VSL AND STATE PREFERENCE METHODS

LESSON OBJECTIVES

01

Explain and calculate VSL

02

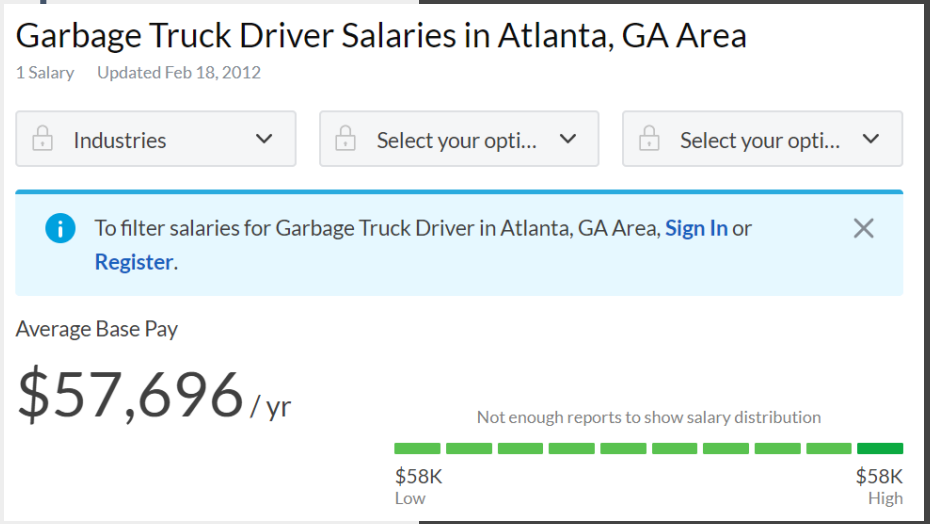
Explain and Analyze Contingent Valuation Methods

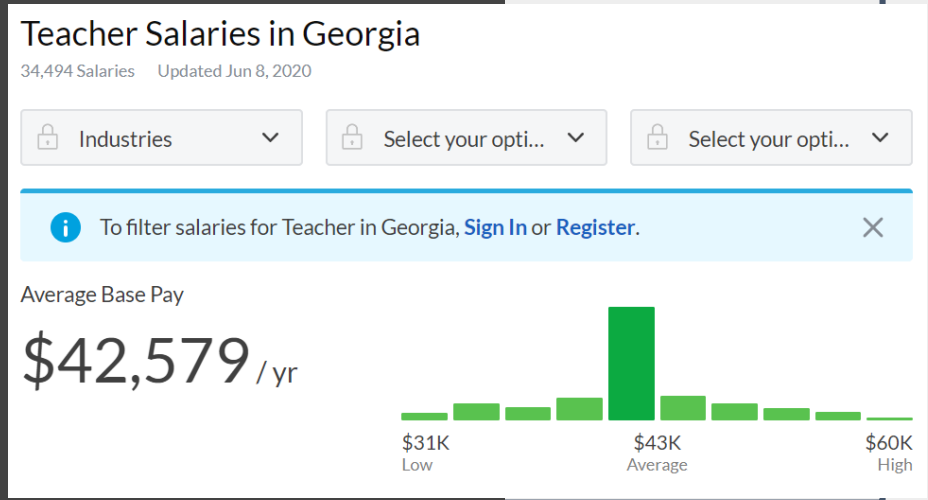
03

Explain and Analyze Choice Experiments

QUESTION OF THE DAY

Why do garbage collectors get paid more than teachers?





01

VALUE OF A STATISTICAL LIFE (VSL)

WHAT IS VALUE OF A STATISTICAL LIFE (VSL)

CONSIDER THE FOLLOWING...

A new policy that requires the labelling of hazardous waste.

A new policy that requires cars to have seatbelts.

What are the benefits of these policies?

- Reduced risk to morbidity or mortality

How do we value these policies?

- Using VSL

VALUE OF A STATISTICAL LIFE

Represents an individual's *willingness to pay* for a marginal reduction in mortality risks.

