isn't a "wrong" model wrong? Sometimes not
- Two things to note:

  1) An underlying assumption not part of the 5 assumptions is that we are ruling out pirates, gangs, mobsters, **corruption**, etc. There has to be law and order for markets to function (property rights for one)

  2) That the market fails in health care or other sectors does not imply that government intervention is the solution in all cases. My personal opinion is that it does imply some form of additional **regulation** at minimum

The **complicated** parts left to cover

- Today:

1. How do we discount costs and why? Why do we discount outcomes?
2. Should health care costs **unrelated to the intervention** be included?
3. Should related or unrelated **non-health care costs** be included?
4. How should overhead costs be calculated? (Using shortcuts)
5. Inflation
6. How do we measure productivity changes?

- Recall: some are complicated in theory but clear in practice while others are complicated in practice but clear in theory

Why do we have to discount costs?

- Using resources in one activity implies that we can't use the same resources in another activity
- Think of this as the **you-can't-have-your-cake-and-eat-it-too principle**
- Last class we learned to call this **opportunity costs**: if we invest $250,000 in a program, the opportunity cost is what we could have earned if we had used that money in some other way (the **best** available alternative)
- This (intuitively) implies that **costs incurred today are more important** than costs incurred in the future
- Or said another way, it implies that **we give more importance to the present than the future**

Why do we have to discount costs?

- If instead of using the \$250K in a program we invested safely at 3% per year, we would have over 335,979 in 10 years $(250,000 \times (1.03)^{10})$
- Investing "safely" often means investing in some sort of Federal bond that is adjusted for inflation. In spite of political problems that prompted the US government to (briefly) not follow their obligations, US bonds are still the safest possible investment in the world
- **Another way**: If somebody asked you, Do you want \$100 today or \$100 in two years, of course you should want it today because you could invest the \$100 today and have more in two years
- Note inflation. You should still want it today if the deal is that you get \$100 plus inflation in two years

Why do we have to discount costs?

- You can also think about it the other way around: If you needed to invest \$250K in 10 years, you need to set aside only \$186,023 now ($\frac{250{,}000}{1.03^{10}}$)
- Regardless of how you look at the problem, the bottom line is that the **timing of costs matters**
- In EEs, the timing of costs could be different in different interventions but we need to **compare them at the same time**. In CEA, the "same time" is (by convention) the **present**
- In the US, the original Panel on Cost Effectiveness recommended using a rate of 3%, which was the real (protected from inflation) rate of return of US bonds
- After the economic crisis of 2007, it has been much lower but it's close to 3% again
- The current expectation is that interest rates will be higher in the future

Panel recommendation

- The new Panel on CEA kept the same recommendation of discounting costs and benefits/outcomes at the same rate
- Recommended sensitivity analysis of 2%-3% to an upper bound of 8%-9%
- In some cases, a 0% rate is recommend (i.e. no discounting)
- They also recommended "revising" the discount rate in response to economic conditions
- The 3% is likely to stay with us for a while

Inflation and time preference

- **Department of Necessary Repetitions**: Again, note that the opportunity cost argument is different from **inflation**
- Even without inflation, there is an opportunity cost
- Discounting is also often framed/related to **time preference**
- Coming back to the example of \$100 today or \$100 in the future: you could be compensated for waiting
- A person who is indifferent between receiving \$100 today or \$105 in one year has an annual **rate of time preference** of 5%
- A **positive** rate of return implies preferring the present over the future (this will become clear in about 10 minutes)

Example

Year	2000	2001	2002	2003
Intervention 1 costs	2500	4500	6200	22000
Intervention 2 costs	25000	10000	200	0

- Intervention 2 looks like prevention. We invest heavily in 2000-2001 but "save" in 2002-2003. Or said another way, no costs in those years
- In alternative 1, few upfront costs but more in the future
- Note that total costs are the same in both cases ($\$35,200$)
- We want to compare both interventions **at the same time**

What about effectiveness/outcomes?

- This lecture is about costs but in EEs benefits (outcomes) are also discounted
- Contrary to money, we can't invest in **health**. So what is the opportunity cost of health today versus health tomorrow?
- Actually... we can **trade off health over time too**
- We do invest on **health care**, which produces health now or in the future
- This is the rationale of the **Grossman** model
- Again, we cannot buy health but we can buy health care, which in turn could get you better health

What about effectiveness/outcomes?

- You can decide to invest $200 now in prevention (gym, dentist visits, metformin) or use those $200 in something else (Valentine's dinner?) and invest on health care later (or not)
- When you think about it this way, **for sure we tend to prefer the present to the future**
- Think about this next time your are too sleepy to floss or next time you are trying to decide between fried chicken or a salad. Think about yourself in 20 years
- **Department of Random Suggestions**: to combat temptation, don't fight emotions with reasons, fight with emotion
- **But discounting benefits/outcomes has always been up for debate**

What about effectiveness/outcomes?

