Econ 2675 – Environmental Economics

Chapter 4 Lecture – Valuing the Environment: Methods

"Yes, the planet got destroyed. But for a beautiful moment in time we created a lot of value for shareholders."

Economic Sociology and Political Economy Community

https://economicsociology.org/2016/11/26/corporate-governance-for-the-society-and-the-environment/

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Why Value the Environment?

Many types of agencies depend on benefit-cost analyses for decision-making.

- **(USA) Natural resources damage assessments, such as for oil spills (National Oceanic and Atmospheric Administration);**
- **(USA) For the designation of critical habitat under the Endangered Species Act (U.S. Fish and Wildlife Service);**
- **(USA) Dam relicensing applications (The Federal Energy and Regulatory Commission).**

- **(Qatar) Ministry of Municipality and Climate Change https://www.mecc.gov.qa/English/Pages/default.aspx**

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Valuation

Types of Values

1. **Use Value*:* Use value reflects the willingness to pay (WTP) for direct use of the environmental resource. To *use* something simply requires one of the senses to be active (sight, sound, touch, taste or smell) All of these constitute some kind of use of natural resources and the environment. Both active use (consumptive) and passive use (non-consumptive).**

2. **Option Value*:* Option value is the willingness to pay for the *future* ability to *use* the environment. This is the value people place on having *the option to use* or ensuring something exists for potential future use. For example, what are your future plans?**

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Valuation

3. **Nonuse or Passive-use Value*:* Nonuse value represents an individual's willingness to pay to preserve a resource that he or she will never use. These values are often called *existence* values. This is a very different category of value and, of course, represents the most problematic as well as controversial with respect to monetization. These are less tangible values, but can be quite large.**

Total Willingness to Pay (TWP):

Total Willingness to Pay = Use Value + Option Value + Nonuse Value

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Valuation

Classifying Valuation Methods

- **Revealed preference method**
  - **Methods which are based on actual observable choices and from which actual resource values can be directly inferred**
- **Stated preference method**
  - **Methods to elicit respondents' willingness to pay when the value is not directly observable**

Each method includes both indirect and direct techniques.

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Economic Methods for Measuring Environmental and Resource Values

Methods	Revealed Preference	Stated Preference
Direct	Market Price	Contingent Valuation
	Simulated Markets	
Indirect	Travel Cost	Attribute-Based Models
	Hedonic Property Values	Conjoint Analysis
	Hedonic Wage Values	Choice Experiments
	Avoidance Expenditures	Contingent Ranking

Source: Modified by the author from Mitchell and Carson, 1989.

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Valuation

Stated Preferences Methods

- **Contingent Valuation Method**
  - **It is to elicit people's willingness-to-pay (WTP) in a hypothetical market**
  - **Major concerns include strategic bias, information bias, starting-point bias, hypothetical bias, and discrepancy between WTP and willingness-to-accept (WTA)**

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Potential Biases with Contingent Valuation

- **Strategic bias is the tendency to overstate or understate WTP in order to affect policy.**
- **Information bias occurs when respondents are forced to evaluate goods/attributes for which they have little or no experience.**
- **Starting point bias is the tendency for reference points for bidding games and payment card mechanisms to induce higher or lower responses.**
- **Hypothetical bias is the tendency for hypothetical payments to differ from actual payments due to a difficulty in correctly picturing the situation.**
- **A final source of bias addresses the gap between the willingness to pay to avoid damage and the willingness to accept compensation for damage.**

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Valuation

Attribute-based methods

- **Choice-based, conjoint analysis, choice experiments**
  - **Respondents are asked to choose among alternate bundles of goods. Each bundle has a set of attributes and the levels of each attribute vary across bundles. Since one of the attributes in each bundle is a price measure, willingness to pay can be identified.**
- **Contingent ranking method**
  - **Respondents are given a set of hypothetical situations that differ in terms of the environmental amenity available (instead of a bundle of attributes) and are asked to rank-order them.**

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Consider an example (Landry and Mires, 2017 working paper) that surveyed North Carolina residents on their preferences and willingness to pay for marine cultural heritage sites (e.g. shipwrecks). The choice experiment included 5 attributes including the preservation zone, the availability of public programs and whether or not their was a walking, virtual or driving trail. The table below reproduces the attributes and levels.