VSL IN POLICY

VSL is used in an array of policies and often represents the dominant share of benefits:

- Environmental quality policies: EPA
- Food safety policies: USDA
- Worker safety policies: OSHA
- Transportation safety polices: DOT

Over 50 studies have implemented hedonic wage models to estimate VSL

Post 2000, majority of estimates lie in $8 to $15 million range, but vary:

$2 million (Kochi, 2011)
$15 million (Kniesner et al., 2012)

US EPA uses approximately $8 million as their central estimate

Consider two identical jobs

- One with high risk of injury (Job A)
- One with low risk of injury (Job B)

If both jobs paid a wage of $50/hr, which would you choose?

Imagine there are many A's and B's. What will happen to the wages for these jobs in the labor market?

- Wages will adjust until workers are sufficiently compensated to work for type A

Say wages end up at A=$60/hr and B=$40/hr

- The compensating wage differential from the difference in risk is $20/hr

Sound familiar?

HOW CAN WE MEASURE VSL?

VSL CALCULATION

Suppose you look at the risk of mortality for two otherwise identical jobs.

- Job A you find 1 in 400,000 workers die on the job annually
- Job B you find 1 in 500,000 workers die on the job annually

You then compare the wages between the two jobs

- You find workers in Job B are paid $14/yr more than Job A

What is the VSL (marginal WTP for a change in risk of dying from 1 to 0)?

$$\frac{\$14}{\left(\frac{1}{400{,}000} - \frac{1}{500{,}000}\right)} = \frac{\$X}{1-0} \rightarrow \$X = \$28 \text{ million}$$

HEDONIC WAGE METHOD IN PRACTICE

In practice, it is hard to find identical jobs, so what do economists do?

Use statistical (regression) models to relate wages to characteristics of jobs.

Wage =
f(Job characteristics,
worker characteristics,
risks)

VSL estimates used in policy are primarily based upon hedonic wage estimates:

wages

risk

worker characteristics

job characteristics

$$wage_{ik} = \alpha + \beta\, risk_k + \gamma_i\, WC_i + \varphi_k JC_k + \varepsilon_{ik}$$

If risk is measuring in deaths per 10,000 workers, and β estimate is $600 (= annual average WTP), then:

VSL = $6 million = $600 x 10,000

PROBLEMS WITH VSL

Risk of a job is correlated with other factors.

- Job characteristics and worker characteristics

Using one VSL for everyone, but is this accurate?

- Likely different groups have different VSL (eg. Young vs. old)
- Bush administration tried to do this in 2002, but met large push back

Morality of putting a dollar value on life

- As economists we know there are tradeoffs between risk and money that people make everyday

