Lecture # 15 – Valuing Environmental Benefits: Revealed Preference Approaches

I. What is Value?

- Up to now, we have found the optimal level of pollution by considering the marginal damage function, which we have taken as given. Now, we discuss how to place a value on environmental amenities.
  - We can use data from firms to measure MAC.
  - Measuring benefits is more difficult, because they are not typically part of market transactions.
    - We can measure damages directly, by looking at damages and the value of what is lost, or we can infer damages indirectly from the behavior of individuals.
- To begin, consider what makes up the value of environmental amenities:
  - Use value -- the benefits people get from direct use of a good.
    - For most consumer goods, this is what we care about.
    - For environmental goods, this can include:
      - The value of recreation at a site
      - The value of open land near a home
      - The value from better health
      - The value of ecological services provided (e.g. by a wetland)
  - Non-use value
    - For environmental goods, not all value is use value.
    - Examples of non-use value:
      - Option value – the amount a person would be willing to pay to preserve the option of being able to experience a particular environmental amenity in the future.
        - Even if you won't go to the Grand Canyon this year, preserving it may have value to you so that you can visit in the future.
      - Existence value – a willingness to pay simply to help preserve the existence of some environmental amenity.
        - Protection of endangered species is an example.
      - Bequest value – a willingness to pay to leave behind environmental quality for future generations.
      - Stewardship value – a value placed on preserving the environment not for human use, but rather to maintain the health of the environment for all living organisms.

- To measure value, economists focus on willingness to pay.
    - We can see willingness to pay from a demand curve.
    - It is the area under the demand curve.
        - Recall that the difference between what consumers actually pay and the actual price is the consumer surplus.
        - Willingness to pay includes actual expenditures and consumer surplus.
            - Thus, simply using a direct measure of expenditures ignores the consumer surplus, and underestimates the value.
    - We need to consider the same issues for costs and supply curves.
        - For example, changes in policy may lead to changes in costs (see figure 7.1 in the text).
        - Thus, we look at changes in producer surplus.
    - Putting these together, the net value is the sum of consumer surplus and producer surplus.
    - Since policy analysis should focus on marginal analysis, we want to ask how these change as we have an incremental change in pollution.

II. Revealed Preference Approaches

- Economists typically use one of two approaches to measure the benefits of environmental quality:
    1. <u>Revealed preference approach</u> – infer the value of environmental goods from other market transactions
        - Note that revealed preference approaches get at use values, but not non-use values.
    2. <u>Stated preference techniques</u> – ask individuals hypothetical questions about their willingness to pay.
- Today we consider revealed preference approaches.

