Lecture # 16 – Valuing Environmental Benefits: Stated Preference Approaches

I. Revealed Preference Approaches (continued)

- D. Hedonic Pricing Techniques: Wages
 - Another application of hedonics is with wages.
 - Examples:
 - 1. People will choose to live in cities with positive characteristics.
 - Differences in wages can be seen as the value of these characteristics.
 - E.g.: Kahn (2017) studied public sector compensation
 - California workers are paid just 9% more than workers in Alabama
 - Adjusting for the cost of living, these workers are paid less
 - Implies they value the other amenities of living in California
 - 2. People need to be compensated to be willing to take riskier jobs.
 - Differences in wages represent the value of a human life.

II. Value of a Statistical Life

- The most controversial aspect of cost-benefit analysis is placing a value on human life.
 - What is the value?
 - Is it merely the opportunity cost (e.g. foregone wages)?
 - Are there other values (perhaps non-market values) that need to be considered?
 - Concepts of the value of a life
 - The most commonly used value is the value of a statistical life.
 - We don't know who will die, but we expect someone will.
 - The value of environmental protection is lessening the risk of someone dying.
 - Note that specific deaths capture the attention of individuals. However, that is not what a statistical life focuses on.
 - We are valuing changes in the probability that a random individual will die, by asking what is the willingness to pay for changes in risk.
 - It is the ratio of marginal utility of a small risk reduction over marginal utility of income: VSL = MU_{Risk reduction}/MU_{Income}.
 - That is, the as the marginal rate of substitution between mortality risk and money
 - Because of diminishing marginal returns, when dealing with large changes in risk, willingness to pay and willingness to accept will differ

- For policy, this is the most appropriate measure, because policy does not prevent death, but rather changes the probability that death will occur.
- Can also be put into annual figures: value of a statistical life year (VSLY)
 - Found by dividing VSL by the discounted expected years of life remaining for the average individual studied.
- Contrast this with the optimal insurance and compensation of accident victims.
 - Colmer notes that other principles apply when lives are identifiable
 - Here, things such as the opportunity cost of foregone wages and medical expenses are often used, since now we are focusing on a specific loss.
- How to measure the value of a life:
 - Revealed preference approaches
 - Expenditures to reduce risk
 - For example, how much more will people spend for a car with airbags, or for bottled drinking water?
 - Challenge: separating value assigned to changing risk to other characteristics (e.g. other features of the car, or better taste for bottled water)
 - Hedonic wage approach
 - People need to be compensated to be willing to take riskier jobs.
 - Differences in wages represent the value of a human life.
 - To calculate, we regress wages on job characteristics, worker characteristics, and risk
 - Key is to compare risk of jobs and compensation required for each.
 - Occupation 1: 1 in 10,000 risk of death per year
 - As a result, 1 worker dies every 10,000 years.
 - If 10,000 workers in this occupation, expect 1 to die each year.
 - Occupation 2: 3 in 10,000 risk of death per year
 - As a result, 3 worker dies every 10,000 years.
 - If 10,000 workers in this occupation, expect 3 to die each year.
 - Comparison
 - Difference in risk is 2 in 10,000
 - Suppose wages in occupation 2 are \$1,000 higher. What is the value of a statistical life?

- The value is the willingness to pay to avoid a risk that results in one more death in the population.
- This is the wage differential divided by the additional risk
 - = \$1,000/0.00002 (or 1,000/(2/10,000))
 - = \$5,000,000
- Note that this assumes people's preferences are linear.
 - Does \$1,000 for 1/1000 => \$100 for 1/10,000?
- Issues:
 - Requires people to have perfect information about risks, and to be able to evaluate this information properly.
 - Do people take risks knowingly and willingly?
 - True locally (that is for marginal changes), but for large changes in risks might not be appropriate.
- Ask people: stated preference methods
 - We will discuss these next
- Estimates of the value of a life in the United States vary by agency. These values were in effect in 2011:
 - E.P.A. \$9.1 million
 - F.D.A. \$7.9 million
 - DOT: \$6 million
- Issues for valuing life
 - WTP depends on:
 - Type of risk
 - Amount reduced for each individual
 - Income
 - Substitutes: other ways to mitigate or avoid the risk
 - Preferences: each individual's subjective disutility from the risk, their risk aversion, and discount rate
 - How do we deal with different groups?
 - Reducing risk extends one's life expectancy.
 - Given this, should we place different weights on the lives of children?
 - Should we place less value on protecting the elderly?
 - EPA explored this idea in 2003
 - In some cases (e.g. air pollution), it is these high risk groups who are most affected by a policy.
 - OMB guidelines advise against adjusting VSL for age.
 - Extrapolating results across groups can be a problem.
 - Many VSL studies look at job risk in middle-aged men. However, the young and old tend to be most vulnerable to pollution.
 - Estimating VSL for children particularly difficult.
 - Cannot ask them directly
 - Parents often willing to pay more to reduce risk to children than to themselves.

