Lecture # 20 – Benefit-Cost Analysis

I. Discounting

- The costs and benefits we've discussed often occur at different times. To compare them fairly, it is important to discount costs and benefits that occur in the future.
  - The idea is to compare a flow of benefits and costs into a single value.
- The present value of a future amount of money is the maximum amount you would be willing to pay today for the right to receive that money in the future.
  - Present value accounts for the opportunity cost of not investing the money elsewhere.
  - Example:
    - You have $100 now
    - If you put it in the bank, you will get 5% interest
    - Next year, that money is worth (1 + 0.05)x100 = $105
    - After two years, it is worth (1.05)(1.05)(100) = $(1.05)^2(100)$ = $110.25
  - General rule:
    - FV = future value, PV = present value, r = interest rate
    - $FV = PV(1 + r)^t$
  - As a result, you wouldn't give up $100 now for $100 next year, because you could invest the money and get $105 next year.
    - The present value of $100 next year is the most you would give up today to get $100 next year
    - FV => PV(1.05) = $100(1.05)
    - PV = FV/r = 100/1.05 = $95.24
  - General rule
    - PV = FV/(1 + r)
  - For a stream of payments:
    - $PV = x + X/(1+r) + X/(1+r)^2 + \ldots + X/(1+r)^t$
    - Please see the spreadsheet from class for additional examples.

- To proceed, we need to know what value to use for r. This is the discount rate.
- The discount rate reflects the relative value a person places on future consumption compared to current consumption.
    - Lower values show a greater preference for future consumption.
        - If your discount rate is greater than the interest rate, you will be willing to borrow money.
            - A high discount rate says that current consumption is important to you.
        - If your discount rate is lower than the interest rate, you will be willing to loan money.
            - A low discount rate says that future consumption is important to you.
    - Since the market interest rate reflects an equilibrium of lenders and borrowers, we can use the market interest rate as a measure of the discount rate.
- There are several market interest rates. Which should we use?
    - Typically, economists use a risk-free rate.
        - Investors looking for a safe return invest in U.S. Treasury bills. Thus, the return on T-bills is a measure of the nominal risk-free rate.
        - To purchase assets that are riskier, investors need to be compensated with a higher rate of return.
            - This additional return is known as a risk premium.
        - The most commonly used rates in government reports are 3% and 7%
            - 3% represents the risk-free rate
                - It is the average real rates on US Treasury bills from 1973-2003
            - 7% represents the returns on private capital, which are higher due to taxes and increased risk.
- Why the discount rate matters
    - Discounting affects the value placed on future benefits and costs.
    - Higher discount rates place less importance on future returns.
    - Note, for example, how this is a particular problem for long-term problems such as climate change.
    - Because the benefits of climate protection extend far into the future, calculations of the social cost of carbon are very sensitive to the choice of discount rates
        - 2%: $121/ton
        - 3%: $51/ton
        - 7%: $6/ton

    - Prest *et al*. give three reasons why a 3% rate is no longer appropriate for climate change
        - Since 2003, average real rates on US Treasury bills have fallen. Would suggest a discount rate of 2%
        - Uncertainty about future discount rates suggests using lower rates for longer time horizons
        - A 7% rate assumes costs of climate protection fall on private capital. But benefits of protection can also help private capital
    - Because we use higher discount rates when growth is higher, uncertainty about future economic growth (e.g. because damages may reduce growth), discount rates also become uncertain
        - E.g. future discount rates should be linked to future growth
- Note also how the discount rate relates to economic growth theory
    - discount rate = pure rate of time preference + growth rate of income x elasticity of marginal utility for income
        - Represented as $r = a + bg$.
        - The first term, a, captures the relative weight placed on the future versus today
            - Involves ethical judgments
        - The second term acknowledges that, due to economic growth, we expect future generations to be richer
            - If the marginal utility of income falls as we get richer, than additional money is less valuable when we are richer
- How to choose the parameters a and b
    - Descriptive approach
        - Find parameters that match observed market rates
        - But note that different combinations of a and b can yield the same rate
        - Thus, theory also matters
    - Prescriptive approach
        - Based on:
            - ethical decisions (e.g. is a positive a appropriate)
            - surveys

