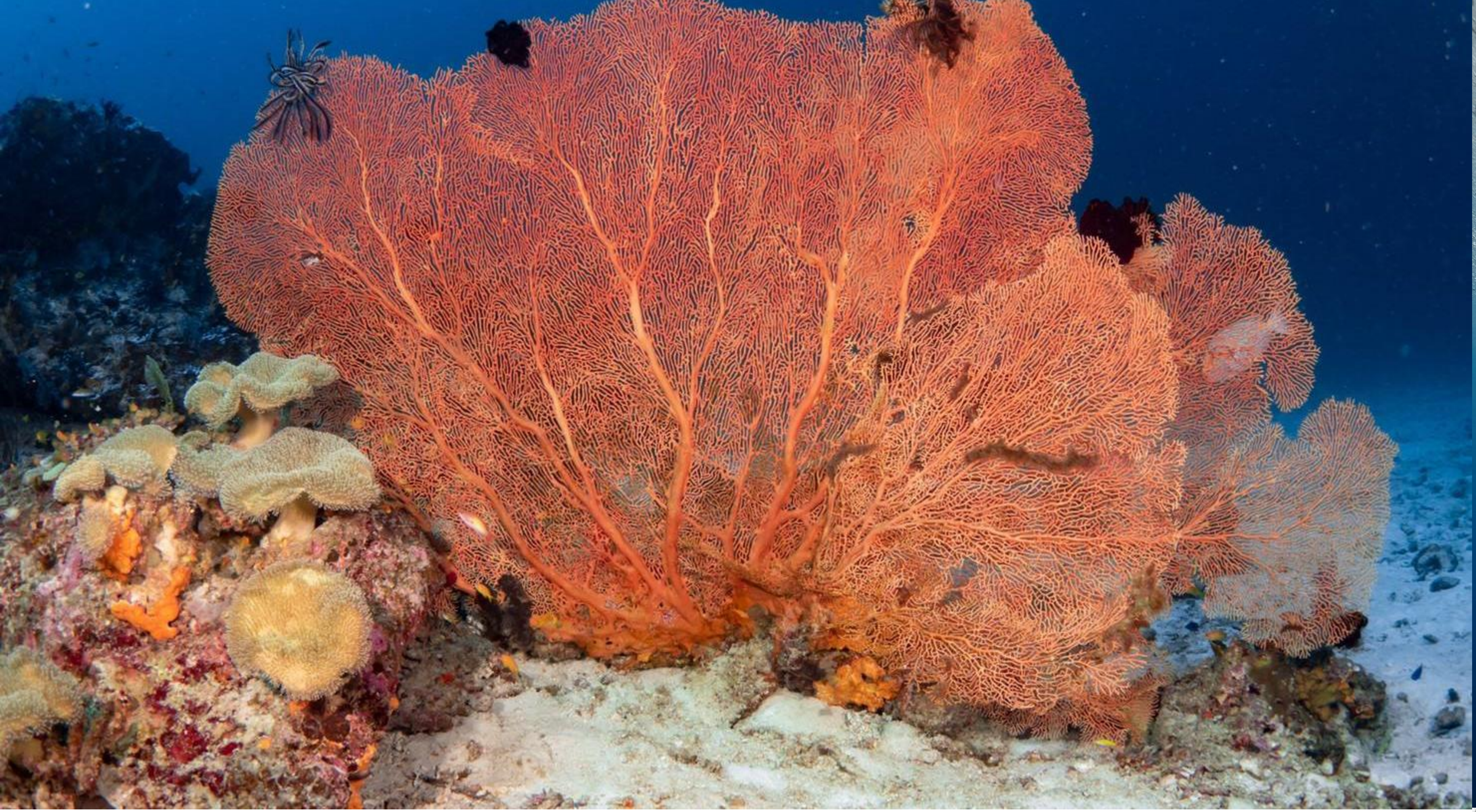
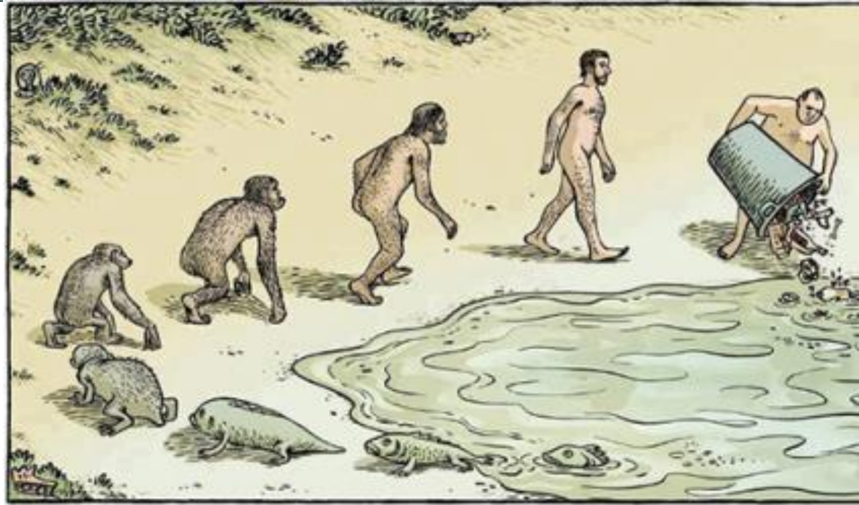