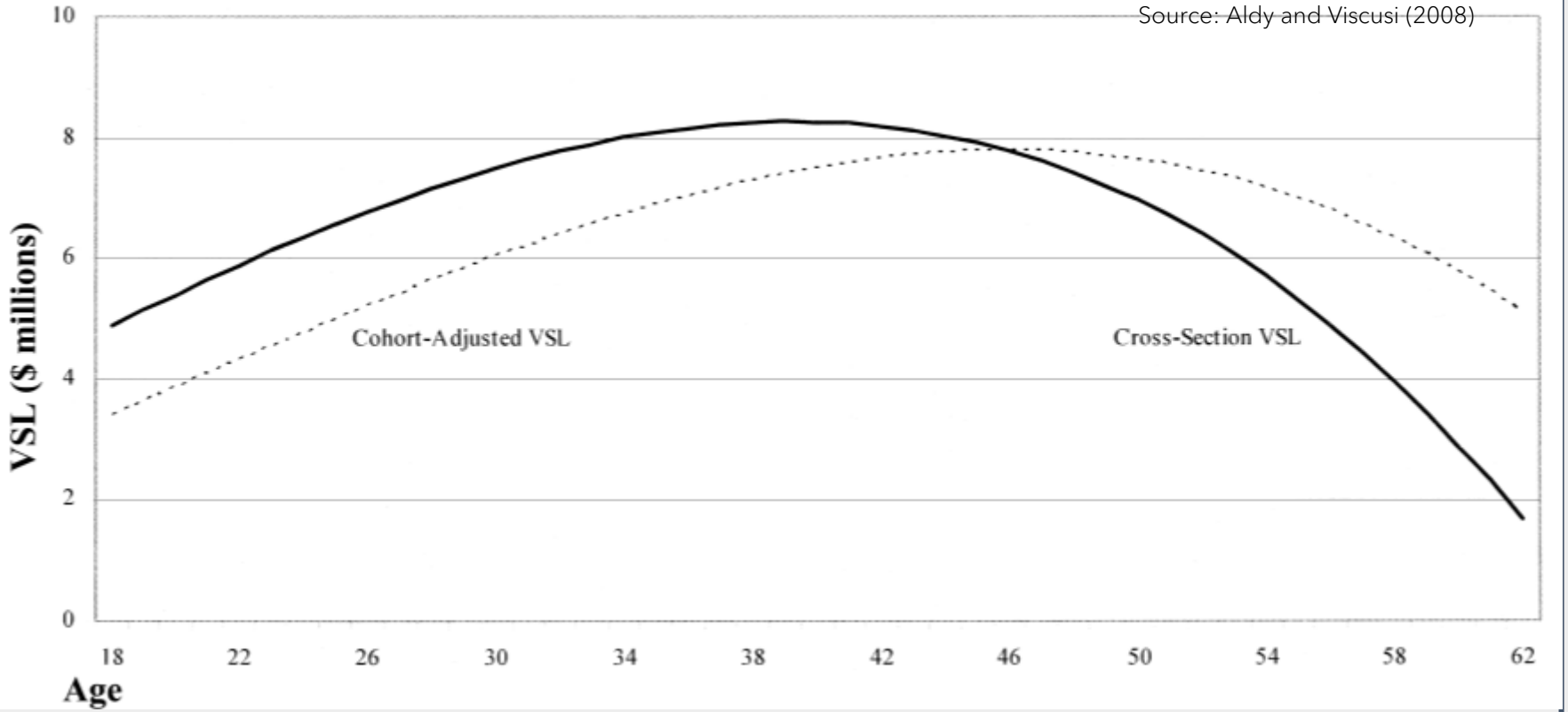
ATTENDANCE ACTIVITY

Suppose you estimate the mean WTP to reduce the risk of death by 1/10,000 is $0.12/hr.

Assuming the average worker works 2,000 hours per year, what is the estimated VSL?

If the workers in the sample are ages 20-50, do you think this estimate is an over- or under-estimate of the VSL for the general population?

ATTENDANCE ACTIVITY



QUESTION OF THE DAY

Why do garbage collectors get paid more than teachers?

- Compensating wage differential

Garbage Truck Driver Salaries in Atlanta, GA Area

1 Salary Updated Feb 18, 2012

Industries | Select your opti... | Select your opti...

To filter salaries for Garbage Truck Driver in Atlanta, GA Area, **Sign In** or **Register**.

Average Base Pay

$57,696 / yr

Not enough reports to show salary distribution

$58K Low $58K High

Teacher Salaries in Georgia

34,494 Salaries Updated Jun 8, 2020

Industries | Select your opti... | Select your opti...

To filter salaries for Teacher in Georgia, **Sign In** or **Register**.

Average Base Pay

$42,579 / yr

$31K Low $43K Average $60K High

STATED PREFERENCE METHODS

TAXONOMY OF METHODS:

	Observed/Revealed Values	Stated/Hypothetical Values
Direct Method (Directly observe value)	Market prices	Contingent Valuation
Indirect Method (have to infer value)	Travel Cost Models Hedonic Models Averting Behavior Models	Choice Experiments

02

CONTINGENT VALUATION

HOW DOES CONTINGENT VALUATION WORK?

Contingent Valuation is a Survey Method (also called “stated preferences”)

- Describe situation
- Describe change in situation (intervention)
- Describe payment vehicle
- Ask WTP

It’s a hypothetical survey – but directly elicits WTP

Importantly, it can measure **non-use values**

STEPS OF CONTINGENT VALUATION ANALYSIS

1. Clearly define the good/service and the change to be valued
   - Eg. Oil spill at a beach (values: beach recreation, biological diversity, water pollution)
2. Identify scope of "market"
   - Focus groups and pretest surveys
3. Administer survey to random sample
   - Response rate and sample representation
4. Test reliability and validity of results
   - Check potential sources of bias
5. Use elicited WTP to construct demand curve and benefits

CV SURVEY COMPONENTS

Respondent information
- Personal characteristics (age, sex, race, income, etc.)
- Relation to good/service (have they used it, do they use it, do they plan to use it)

Background
- Describe clearly the good/service
- Describe change to be valued

Payment vehicle
- Describe payment vehicle (tax, fee, price, etc.)
- Relation to good/service (have they used it, do they use it, do they plan to use it)