III. Stated Preference Valuation

- So far, we have studied revealed preference approaches to valuing environmental amenities. Those approaches look at actual market transactions to infer value.
- Unfortunately, there aren't always market transactions that can serve this purpose. For example, how do we value protection of endangered species?
- In these cases, economists simply ask people for their valuation. These are known as <u>stated preference</u> techniques
- Types of stated preference approaches
 - Contingent valuation
 - Uses surveys to assess WTP
 - Typically a yes/no response to a posted price
 - "Contingent" because asking people what they would do if faced with a market for environmental amenities, since the actual markets do not exist.
 - Uses textual description of scenarios
 - Will respondents identify key features in the text?
 - o Choice experiments: conjoint analysis
 - Respondent asked to consider an environmental commodity defined by several attributes
 - Choose among three or more options during each task
 - Reveal information on value of individual attributes, which are not emphasized in CV
 - But short descriptions of attributes may oversimplify
- Contingent valuation versus choice experiments
 - Decision of which to use depends on how respondents tend to perceive the good. Suggest three considerations:
 - Will the change being valued affect specific characteristics of the item or the item as a whole
 - CV works well if estimating fixed set of changes as a whole (e.g. oil spill damages)
 - CE useful if some attributes affected but not others
 - Do respondents think of the change in terms of individual attributes or as a whole?
 - E.g. do they think of an ecosystem holistically?
 - If they think of individual attributes, can the attributes be thought of separately?
 - If so, CE appropriate.
 - How does information presentation affect respondents understanding of item to be valued?
 - If complex, listing individual attributes (CE) may be confusing

- Policy background
 - The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) gave government the right to sue for damages to natural resources for which they are trustees.
 - In 1986, the Department of Interior said nonuse (largely existence) values were recoverable if use values were not measurable.
 - Sanctioned the use of CV
 - In 1989, a federal court of appeals directed the Department of the Interior to redraft its regulations with equal weight on use and nonuse values.
 - After the Exxon Valdez crash in March of 1989, DOI regulations meant that Exxon would have to pay for non-use damages.
 - CV estimate of damages: \$3 billion. Other studies cited in Kling et al. range from \$3.8 million (recreation demand study) to \$4.9 billion
 - Difference is almost entirely that the larger study includes non-use values, rather than just the loss of actual visits to the spill area
 - Thus, CV became a focus of court cases.
 - Settled through a U.S. District Court consent decree in 1991.
 - Paid out \$1 billion in damages and over \$2 billion in immediate responses and restoration efforts
 - In response to the Exxon Valdez, Congress passed the Oil Pollution Act of 1990.
 - In addition to reducing the likelihood of future spills, the act provided for damage recovery.
 - The Department of Commerce was to draw up regulations on damage assessment.
 - The Dept., through the National Oceanic and Atmospheric Administration (NOAA), assembled a blue ribbon panel to evaluate CV.
 - Question to panel: Is the CV method capable of providing estimates of lost nonuse or existence values that are reliable enough to be used in natural resource damage assessments?
 - BP accident in 2010 raised the issue again