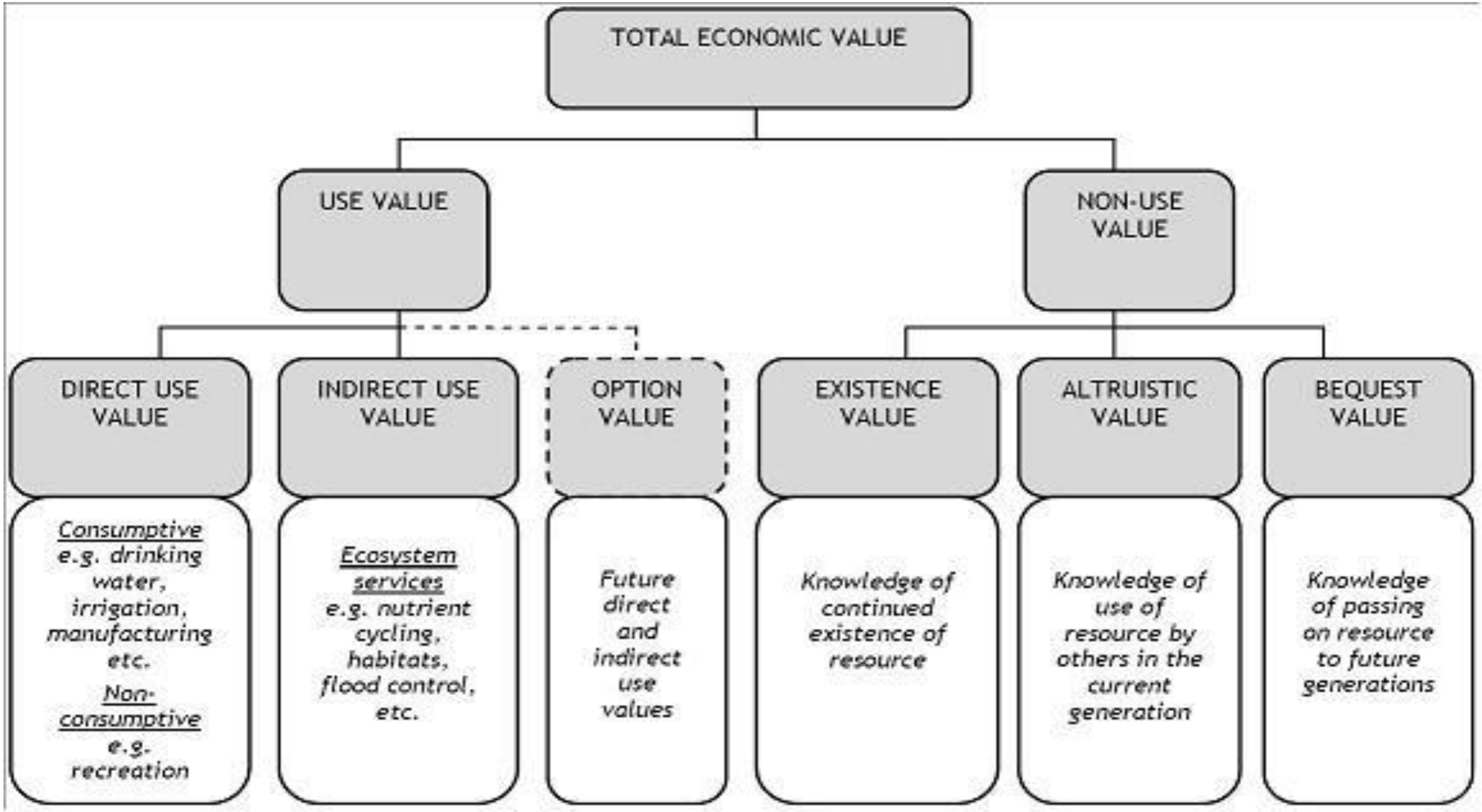


EE476
Environmental Economics

Lecture Non Market Valuation 2

2022

Total Economic Value



Valuation method	Relevant forest benefits	Strengths and weaknesses
Market prices: Use data from surveys of producers and consumers, adjusted if necessary to account for seasonal variation, value added processing and/or public policy distortion.	Price-based valuation is commonly applied to NTFPs which are partly or informally traded, in order to estimate subsistence and/or unrecorded consumption.	Market prices clearly reflect consumer preferences, but often need adjustment to account for public policy distortions or market failures. Aggregation or extrapolation of values based on potential production is not valid unless account is taken of likely price effects (elasticity of demand).
Surrogate markets: 1) Travel cost-use survey data on direct costs (e.g. fares, accommodation) and, in some cases, opportunity costs of time spent travelling to and from a site, evaluated at some fraction of the average wage rate. 2) Hedonic pricing-use statistical methods to correlate variation in the price of a marketed good to changes in the level of a related, non-marketed environmental amenity 3) Substitute goods-use market prices of substitutes for non-marketed benefits and level (or quality) of output of a marketed good/service	1) Travel cost is often used to estimate demand for forest recreation at specific locations. Related methods used mainly in developing countries estimate the value non-marketed, NTFPs in terms of the opportunity cost of time spent collecting and/or processing them. 2) Hedonic pricing is used to estimate the impact of proximity to forested land and/or logging on the prices of residential and commercial property 3) Substitute goods approaches may be used wherever close market substitutes for non-timber benefits exist. The effect of logging on hunting, downstream water users, fisheries and climate.	