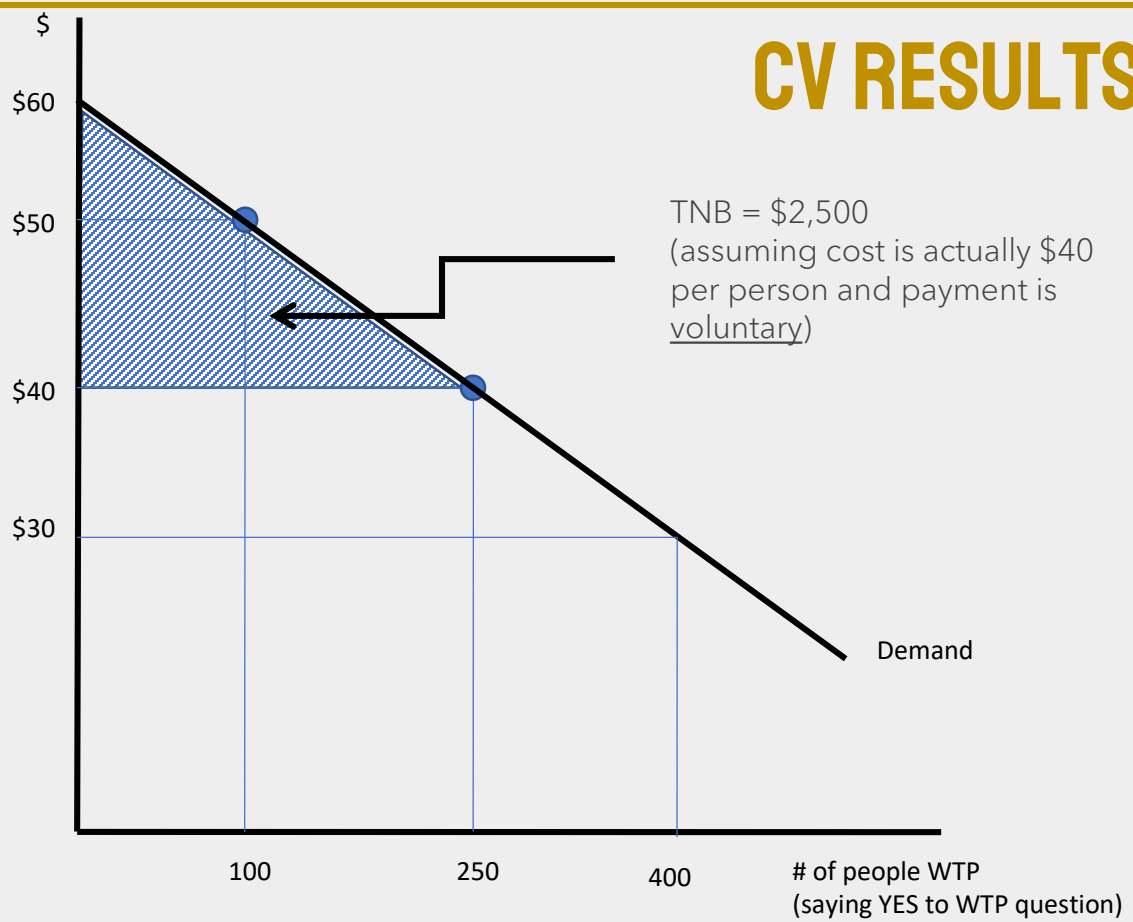
Elicit WTP
- Ask WTP
- Ask yes/no WTP question
- Step process ($1, $2, etc.)

CV RESULTS

Survey elicits WTP
- Get Q at multiple P's

Thus, we can trace out a demand curve directly!

So, what is the total net benefit if cost is $40 and payment is voluntary?



CV RESULTS

What if payment is not voluntary
- Think of a tax

Say you survey 500 households and compute the avg. WTP for each quintile.