Attributes	Levels
Preservation Zone	• **Status Quo; 30 shipwrecks protected** • **38 more shipwrecks (68 total; 127% increase); 2,192 m² of bottomland** • **56 more shipwrecks (124 total; 313% increase); 13,498 m² of bottomland**
Public Programs	• **No change** • **Increase museum exhibits and provide educational workshops** • **Increase museum exhibits and provide educational workshops, plus public television series about shipwrecks and creation of boating tours to shipwrecks**
Walking Trail	• **Yes/ No**
Virtual Trail	• **Yes/ No**
Diving Trail	• **Yes/ No**

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I: Here is the first voting opportunity

(Please chose one of the four options below by putting an "X" in one of the empty boxes)

26.	Program 1	Program 2	Program 3	Status Quo
Preservation Zone	Yellow Zone	Yellow Zone	Red Zone	Red Zone
Public Programs	Large Investment	No Investment	Large Investment	No Investment
Walking Trails	Yes	No	No	No
Virtual Trails	No	Yes	Yes	No
SCUBA Diving Trails	Yes	No	No	No
One-time Tax	$12	$55	$145	$0
put an "X" in one of the boxes to the right	☐	☐	☐	☐

27. How confident are you about this choice from these options? (Please select one)

○ Very Certain ○ Somewhat Certain ○ Somewhat Uncertain ○ Very Uncertain ○ Don't Know

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Tourism Example

If these were your only choices for vacation packages, which would you choose?
Or would you choose to not go on vacation?

Destination:	San Francisco, CA	Washington, DC	Las Vegas, NV	None: I would prefer not to go on vacation rather than choose any of these.
Number of Nights:	5 nights	3 nights	7 nights	
Accomodation:	Luxury (5 star)	Upscale (3 star)	Deluxe (4 star)	
Hotel Type:	Boutique (with distinct style)	Resort (usually with spa, golf, etc.)	Business	
Car Rental:	Full-Size	None included	Compact	
Price (per person):	$1,380	$810	$1,500	
	○	○	○	○

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A Sample Conjoint Analysis Survey Question

Attribute	Alternatives				
	A	B	C	D	E
Remaining live trees	No trees	459/acre	No trees	153/acre	No change
Removing dead trees	Remove all	Remove all	5/acre	10/acre	No change
Percent set aside	80%	20%	50%	20%	No change
Tax	$40	$200	$10	$80	No change
I would vote for (please check off)	❑	❑	❑	❑	❑

Source: Holmes, Thomas P. and Wiktor L. Adamowicz, "Attribute-Based Methods," *A Primer on Nonmarket Valuation*, Bateman, Ian, ed. (The Netherlands: Kluwer Academic Publishers, 2003): Chapter 6.

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Contingent Ranking Method (CRM)

- Referendum method
- Ranking of environmental attributes
- Easy for the respondent
- Example,

Choice #	Savings in travel time (in minutes)	Cost of saving (in dollars)
1	10	0.50
2	20	1.50
3	30	2.20
4	40	3.00

- Confusion if too many choices

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The Value of U.S. National Parks

In 2016, the National Park Service in the United States turned 100 years old. As federal budget deficits loom, there has been some talk of selling off some of these sites. What is the value of the National Park lands, waters and historic sites? According to the first ever comprehensive estimate, it is, at a minimum, valued at $92 Billion.

Haefele et al (2016) present the results of a survey of American households focused on estimating the total economic value (TEV) of national parks and programs. Previous studies have focused on the value of specific national park or monument sites, but none had attempted to estimate the value of all of these national treasures. The goal was to calculate total economic value; visitation values and passive use (or nonsue) values.

Using the population of all U.S. households from which to draw a sample, researchers used a mixed mode approach that utilized both mail and internet surveys with phone call reminders. Two rounds of surveys were implemented between 2013-2015.

In the survey, participants were asked whether protecting National Parks was important to them. Nearly 95% of the sample said they were, even if they did not visit them. 93.5% thought it was important to protect trails, parks and open spaces for current and future generations whether they use them or not. The language in these questions suggests bequest and passive use values. Only 6.2% thought the U.S. should sell off some National Parks. The survey also included question on respondents' political point of view. The sample of respondents leaned to the conservative side of the aisle.