- Might the social discount rate deviate from the market rate?
    - The above estimates use market data to determine the discount rate. Are their reasons to believe that the market rate is flawed?
    - Some economists argue that the opportunity cost of foregone future consumption might differ from the opportunity cost revealed in the markets.
        - In this case, it might make sense to use a social discount rate which is lower than the rates observed in the marketplace.
            - The social discount rate represents the willingness of society to trade off present and future consumption.
                - If there are market failures, this may differ from discount rates observed from market behavior.
        - Why might market rates not be appropriate?
            - Long term projects involve benefits or costs for future generations.
                - However, future generations are not represented in the market.
            - People may be myopic, and thus not save sufficiently.
            - There may also be other externalities that cause the market rate of return on investments to deviate from the social discount rate, such as positive externalities from research and development.
            - Uncertainty may be a concern
                - Therefore, risk aversion may justify using a lower discount rate. However, uncertainty is not an excuse to do nothing.
- Drupp *et al*. (2018) survey economists on the social discount rate.
    - They asked economists who have published on the topic.
        - Survey had 262 responses
    - They ask about each component of $r = \delta + g\eta$.
    - Also asked what social discount rate they would recommend for a global public project with intergenerational consequences.
        - Mean risk-free rate: 2.38
        - Mean social discount rate: 2.27
            - 68% of responses between 1 & 3 percent
            - Most common response: 2%
        - Mean rate of time preference 1.1%
        - Mean elasticity of marginal utility 1.35%
        - Should normative weights be used for SDR?
            - 80% think both normative and positive matter, and that normative matters should get more weight

II. Including Environmental Justice in Benefit-Cost Analysis

- E.O. 14008 (2021) called on federal agencies to secure environmental justice for communities that have been "historically marginalized and overburdened by pollution and under-investment in housing, transportation, water and wastewater infrastructure and health care."
    - How might this be done?

- Because EJ acknowledges historical record of injustice contributes to existing vulnerabilities, analysis considers how preexisting vulnerabilities may interact with new policies
    - Puts focus on cumulative exposure, instead of simply changes in impacts across households
    - Environmental justice analysis focuses on:
        - low-income populations
        - minority populations
        - indigenous peoples

- EPA technical guidance on EJ (2016) suggests three questions:
    - Are there preexisting EJ concerns absent the regulatory action (i.e., in the baseline)?
    - Are there potential EJ concerns for the regulatory option(s) under consideration?
    - Do the regulatory option(s) under consideration exacerbate, create, or mitigate potential EJ concerns relative to the baseline?

- Ways to address equity in benefit-cost analysis
    - Distributional weights assign different weights to the net benefits of each group.
        - For example, to evaluate EJ, could apply greater weight to outcomes of low-income groups.
        - But this doesn't provide information on *how* different groups are affected – still provides just net benefits and costs.
    - Provide analysis for different subgroups
        - Here, we must distinguish between benefits, costs, and transfers
        - Transfer payments are shifts of resources from one group to another that do not involve a net change in the value of resources available to society as a whole.
        - Since there is no net change in the value to society, no resources are used, and no new value is created.
            - However, all of the transfers that we have discussed have important equity considerations.
            - A project that passes whose benefits exceed the costs may nonetheless be rejected if the distribution of benefits and costs is seen as unfair.

        - Examples of transfer payments:
            - Taxes paid (such as emissions fees)
            - Benefits provided to specific groups (e.g. welfare payments)
        - Two principles for identifying and measuring transfer payments:
            - At the level of particular groups, transfer payments resemble conventional benefits and costs.
                - That is, resources they are willing to pay to acquire, or resources expended by the group represent a loss of opportunity value to the group.
            - However, for society as a whole, the sum of transfer payments to particular groups must sum to zero.
                - Since no value is created or destroyed, one group's benefit is another group's cost.
                - Transfer payments merely represent shifts of resources.
        - Guidelines for defining groups
            - Groups should not overlap, and should add up to comprise the total society affected by the program.
                - Overlapping groups lead to double counting costs and benefits.
            - The sum of transfer payments across groups should be zero.

- How often does the EPA consider EJ analysis?
    - Emphasis tends to be on health risks or impacts, rather than monetized benefits or costs
    - No recent studies consider how *costs* of regulation vary for different groups

- Examples
    - Lead dust hazard and lead dust clearance
        - Would reduce the amount of lead dust considered a hazard and lower the allowed amount of lead dust remaining after remediation
        - EJ analysis centered on the extent to which low-income children and children of color are exposed to higher levels through lead dust from paint in older housing.
        - EPA linked predicted blood levels from risk modeling with data on housing to predict changes in exposure for different groups
    - Baseline assessment of hydrofluorocarbon (HFC) phase-down (2021)
        - Incentivized switch to new chemicals
        - Potential EJ effects
            - No local health impacts, but because vulnerability to climate change differs for different groups, benefits may affect marginalized communities more
            - Production of HFCs uses toxic chemicals.
                - Those living near plants producing HFCS will benefit
                - But those near plants producing substitutes for HFCs could be harmed
            - Trading allowed to meet reduction targets could change distribution of local impacts.
        - How the analysis addressed EJ
            - Qualitatively discussed evidence on vulnerability of specific populations to climate change
            - Quantitatively characterized changes in local effects relative to baseline
                - Used Toxics Release Inventory to get facility-level data on chemicals released
                - Conducted analysis to understand characteristics of population near these plants, relative to national averages
                    - Higher percentage of people of color near HFC facilities.
                - More difficult to make projections about substitutes, since don’t know where those will be produced