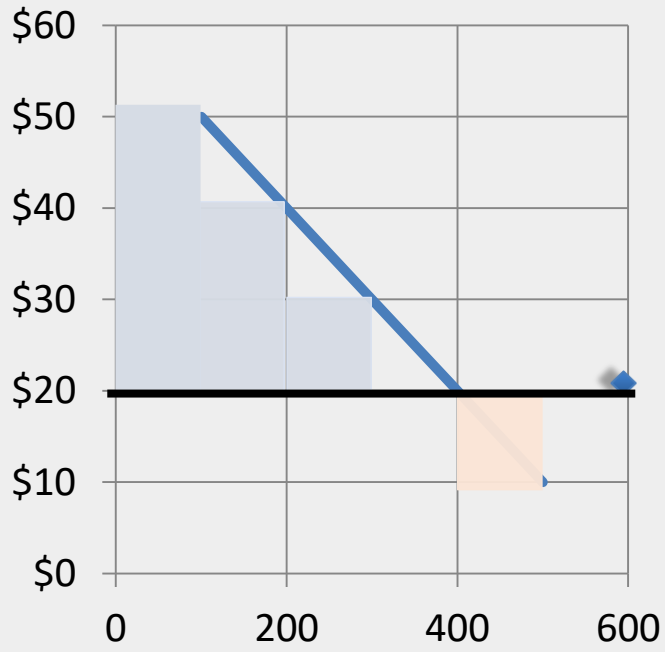
Say to implement the policy requires a tax of $20.

What is the net benefit for the households?

= $30x100+$20x100
+$10x100+$0x100+$-10x100
= $5,000

If there are 10 million households in the "market"

TNB = $5,000/500x10 million
= $100 million



CONTINGENT VALUATION METHOD EXAMPLE: BP OIL SPILL

BP OIL SPILL

Deepwater Horizon by the Numbers

- **3.19 million barrels (134 million gallons)** of oil released into the ocean.
- **15,300 square miles:** the maximum extent of the oil slick on a single day (June 19, 2010)—an area 10 times the size of Rhode Island.
- **43,300 square miles:** cumulative extent of the surface slick during the course of the spill—an area approximately equal to the size of Virginia.
- **At least 1,300 miles** of shoreline fouled by oil—more than the distance by road from New Orleans to New York City.
- **1.84 million gallons** of chemical dispersant used.

STEP I: DEFINE PROBLEM

Step 1: Injury Determination

In this step, the Trustees evaluated whether the *Deepwater Horizon* incident injured natural resources or impaired their ability to provide services. This part

Step 2: Injury Quantification

In this step, the Trustees determined the severity, geographic extent, and duration of the injuries and service losses that occurred. To do this, the Trustees compared the injured natural resources and services with baseline conditions—that is, the condition that would have existed if the *Deepwater Horizon* incident had not occurred.

A heavily oiled, small juvenile Kemp's ridley turtle rescued by response workers.

What Is Injury?

According to the regulations associated with the Oil Pollution Act, injury is: **"An observable or measurable adverse change in a natural resource or impairment of a natural resource service. Injury may occur directly or indirectly to a natural resource and/or service."**

Types of injuries can include (but are not limited to) adverse changes in survival, growth, and reproduction; health, physiology, and biological condition; behavior; community composition; ecological processes and functions; physical and chemical habitat quality or structure; and public services.

All of these types of injury occurred as a result of the *Deepwater Horizon* incident.

STEP I: DEFINE PROBLEM

Injury Quantification

The Trustees quantified injuries to bottlenose dolphins in four bay, sound, and estuary areas: Barataria Bay, the Mississippi River Delta, Mississippi Sound, and Mobile Bay. The Barataria Bay bottlenose dolphin stock was one of the most severely injured populations: the *Deepwater Horizon* oil spill caused a 35-percent increase in death, a 46-percent increase in failed reproduction, and a 37-percent increase in adverse health effects to Barataria Bay bottlenose dolphins, compared with a healthy population. These injuries are estimated to result in up to a 51-percent decrease in the Barataria Bay dolphin population, which will require approximately 39 years to recover from the effects of the *Deepwater Horizon* oil spill without any active restoration.

For <u>each</u> component of the entire eco-system, Trustees conducted injury determination and injury quantification

A female bottlenose dolphin in Barataria Bay, Louisiana, in 2013, supporting her dead calf, her second failed pregnancy in 2 years.

STEP 2+3+4: IDENTIFY SCOPE AND ADMINISTER RANDOM SURVEY

Surveyed a nationally-representative random sample of American adults

Provided background information about incident and impact

Proposed a tax to pay for a program that would prevent a similar accident in the next 15 years

Randomly assign each respondent a different tax value: $15, $65, $135, $265, $435

STEP 5: ELICIT WTP

The study was designed to capture each component of total values.