The stated preference survey design was a choice experiment in which respondents chose among bundles that included the size of cuts to programs as well as the percentages of lands sold. Choice experiments typically allow respondents to choose a status quo bundle for which the price is $0. In order to minimize hypothetical bias (respondents stating a higher willingness to pay than they would actually pay), the choice question was followed by reminders to consider their budgets. This "cheap talk" technique has been shown to significantly reduce hypothetical bias.

Respondents were asked their willingness to pay a specific amount of money to pay for the National Park Service Programs. The payment vehicle utilized was an increase in federal income tax for each of the next 10 years. As we have discussed in this chapter, protest responses must be omitted from the data since those answers do not represent willingness to pay, instead representing a scenario (usually payment vehicle) protest. Since the payment vehicle chosen was federal income tax, there was some initial concern that protest zeros would be problematic, however, only 7.5% of the responses were considered to be protests.

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These household values were then multiplied by the total number of households in the population to determine the total economic value. In order to present a minimum bound (or very conservative estimate), they assumed that households that did not return a survey were willing to pay $0.

The final tally of $92 billion includes both use values for visitors and passive use or existence values, $62 billion of which (or two-thirds) is for the National Park Service lands and waters and historic sites, with $30 billion for programs. Of the $62 billion, they authors suggest that approximately half of that value is passive use value. Of course, these values do not even include the willingness to pay of the millions of international tourists that visit U.S. National Parks each year or those who hold passive us values for these locations. Thus, the $92 billion TEV also represents "the minimum amount that U.S. households are willing to pay to avoid the loss of the NPS and its programs."

According to one of the authors of the study, Limda Bilmes at Harvard Univesrity, the study shows that "Americans value the National Park Service at least 30 times more than the governments spends on them." It is a happy 100th birthday indeed.

Source: Haefele, Michelle, John Loomis and Linda Bilmes. 2016. Total Economic Valuation of the National Park Service Lands and Programs: Results of a Survey of the American Public. Faculty Research Working Paper Series. RWP16-024. June.
Haefele, Michelle, John Loomis and Linda Bilmes. 2016. Total Economic Valuation of US National Park Service Estimated to be $92 Billion: Implications for Policy. The George Wright Forum 33(3): 335-345.

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Using econometric analysis, the marginal willingness to pay (or implicit price) for each type of National Park or National Park Service program were estimated. These values are reproduced here.

Per-household total economic value (TEV) for the national park system and NPS programs	
National Parks	**Estimated value**
Nature-focused national parks (79,096,632 acres)	$1,113.24
History-focused national parks (226 sites)	$874.72
Water-focused national parks (4,818,275 acres)	$977.93
Per household value for all national park acres/sites	$2,967.00
NPS Programs	
Historic sites and buildings protected each year (2,000)	$316.31
Acres transferred to communities each year (2,700)	$98.41
National landmarks protected each year (114)	$347.98
Schoolchildren served by NPS educational programs (4.1 million)	$682.62
Per household value for all NPS programs	$1,445.00

Source: Table 4 in Haefele et al. (2016)

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Valuation

Revealed Preferences Methods

- **Travel-Cost Method**
  - **Travel-cost models infer values of recreational resources by determining how much visitors spent getting to a site and then using this information to estimate a demand curve for that site.**
  - **Travel-cost models have been used to value national parks, mountain climbing, recreational fishing, and beaches. Travel-cost models have also been used to value loses.**

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What Is the Value of a Polar Bear?

Because polar bears are such a charismatic species, they have obviously attracted lots of popular support, but exactly how valuable are they? In 2011, the Canadian government issued a report in which it attempted to estimate the different socio-economic values of polar bears in Canada.

They commissioned the study in part to determine the economic impact of adding the polar bear to a list of at-risk species. This study represents one of the few studies to try to estimate the value of polar bears and the only one that tries to do it in a comprehensive fashion.

The authors tried to capture active use values (subsistence and sport hunting, polar bear viewing, and value in scientific research), as well as passive use values (existence and bequest values). Multiple nonmarket valuation methods were used in this study including travel cost (viewing), market prices (hunting), meta-analysis and benefit transfer (passive-use values). Time and budgetary constraints precluded the use of stated preference methods such as contingent valuation or choice experiments. The summary of their findings is reproduced in the figure below. Note that the direct use values actually comprise a relatively small portion of the total value.