A. Aversion Costs

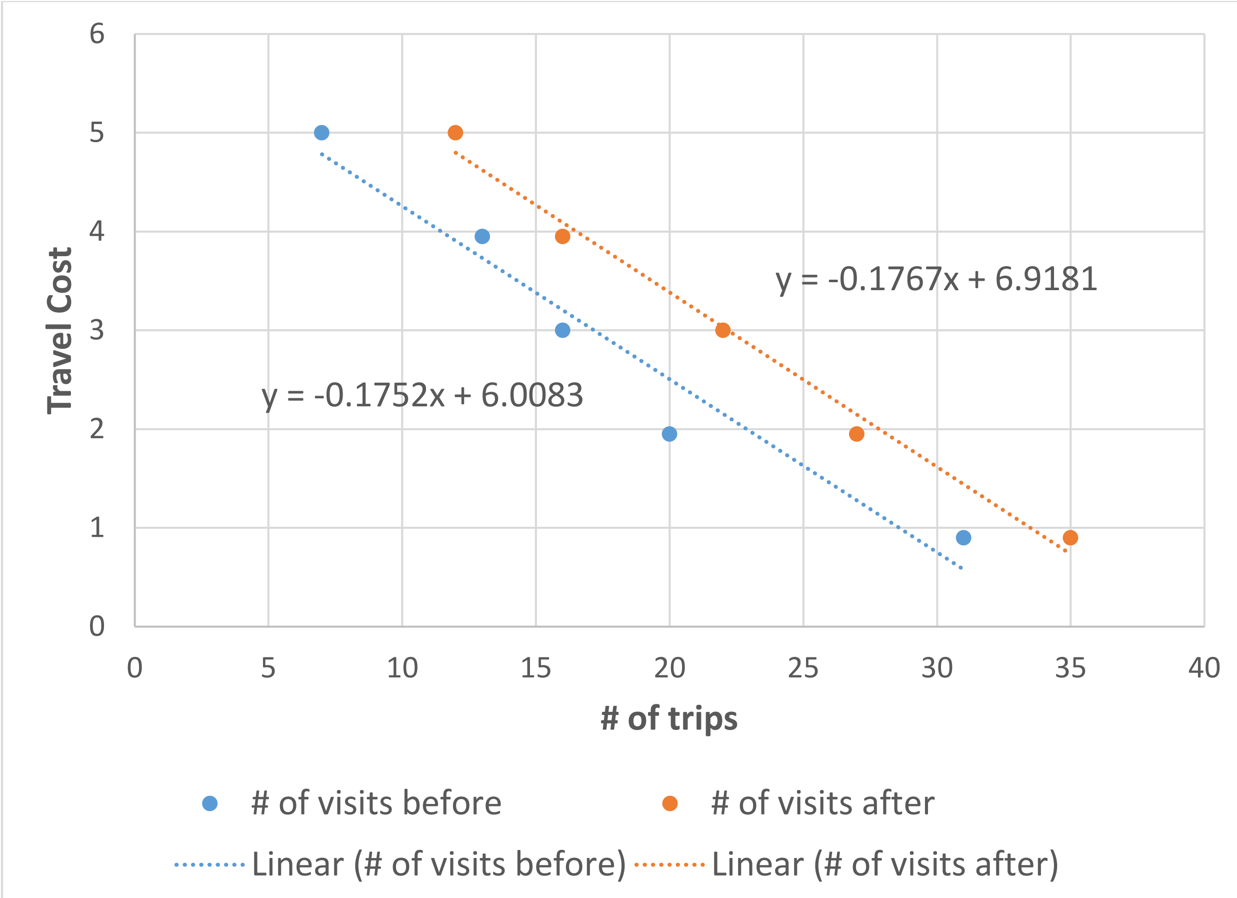
- Note that, in reaction to environmental harms, people may undergo expenses to remedy the problem.
    - Examples:
        - Filters for drinking water
        - Air conditioners so that windows can remain closed
        - Medication to mask symptoms of health effects
        - Shrubbery to hide a polluted neighboring site
- By studying how much people spend on averting expenditures, we can estimate the benefits they would receive if the harm were removed.
- Potential issues:
    - Perceived risk vs. actual risk: Consumers decisions are based on what they perceive risk to be, which may differ from actual risk
    - Actions that avoid risk also have other benefits (e.g. air conditioners provide cooling, bottled water tastes better)
    - Is the study related to a specific contamination episode (e.g. groundwater contamination) or a general risk (e.g. shortness of breath)
        - For general risks, it is harder to connect the concern to a specific contaminant.

B. Travel Cost Method

- The travel cost method looks at how far visitors travel to come to a site.
- By placing a value on the cost of travel, we can infer the value of the site.
    - The travel cost includes both direct costs (e.g. airfare) and indirect costs (e.g. the opportunity cost of travel time).
    - We can infer the value of a change in *quality* by looking at demand during different days (e.g. in different types of weather).
- Travel cost example. Consider a survey that collects data on the number of visits a person makes to a beach.
    - Based on how far they travel, the survey includes an estimate of the travel cost for each person.
    - Suppose we also have data on how many more trips they would make if the water quality were higher.
    - These data are given in the chart below:

	Travel Cost	**# of visits before**	**# of visits after**
A	0.9	31	35
B	1.95	20	27
C	3	16	22
D	3.95	13	16
E	5	7	12