Lost ecosystem service values (use)
- Recreational values

- Lost ecosystem service values (market)
  - Relatively easier to quantify
    - Lost market value due to fisheries (including oysters/shrimp) closures
    - Lost market value due to decreased landings/productivity of fisheries post-oil spill until recover

- Lost ecosystem service values (nonuse)

Injury descriptions, tax amounts influence program support

For each injury description, support for the program declines as the tax increases, consistent with the first test for consistent decisions. For each tax amount, support for the program increases as the set of injuries increases, consistent with the second test.

Smaller set of injuries

TAX AMOUNT	$15	$65	$135	$265	$435
Sample size	368	370	368	371	356
Percent for	52.2	43.5	35.6	28.3	24.2

Larger set of injuries

TAX AMOUNT	$15	$65	$135	$265	$435
Sample size	364	377	366	356	360
Percent for	57.7	48.8	38.0	34.6	28.1

Source: Richard C. Bishop et al. (2017)

CONTINGENT VALUATION OVERVIEW

CONTINGENT VALUATION

Can capture non-use values

Flexible in application

Can be used to elicit peoples willingness-to pay for anything!

So why don't people use CV all the time?

- Expensive
- Bias

SIX TYPES OF BIAS IN CV METHODS

1. Information bias
2. Hypothetical bias
3. Strategic bias
4. Payment vehicle bias
5. Starting-point bias
6. WTP and WTA discrepancy

INFORMATION BIAS

If I have little experience with the good/service it can be hard to put a value on it

- May substitute with close experience
- May be entirely based on false perception
- Positive bias

Provide comprehensive detail

HYPOTHETICAL BIAS

If I believe the scenario is contrived

- May respond casually
- May not fully think through responses
- Positive bias

Make scenarios realistic (eg. reasonable tax rates, reminders about personal budget constraint)

If I know the results of the survey will impact policy I may answer strategically

- May respond artificially high knowing you will only pay portion
  - Free-riding problem
- May respond artificially high to be seen in favorable light
- Positive bias

Referendum format

If I have feelings about the choice of payment vehicle

- If I dislike the payment vehicle (eg. tax) I may respond artificially low
- Negative bias

Follow up questions

STRATEGIC BIAS

PAYMENT VEHICLE BIAS

STARTING-POINT BIAS

If my response is influenced by the values presented

- May anchor response to initial value
- Eg. range of $0-100 vs. $10-$100

Referendum format

WTP AND WTA DISCREPANCY

If I am asked about WTP vs. WTA I may give a different response

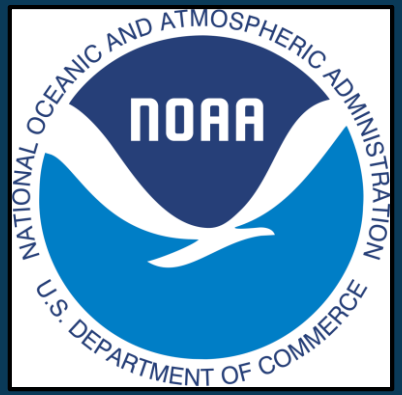
- WTP is constrained by income
- WTA>WTP

STATE OF CONTINGENT VALUATION

Economists (and psychologists) are working to identify direction of biases and develop methods to minimize bias

NOAA panel recommendations:

- Pretesting survey
- Face-to-face interviews
- Clear scenario descriptions
- Referendum-type WTP questions
- Reminders about personal budget constraint
- Follow up questions



WHAT IF WE DIDN'T ASK WTP DIRECTLY, BUT INSTEAD ASKED PREFERENCE BETWEEN SCENARIOS?

03

CHOICE EXPERIMENTS

TAXONOMY OF METHODS:

	Observed/Revealed Values	Stated/Hypothetical Values
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CONTINGENT VALUATION SURVEYS VS. CHOICE EXPERIMENT SURVEYS

Contingent valuation survey

- asking yes/no WTP questions
- flat-out asking "How much are you WTP?"