An effort to document the value of a species like this produces a value that is no doubt much closer to the truth than the default value of zero, but how close are these numbers to the true value? There are several caveats to consider:

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- Consider the calculation of the value of polar bear meat. For this the cost of the next best substitute, which in this case was beef (for humans) and dog food was used. One could certainly argue for alternatives.
- Sport values were estimated using the benefit transfer method. Recall the challenges for using benefit transfer, in particular for a unique species like the polar bear. The study closest to this one was conducted in 1989 and focused on big game and grizzly bear hunting. For the polar bear study, the 1989 values were translated into 2009 dollars. The authors suggest their number might be an underestimate since hunting for a polar bear is such a unique experience. On the other hand, they also acknowledge that the number could just as easily be an overestimate if the charismatic image of the polar bear reduces willingness to pay for hunting.
- Finally, passive-use values were also calculated using benefit transfer. Since no study has been done on the preservation value of the polar bear in Canada, the researchers used a meta-analysis of species at risk (Richardson & Loomis 2009). While that study calculated a total economic value, for the polar bear study the benefit transfer was specifically designed to capture only preservation value. It was relatively straightforward to remove direct uses (visitors) from the transferred value, but not the indirect use benefits such as scientific value.

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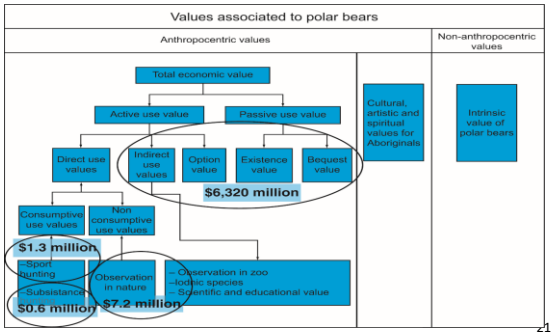
Monetary Values Associated with Polar Bears in Canada, by Value Category (Aggregate Amounts for Canada)



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Valuation

Valuing Human Life

- **Focusing on calculating the change in the probability of death resulting from a reduction in some environmental risk and then placing a value on that change.**
- **Statistical life values across different studies using meta-analysis**
- **Statistical life across different incomes**

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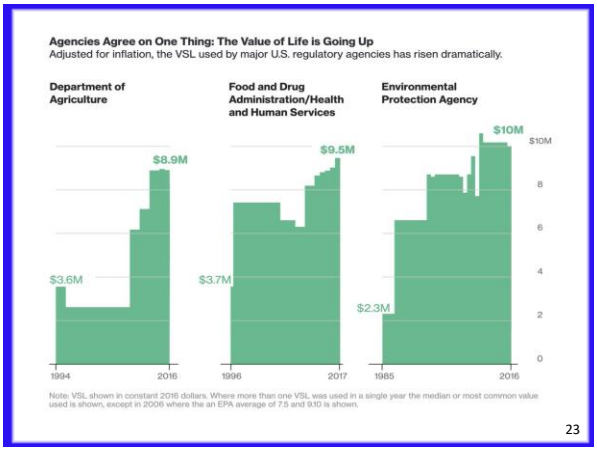

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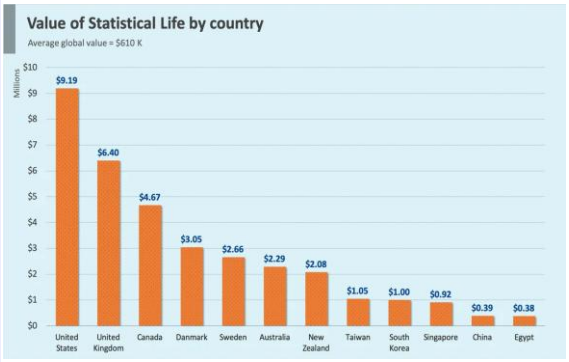

https://www.reddit.com/r/dataisbeautiful/comments/fyqowq/oc_an_american_life_is_worth_92_million_dollars/

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