- How contingent valuation works:
 - 1. Ask people their willingness to pay (WTP) to bring about a specific environmental improvement (e.g. improved visibility from air pollution, protection of an endangered species).
 - 2. A payment mechanism is specified.
 - The respondent must believe that the money paid could lead to the desired effect.
 - E.g.: increase sewer fees to improve water quality.
 - It should not be controversial (e.g. property taxes).
 - Because the survey shouldn't serve as a referendum on the type of payment mechanism chosen.
 - Other alternatives include surcharges on utility bills or generally assessed fees
 - 3. Information about the respondent is usually gathered.
 - E.g. income, age, education...
 - Allows verification of results, estimation of income elasticities, etc.
- Survey development and implementation how to describe the scenario
 - o Goal of good survey design is to maximize validity and reliability of results
 - Scenario description
 - Both the baseline (status quo) and proposed change must be described in a way that is understood and viewed as credible
 - Description should be specific
 - Want to capture the value of a specific amenity (e.g. cleaning a local lakes) not a general class (e.g. preferences for lakes in general)
 - People may react to news (e.g. oil spills)
 - Do people care about the resource (e.g. Alaskan coast) or preventing the action (e.g. clean up oil spills)?
 - Provide information on the mechanisms that will lead to the change
 - Payment mechanism must be clear and credible (e.g. on tax bill or utility bill)

- Data collection
 - Sample
 - Market studied should be the group of people whose welfare is affected by the change being valued
 - Harder to identify for non-use values
 - Draw sample from known frames consistent with the population
 - Check for non-response bias
 - Choice of sample relates to generalizability
 - To use WTP results to guide policy often requires aggregating results to a population
 - Knowledge of the sample frame is important for establishing generalizability
 - Socioeconomic characteristics of respondents should be documented
 - \circ Test for non-response bias
 - Do the demographics of respondents compare to demographics of the population?
 - If there are differences, demographic data can be used to re-weight the responses
- Value elicitation a payment mechanism is specified
 - The respondent must believe that the money paid could lead to the desired effect.
 - E.g.: increase sewer fees to improve water quality.
 - Surveys should be designed so participants believe the study's results could affect their well-being (consequentiality)
 - It should not be controversial.
 - Because the survey shouldn't serve as a referendum on the type of payment mechanism chosen.
 - Other alternatives include surcharges on utility bills or generally assessed fees (although Kling *et al.* do consider property taxes an alternative)
 - Use incentive-compatible response formats
 - Incentive compatible means that respondents have incentives to reveal their true value
 - E.g. there aren't strategic reasons to give a higher or lower answer
 - Voluntary contributions to public goods are an example
 - If the respondent believes the survey will be used to decide on the ultimate provision of a public good, may have incentive to report *more* that the true WTP and to contribute less should it become a reality
 - So as to influence provision and have an opportunity to free ride
 - Binding payment vehicles are incentive compatible and avoid free riding

- Some taxes (e.g. income or sales taxes) can be avoided by consumers, and are thus not good choices
- The question should involve a firm sense of commitment.
 - "If the program is approved, firms will raise prices by \$X."
- Must be credible
- Timing
 - Is it a one-time or annual payment?
- Types of questions:
 - <u>Open-ended</u> ask respondents for maximum WTP.
 - "What is the highest amount you would be willing to pay each year to ...?"
 - Open-ended questions are not incentive compatible.
 - May think strategically (how much do I need to offer to get the project done), rather than full value of the project.
 - <u>Close-ended</u> ask respondents whether they are WTP a certain amount. This amount is varied across respondents.
 - "Would you pay \$X for ...?"
 - Close-ended questions are more like the everyday decisions that consumers make every day, and are thus easier for respondents to understand.
 - Best practice is to describe the market as a referendum
 - <u>Bidding games</u> ask respondents if they are WTP a certain amount. If they say yes, raise the bid until they say no.
 - "Would you pay \$5 for...?" "Yes." "Would you pay \$10?"...
 - While early studies used a range of methods, standard practice now is to use close-ended responses.
 - A single bid offer is best, as iterative bidding can be subject to anchoring (e.g. influenced by where bidding started)
- What value to elicit? Willingness to pay (WTP) or willingness to accept (WTA)?
 - Implied property rights can inform the decision
 - Most studies estimate WTP
 - Framing WTA is more difficult