- The consensus is that that benefits need to be discounted
- The debate has been mostly about **what discount rate** to use (no US bonds for health), or alternatively, why outcomes should be discounted at the same rate as costs
- Two related arguments:
  1. **Consistency**: In CEA, we compare costs to benefits. If we discount costs in each period we must discount outcomes; otherwise the comparison of $\Delta C/\Delta E$ would be distorted. It follows that we need to use the same discount rate (Weinstein and Stason, 1977)
  2. **Paradox of Keeler and Cretin**: K&C set up a problem in which identical cohorts will use resources that need to be allocated now (but some will be used later). They show that if different discount rates are used for cost and outcomes, paradoxes result. In particular, if health is valued more in the future, the decision is postponed forever

What about effectiveness/outcomes?

- However... some argue that benefits of prevention programs should be discounted differently
- In this view, the discount rate for benefits should be lower or zero because otherwise health gains that occur in the future would be devalued (more on this in a second; see Excel file on discounting)
- **This view is not followed in the US** but prevention studies often use sensitivity analyses with different discount rates (including 0%)
- So, where are we? Discounting of benefits is up for debate in theory but in practice we just discount costs and benefits at the same rate of 3%. End of debate.

Mechanics of discounting

- The basic formula is easy to derive
- Imagine that you deposit \$100 at the beginning of the year and you earn 3% of interest. How much do you have at end of the year?
- One way: $100 \times 0.03 = 3$, so at the end of the year $100 + 3 = 103$
- Same as $100 \times (1 + 0.03)$ because multiplying/expanding you get $100 + (100 \times 0.03)$

Discounting

- What about if you deposit the \$100 for three years?

  1st year : $100 \times (1 + 0.03)$
  2nd year: $[100 \times (1 + 0.03)](1 + 0.03) = 100 \times (1 + 0.03)^2$
  3rd year : $[100 \times (1 + 0.03)(1 + 0.03)](1 + 0.03) = 100 \times (1 + 0.03)^3$

- So looks like we can write: $100 \times (1 + 0.03)^n$, where n is the number of years
- Now call the \$100 the present value, or PV, and call the money that we have after depositing the PV the future value, or FV, of the \$100. r is the interest rate
- Rather than in numbers, we can write the formula more generally: $FV = PV(1 + r)^n$
- Solving for PV:
- $PV = \frac{FV}{(1+r)^n}$
- And that's how you can derive a formula to "move" things from the present to the future

Discounting

- From your textbook:
  $PV = \sum_{n=1}^{3} FV_n(1+r)^{-n} = \frac{FV_1}{(1+r)} + \frac{FV_2}{(1+r)^2} + \frac{FV_3}{(1+r)^3}$
- Just an application of the general formula $PV = \frac{FV}{(1+r)^n}$. Now we are bringing three different values to the present and adding them up. That's all
- The above equation assumes that costs happen at the **end** of the year (so you need to bring them to the beginning of the year). If you assume that costs happen at the **beginning** of the year, no need to discount the first year and the second year is the first cost discounted:
  $PV = \sum_{n=0}^{2} FV_n(1+r)^{-n} = FV_1 + \frac{FV_2}{(1+r)^1} + \frac{FV_3}{(1+r)^2}$
- Recall exponent rules: $X^0 = 1$

Back to example

Year	2000	2001	2002	2003
Intervention 1 costs	2500	4500	6200	22000
Intervention 2 costs	25000	10000	200	0

- Assume a discount rate of 3% and cost happening at the beginning of the year
- What is the present value (PV) of costs for each intervention?

Example

- $PV_1 = 2500 + \frac{4500}{(1+0.03)} + \frac{6200}{(1+0.03)^2} + \frac{22000}{(1+0.03)^3} = 32846.1$
- $PV_2 = 25000 + \frac{10000}{(1+0.03)} + \frac{200}{(1+0.03)^2} = 34897.3$
- Notice how the **discount factor** works (see Excel file in the Files folder)
- Discount factor by year: 1.00, 1.03, 1.06, 1.09,...
- After about 25 years, 2.032
- If a prevention intervention saves a total of 100 years of life in 25 years, because of discounting, **the benefits are reduced by about half today** (hence the argument about a different discounting rate for prevention interventions)
- With a discount rate of 5%, that happens in about 15 years

Overhead costs

- Cost of resources that serve many departments: administration, cleaning, electricity, security, etc
- In many cases, the alternatives will use the same resources so there is no need to worry about overhead costs (not the same as **sunk** costs)
- If this is not the case, we need a way to figure out what share of the overhead costs are part of the intervention costs
- **Accounting to the rescue**: there are different methods, which are based on different ideas of allocation (not exact science)
- Direct allocation, step-down allocation, step-down allocation with iterations, simultaneous allocation...

