Spatial Environmental Economics
Lecture 4: Valuation of Environmental Quality

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Roadmap

1. Purpose of Valuation
2. Revealed Preference
3. Revealed vs. Stated Preference
4. Defensive Behavior
5. Model of Defensive Behavior
6. Defensive Behavior and VSL

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3. Revealed vs. Stated Preference
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What is the purpose of monetary valuation of the environment?

- Allows for cost-benefit analyses
  - Money is a common unit of measurement
  - And most environmental goods and services are not traded on markets (so have no prices)
- Required to implement policies addressing market failures
  - Pigou tax = marginal value of the externality (in money!)
  - Payments for preservation require knowing the value of damage avoided
  - Compensating payments require knowing the value of damage incurred

Methods for monetary valuation

- **Stated preferences**: ask people about their willingness to pay for an hypothetical environmental good or service
- **Revealed preference**: infer preferences for environmental quality by analyzing actual behavior in related markets
  - Defensive expenditure
  - Travel cost
  - Hedonic pricing

Roadmap

Defensive expenditure method

- Studies defensive expenditure on consumption and investment, avertive behaviour
- The observed related market is a **substitute** for environmental quality
  - Expenditures that compensate for the lack of something in the environment that you like
- Examples:
  - Purchasing bottled water instead of drinking tap water
  - Buying double-glazed windows to keep the noise out
  - Early morning jogging to avoid air pollution of rush hour
  - Building coastal defenses, such as seawalls

Travel cost method

- Studies travel to desirable sites
  - Location (space) matters!
- The observed related market is a **complement** for environmental quality
  - You cannot get to the nonmarket good without traveling
  - Traveling costs time and money
- Examples: travel to beaches, nature reserves, monuments, museums

Travel cost method: intuition

- Suppose you want to value the Great Barrier Reef (Australia) and Westpark (Munich)
- In each place, you collect data on number of visitors and where they live
  - Great Barrier: most visitors are not local, and many flew from far away
  - Westpark: most visitors come from neighborhood, some cycled or took train for 10-15 min
- Why?
  - The Great Barrier it is beautiful and unique
  - Westpark is very nice! But there are similar parks elsewhere
- If you extend your data to include (i) how long they traveled and (ii) how much it cost
  - You would find that many paid little, few paid more, and none paid a whole lot
  - That is a demand curve!
- Conceptually clear, but practical difficulties: how valuable is travel time?

Hedonic pricing method

- Studies goods/services where environmental quality is one of many attributes of the good
- The observed related market is of a good with **bundled** attributes
  - Many market goods are a finite mix of characteristics
  - These characteristics are not available to purchase individually
  - We can use the market price to infer the implicit (hedonic) price of individual characteristics
- Example: housing market
  - A house is a bundle of floorspace, age, upkeep, neighborhood
  - The neighborhood has its schools, crime, air pollution

Hedonic pricing method: intuition

- A house located next to the English Garden is worth more than an identical house situated in an unattractive environment
  - The price difference reflects the value of environmental beauty
  - Issue: these two houses may not actually exist! Builders tend to construct larger and more attractive homes in desirable locations, which attract wealthier homeowners who, in turn, contribute to better local schools and other public goods. The implied value may then be biased
  - Issue: buyers may not be fully informed (e.g., regarding energy ratings, flood risk)
- I would require a higher wage to accept an engineering job with Shell on an oil rig in the North Sea compared to one in Munich
  - The wage difference compensates for injury risk and discomfort
  - Issue: wages also reflect the cost of living, and supplying goods to the rig is expensive
  - Issue: many other amenities differ between locations, and differences may be correlated

Roadmap

Strengths and weaknesses of revealed preference

- **Main strength**: values are inferred from actual choices
  - We don't need to believe what people say or trust their memory
- **Another strength**: studies are relatively cheap
  - Many sources of administrative data: travel surveys, home listings, hotel records
- **Main weakness**: only reveal preferences about direct use values
  - Recall types of values in Lecture 1
  - E.g. I am willing to pay more for a house because it has a lake view, not because I care about the biodiversity benefits of the lake
- **Another weakness**: preferences are revealed indirectly, thus requiring assumptions
  - Take a stand on the structure of the market, information held by agents, and their rationality
  - E.g. willingness to pay for vitamin C supplements depends on perceived, not actual, benefits

Stated preferences

- **Main strength** is the main weakness of revealed preference: estimating non-use values
- People are interviewed about their willingness to pay to protect the environment. E.g.:
  - How much are you willing to pay to eat whale meat? (consumptive direct use)
  - How much are you willing to pay to protect whales so that your children will enjoy them? (bequest value)
- The **weakness** is that the method is subject to potential biases
  - E.g. the respondent may have in mind something different than the researcher
  - Non-response bias, strategic responses, motivated thinking, etc