- Example: study of the damage from the BP oil spill
 - Part of an effort to determine the value of natural resource damage from the spill
 - o Used a nationally representative stated-preference survey
 - Would respondents support investing at least \$17.2 billion to prevent future oil spills of this type in the Gulf of Mexico?
 - Took three years to design and pre-test the survey
 - Surveyed 3656 people
 - Response rate of 48%
 - o Tests whether responses are consistent with economic decisions
 - o Survey
 - Describes:
 - the state of the Gulf before the accident
 - what caused the accident
 - injuries to the Gulf's natural resources
 - This was randomly varied, describing different sets of injuries, to test for sensitivity to scope of injury. Examples:
 - Smaller set: # of miles of oiled marshes, dead birds, and lost recreation trips
 - Larger set: also included injuries to dolphins, coral, snails, and young fish and sea turtles
 - a proposed program for preventing future accidents
 - Can be seen as insurance against another spill occurring in the next 15 years
 - Involves drilling a second pipe as the same time a well is drilled
 - Because it takes at least three months to drill a pipe, waiting until a leak occurs will not prevent an accident
 - Doubles the cost of drilling, so survey says companies will need government support to pay for it
 - how much extra the household would pay in taxes if the program were implemented
 - Randomly assigned one of five different tax amounts: \$15, \$65, \$135, \$265, or \$435.
 - Votes are used to establish a lower bound for WTP

- *Question*: What did the researchers do to ensure respondents believed their answers were consequential?
 - Respondents received official letter from US Department of Commerce, on letterhead, emphasizing that the survey results would be used for policy-making.
 - Interviewers reviewed content of that letter before administering the survey
 - Questionnaire explained that a decision on the program hadn't been made yet, and if it did move forward, it would require new tax revenue.
- *Question*: How do they show the results are represent consistent decisions?
 - Proportion of people voting for a proposal shouldn't increase as the tax increases
 - For a given tax amount, a program avoiding more injuries should be preferred
 - Table in paper shows both conditions were met.
- Results:
 - WTP for smaller set of injuries: \$136 (s.e. \$6.34)
 - WTP for larger set of injuries: \$153 (s.e. \$6.87)
 - Implies an aggregate benefit of \$17.2 billion
 - Equals \$153 X 112,647, 215 households in the US

- Conjoint analysis example: (<u>Welling *et al.*, *Environmental and Resource* <u>*Economics* 2022</u>)</u>
 - This paper estimates willingness to pay for climate adaptation investments
 - Used an on-line survey in Bremen, Germany
 - 1178 respondents
 - Socioeconomic information collected:
 - Age, gender, household size, # of children > 14, monthly income
 - Respondents were given different levels of background information
 - Goal: to test how information provided in surveys affects results
 - Randomly divided into two groups
 - *Script* sample given the following introduction:
 - The Senate of Bremen adopted the climate change adaptation strategy for Bremen in April 2018. The strategy document explains the consequences of climate change for the city of Bremen. Strong rain, river and storm floods will become more likely. The strategy document predicts a rising risk of flooding with property damages, such as flooded basements and underground garages. According to the strategy document, heat waves will also become more likely. These can reduce your productivity and strain your cardiovascular system. The climate change adaptation strategy mentions several measures which the city of Bremen could apply. The first part of this survey focuses on some of these measures.
 - No Script sample given no background on climate change:
 - The first part of this survey focuses on possible urban green measures for the city of Bremen
 - The survey was otherwise identical.

- Choice experiment
 - Each survey included 9 choice scenarios
 - Payment mechanism: city administration would implement the policy and collect payments depending on the survey outcome
 - Community characteristics considered:
 - Number of trees on streets
 - Green space
 - Green roofs
 - Provided background information on current level of characteristics in Bremen
 - Asked two questions to verify whether respondents believed whether the changes (policy consequentiality) and the payment (payment consequentiality) would have an impact
 - "To what degree do you believe that your responses will affect which measures will be implemented in the city of Bremen?"
 - "To what degree do you believe that your responses will affect whether you will have to pay the additional cost if the measures are implemented?"
- Results (Average WTP):
 - €29 for one additional tree per 100 meters
 - €23 per additional percentage point of green area
 - €2 per 1 additional "extensive" green roof/100 roofs
 - €12 per 1 additional "intensive" green roof/100 roofs
 - Information matters
 - WTP higher for those receiving background information on climate change
 - More likely to select an alternative
 - 28% chose status quo if given no information
 - 20% chose status quo if given background information
 - Information improved credibility of proposed changes, but did not affect consequentiality