CV is a direct method for eliciting WTP

Choice experiment survey

- Provide a set of alternatives that vary in their attributes and prices
- Ask respondents to pick which they prefer

CE is an indirect method for eliciting WTP

we don't observe a dollar value, but rather we infer what the value must be based on observed choices (very similar to the hedonic method)

CE EXAMPLE : OFFSHORE WIND IN NC

Proposals to build offshore wind turbines in NC

- Turbines are 50 stories high
- Technically visible up to 30 miles from shore
  - Practically, visible 10-15 miles or so.
- Lit at night, flashing in unison every 2-3 seconds
- Utility scale farm likely to be over 100 turbines

Question: How would visitors to coastline react to change in viewshed?

(Source Lutzeyer et al., 2017)

OCEANFRONT EXAMPLE

8 bedrooms

$12,500 to
$15,875 *per week*

100% occupancy
during summer
peak season

OCEANFRONT EXAMPLE

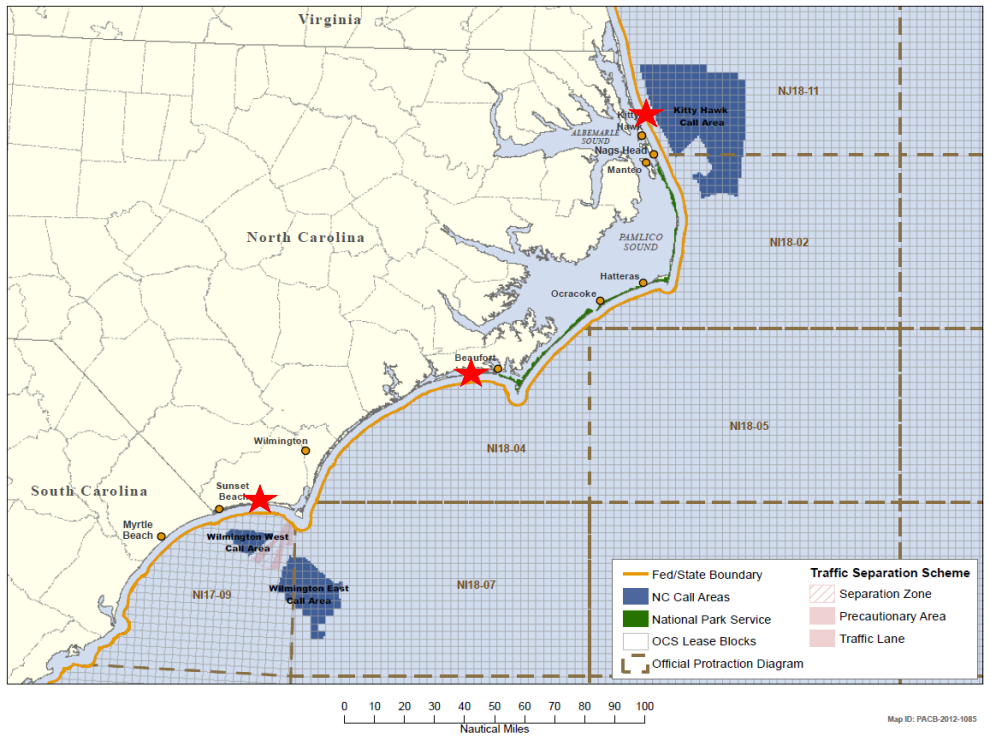
How might deployment of wind farms of **various sizes and distances** affect visitors' utility & the rental market?

VACATION RENTAL SURVEY

Partnered with rental agencies in three locations:

Surveyed **actual renters** in January 2012 about their summer 2011 rental

792 surveys mailed
484 returned
61% response rate



CHOICE EXPERIMENT DESIGN

Attributes and Attribute Levels:

- Turbines 5, 8, 12 and 18 miles from shore
- 64, 100, or 144 turbines
- Rental price changes:
  +5%, 0%, −15%, −20%, −25%

Percentages converted to dollars for survey

CHOICE EXPERIMENT DESIGN

Choice task:

"Imagine you are considering re-renting the house you recently rented…"

Rank three options from best (=1) to worst (=3):

→ View A + rent change 1
→ View B + rent change 2
→ status quo

All options include 144 turbines, only the number visible varies!
(This includes the status quo)

- 5 MW turbines are 50 stories tall
- Perimeter lit at night
  (flash in unison each 3 seconds)
- Technically visible 30 miles out to sea

SAMPLE CHOICE QUESTION

Choice 1: Imagine you are re-renting your beach house. Please rank the following scenarios with a 1, 2 and 3 in order of your preference (1= Most preferred, 3= Least preferred). Use each number only once.
Remember, 144 turbines are always built – only the number visible from shore varies across scenarios.