Overhead costs: shortcut

- An example of shortcut for hospital costs

1. Figure out the total costs that you can for sure allocate to intervention: nurse or doctor time, medications, labs, training, and so on. These are (**direct allocatable**) costs
2. Figure out the **total hospital operating expenses** and subtract the costs that are already included in 1) and costs from departments that are not part of the interventions
3. After subtracting (call the result **net hospital expenditure**), divide it by total number of hospital-patient days. The results are the remaining costs that need to be allocated per *patient-day*
4. Figure out hospital patient-days attributable to the intervention and you are done

Overhead costs: shortcut

$$\text{Hospital cost of the programme} = \text{Directly allocatable costs} + \frac{\text{Net hospital expenditure}}{\text{Total number of hospital patient-days}} \times \text{Hospital patient-days attributable to the programme}$$

- In other words, based on **volume**, estimate the operating costs per patient-days
- Do a sensitivity analysis when in doubt

Unrelated **health care** costs

- An intervention extends lifespan (for example, because it prevents heart disease)
- In their extra years of life, some people may get cancer instead of an MI. Should we consider the costs of treating cancer when doing a CEA of the program that prevents heart disease?
- In economics two related concepts, **partial equilibrium** versus **general equilibrium**
- If the costs are far away in time, it may be reasonable to ignore them
- The consensus is to think if the unrelated health care costs are a **direct consequence** of the intervention
- Mostly ignored for practical reasons (so partial equilibrium) but it's **clear from theory** that they should be included

Related and unrelated **non-health care** costs

- This has been debated a lot in the literature
- Meltzer (1997) model shows that all future costs (and gains), including productivity and consumption, should be included
- Example: people living longer will use more funds from Social Security but they will also live longer and contribute more in taxes and will earn more income
- It may make a difference (from a societal perspective) to include these costs in practice
- **The implications are somewhat unsavory**. For example, other things being equal, an intervention that extends the life of teenagers is more valuable that an intervention that extends the life of the elderly because the elderly have fewer "productive" years of life

Related and unrelated **non-health care** costs

- In general, if we include all productivity and consumption costs (and gains), then interventions that add years of life to the young are more valuable than interventions that add years of life to the old
- Also, as in tobacco cessation, if people die prematurely, costs are "saved." Deceased individuals do not use resources
- A debate mostly in theory because in practice it is already very hard to figure out related health care costs, let alone *unrelated* healthcare and non-healthcare costs
- It's an interesting debate that you should be aware of but not feasible in practice

What about inflation?

- Some costs need to be adjusted for inflation. For example, if an intervention will use physician and nurse time in the next 10 years, we need to take into account that the wages for physicians and nurses will likely go up every year
- More common: you use older data and need to take into account that the current price is higher
- Adjusting for inflation is often called "inflating prices"
- The Bureau of Labor Statistics publishes these data (`http://www.bls.gov/cpi/home.htm`)
- Historically, inflation for medical items has been a lot higher than other goods and services (an average of 4% to 5%). That's **a lot**: $100 \times (1.05)^{10} = 163$
- You can use the same formulas for FV to adjust for inflation
- **Digression**: Bolivian hyperinflation: 23,000% increase per year. Money became paper

Valuing productivity changes

- Suppose that a new intervention keeps patients out of the hospital for a long period of time by providing outpatient treatment instead of the usual treatment which implies more disable time (think of a mental health intervention)
- The community health care costs are more expensive than the usual treatment
- From the perspective of the payer (say, VA, Medicare, or Medicaid), the program may not be cost-effective
- But from the point of view of the society, it may be. There is value created when people can work
- **How do we calculate the cost of time not working?**

Productivity changes

- Two ways:
  1. **Human capital approach**: Use wages or earnings lost (same as valuing non-market items like volunteer time)
  2. **Friction costs**: What is the replacement cost of those workers?
- The friction method requires some estimation of the **time** that it takes employers replace workers
- Econ term: **frictional unemployment**: the time period between jobs when a worker is searching for a job or transitioning from one job to another
- The friction method usually result in lower estimates but depends on economic conditions (not a common method)

Ethical concerns

- We haven't talked much about ethical issues in this class (health equity, disparities, etc)
- But think about the implications of the previous example. If the same program involved, say, CEOs instead of uneducated individuals, the "value" to society would be higher for the CEOs (nothing wrong with CEOs by the way)
- This reasoning makes perfect sense in other scenarios. Say, in a malpractice lawsuit, it does make sense to consider (so to speak) a "replacement" value, which is related to earnings potential
- An alternative could be to use 1) **average national wages** or 2) simply present the **difference in work days between** the programs and let the decision maker judge
- Average wages if perfectly fine in my opinion

Ethical concerns

- Your textbook has useful advice:
  1. Report productivity changes separately
  2. Report quantities separately from prices (wages)
  3. Consider using the friction method (I'd ignore this one)
  4. Consider ethical factors. Conduct sensitivity analyses using different wages
  5. Consider double counting (we will talk about this when we cover cost-utility)
  6. Follow official guidelines (we will talk about this later; the Panel on CEA sort of punted)
- You should have detected a pattern by now: *when in doubt, sensitivity analysis*!

Big picture

- Three steps for dealing the cost side of EEs
  1. Figure out the items that you need to include, which depend on 1) perspective, 2) time horizon, and 3) relevance of the costs for the decision
  2. Count units
  3. Value units
- Valuation tends to be the hardest part, although there are **conventions** that make your life easier
- Be aware of theoretical issues and ethical concerns
- Understand the logic of discounting and its effects, particular when it comes to discounting benefits