Roadmap

Defensive behavior

- When people are faced with a risk or danger, they may be able to act in a way that reduces either
  - their chances of facing that risk, or
  - the severity of the bad outcome
- What are examples of things that you do to help protect yourself from risk?
  - Wear a seat belt or a bicycle helmet, other safety items like steel toed boots or harnesses
  - Personal cybersecurity steps such as a passcode on your phone
  - Financial security such as diversifying your investments
  - Risks to assets such as rental or auto insurance, obviously health insurance
- These are useful observations because they are **revealed** behaviors that give insight into how people respond to everyday risks

Mitigation or abatement measures for non-market bads

- Air Pollution
  - Install air filters, air conditioners, or move away entirely
- Water Pollution
  - Water filters, bottled water, test more frequently/drill a deeper well, move
- Noise Pollution
  - Better windows/doors, insulation, move
- Climate Change
  - Find job where you work inside, move away from equator, live in a developed country

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Model

- As with all economic models, the optimal level of individual expenditure can be determined by equating the marginal benefits of risk reduction (e.g., changes in environmental quality) with the marginal costs of those reductions (e.g., expenditures):

$$\frac{\frac{\partial U}{\partial EnvQ}}{\frac{\partial U}{\partial money}} = \frac{MU_{EnvQ}}{MU_{money}} = MRS_{EnvQ,money} = MWTP_{EnvQ}$$

  - We'll come back to the concept of MWTP when we discuss the Roback (spatial) model
- *EnvQ* captures many things, the perceived environmental quality and the perceived risk associated with the perceived exposure

Estimation

- One common way to estimate $MWTP_{EnvQ}$ is through observed expenditures:

$$cost_{it} = \beta_0 + \beta_1 EnvQ + X\gamma + \varepsilon_{it}$$

where

$$\frac{\partial cost_{it}}{\partial EnvQ} = \beta_1 = MWTP_{EnvQ}$$

- The dependent variable $cost_{it}$ can mean many things
  - Cost of a hospital visit, asthma treatments, etc.
  - Defensive expenditures, things like air purifiers, water filters, etc.

Estimation (cont.)

- The explanatory variable $EnvQ$ (environmental quality) can also be difficult to measure
  - The level of the variable $EnvQ$ can be difficult to directly link to surrounding populations. For example, wildfire smoke plumes are difficult to trace directly to exposure. Compare this nonmarket amenity to something like a park that has a known location, etc
  - In addition to variation in preferences for $EnvQ$, there is a latent preference related to risk and risk aversion that is difficult to measure

Roadmap

Value of statistical life (VSL)

- The VSL is the monetary value of a mortality risk reduction
  - "Statistical" in the sense that it is an ex-ante reduction in the probability of death of an unidentified person
- It feels wrong to put a price on a human life, but
  - Treating life as priceless may, in practice, simply result in overlooking important benefits or costs associated with a policy or phenomenon
  - Also, people do not behave "as if" life were priceless: we all take on some risk in our day-to-day life
- VSL estimates are widely used
  - Increasingly common part of cost-benefit analysis of traffic safety, health policy, and environmental regulation
  - Component of estimates of impacts of climate change

Shogren and Stamland (2005): "Self-protection and VSL Estimation"

- The value that we estimate is the MWTP for environmental quality conditional on the decision to self protect, or

$$MWTP_{EnvQ|protection}$$

- We can think of the estimate as a lower bound for a self-protector's WTP
  - A person spending €50 on self-protection reveals valuing that protection at least €50
- But to get to a bound on the VSL we need to go from the individual's lower bound to a societal or aggregate lower bound:

$$MWTP_{EnvQ}^{Society}$$

  - From the individual self-protector to everybody

Difficulties in interpreting self-protection expenditures as a lower bound

Those who choose to not self protect may either:

- Have a lower WTP (perhaps even zero)
- Are less risk averse, or skilled at defending against it
- Perceive the reduction in risk differently (efficacy of the defensive mechanism)
- Are simply not able to, do not have the means (money)
- Are unaware of the risk entirely! (or the cost of/availability to protect)

Shogren and Stamland (2005) bounds on VSL

- Takeaway:

$$MWTP_{EnvQ|protection} > MWTP_{EnvQ}^{Society} > MWTP_{EnvQ|NOprotection}$$

- And a conservative lower bound:

$$MWTP_{EnvQ}^{Society} > MWTP_{EnvQ|protection} \times Pr\,(protection)$$

  - $Pr\,(protection)$: probability that an arbitrarily chosen individual self-protects
  - Implies using *zero* as the bound for those who don't self-protect

Appendix

References I

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