____ **Scenario 1A:** 100 turbines visible at 8 miles & rent increased by $120.
____ **Scenario 1B:** 144 turbines visible at 18 miles & no rent change.
____ **Baseline view:** No turbines are visible from shore & no rent change.

Scenario 1A: This view from the beach closest to your house & a **$120 increase in rent**

Scenario 1B: This view from the beach closest to your house & **no change in rent**

SUMMARY OF RESULTS

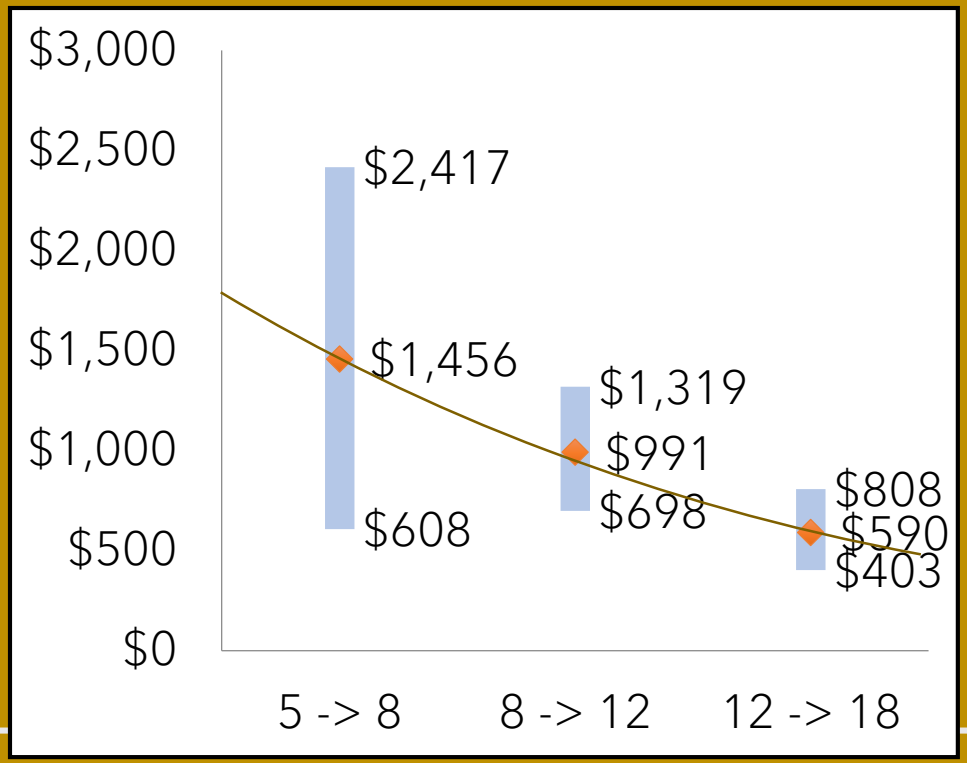
54% would not re-rent the house if visible turbines were constructed in front of their last rental

26% would require substantial reductions to be induced to re-rent in a location with turbines

20% are indifferent to the view, requiring only small discounts with the largest visual impact (if that)

DISCRETE CHOICE EXPERIMENTS

WTP to move turbines further from shore:



RESULTS

What is the benefit of having developers move a 144 turbine farm from 5 miles to 8 miles from shore?

Use rental price losses from survey and apply them to homes impacted by view.
{rental price @ 8 miles} – {rental price @ 5 miles} = benefit

Benefits = $31 million over a 20 year period.

Costs = <$1 million per mile for cabling – so potential to pass a benefit/cost test.

STATED PREFERENCE METHODS IN REVIEW

Pros:

- It is the only method we have to estimate non-use values.
- Flexible in application (can elicit WTP of anything!)

Cons:

- Expensive
- Many sources of bias

CE helps relieve some of the biases in contingent valuation studies by asking respondents to make a familiar choice.

- CE acts more like a market where consumers are presented with a choice (bundle)
- CE can also introduce new sources of bias

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Explain and calculate VSL

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