- This graph shows the scatter plot of these data, along with the regression line that best fits the data:



- Using the estimated demand functions, we can calculate the consumer surplus before and after. The change in consumer surplus is the value of improved water quality.
- For simplicity, we'll assume there is no admission fee for the beach, so that the price is 0 – anyone willing to travel to the beach can use it.
    - The only costs are the travel costs for visitors
- Rounding to simplify the math, we have two demand curves:
    - Before: $P = 6-0.175Q$
    - After: $P = 7-0.175Q$

- To calculate the change in WTP as water quality changes, assume that the current average travel cost of visitors is $1.
    - Thus, we begin by finding how many visitors come with the old and new demand curves.
    - Before:

      1 = 6 – 0.175Q

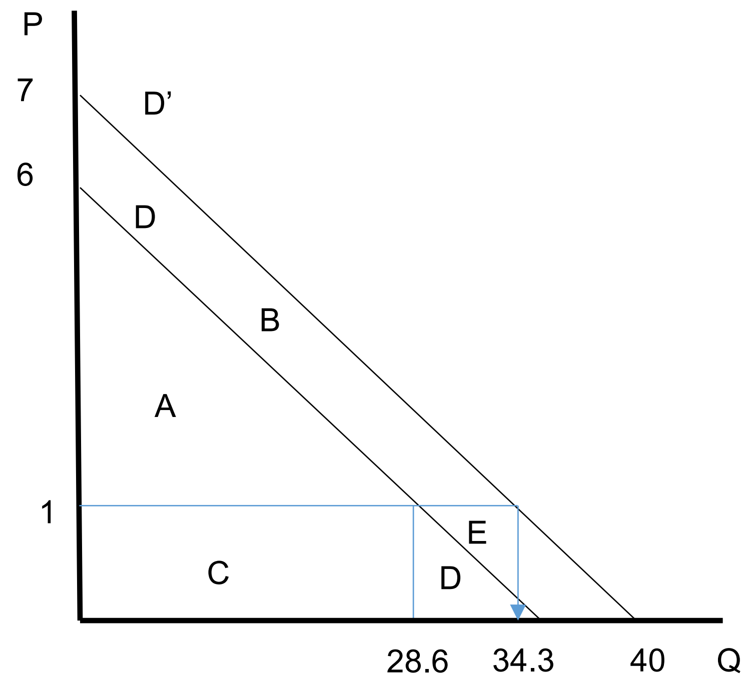
      0.175Q = 5

      Q = 5/0.175 = **28.6**
    - After:

      1 = 7 – 0.175Q

      0.175Q = 6

      Q = 6/0.175 = **34.3**
- Our graph is thus:



    - Willingness to pay after = A + B + C + D + E
    - Willingness to pay before = A + C
        - Change in WTP = B + D + E
    - To calculate, note that B is the change in consumer surplus and D + E is the change in expenditure
        - Change in consumer surplus
            - CS After = 0.5(6)(34.3) = $102.9
            - CS Before = 0.5(5)(28.6) = $71.50
                - Change in CS = $31.40
        - Additional expenditure = ($1)(34.3-28.6) = $5.7
        - Total change in WTP = $31.40 + $5.70 = $37.10

- Potential problems with the travel cost method
    - Compare single-site vs. multiple site models
        - Single site looks at how value changes as access to a site changes (e.g. closing a lake due to poor water quality)
            - Doesn't address possible substitutes
                - If one lake closes, can go to a nearby lake
        - Multiple-site models consider the choice of which site to visit
            - Include distance (or travel cost) to neighboring sites as additional controls
            - Key question: what are the relevant sites in the choice set?
                - e.g. 1000's of lakes in Minnesota – do we include them all
    - What is the opportunity cost of time?
    - Only measures value of those that use the amenity. We need to account for substitutes.
        - For example, do all beach users in Florida come for the beaches, or are they there for other reasons (e.g. Disney)?
    - Sampling bias in surveys.