1) Provided the relation between the benefit being valued and the surrogate market is correctly specified, and prices in the surrogate market are not very distorted (e.g. by policy intervention), such methods are generally reliable. 2) Travel cost estimates may need to account for various objectives (benefits) in a single trip. 3) Hedonic pricing requires large data sets, in order to isolate the influence of a non-market benefit on market price, relative to other factors.
Stated preference: 1) Contingent valuation method-use consumer surveys to elicit hypothetical individual willingness-to-pay for a benefit, or willingness-to-accept compensation for the loss of that benefit 2) Contingent ranking/focus groups-use participatory techniques in group setting to elicit preferences for non-market benefits, either in relative terms (ranking) or in monetary terms.	1) Recreation values are often estimated using contingent valuation. 2) Stated preference methods such as Contingent Valuation Method (CVM) are the only generally accepted way to estimate non-use values, e.g. landscape or biodiversity values, for which price data do not exist and/or links to marketed goods cannot easily be established. Contingent ranking may be used where target groups are unfamiliar with cash valuation.	1) Contingent valuation estimates are generally considered reliable if strict procedural rules are followed. 2) Participatory valuation techniques are more experimental and not widely used to estimate non-market forest benefits. They are good at eliciting qualitative or “contextual” information, but there are doubts about their reliability for estimating willingness to pay.
Cost-based approaches: Uses data on the costs of measures taken to secure, maintain and/or replace forest goods and services.	Cost-based approaches include replacement/relocation cost, defensive expenditure and opportunity cost analysis; may be used (with caution) to value any type of forest benefit.	Cost-based approaches are usually considered less reliable than other methods. One test of validity is evidence that people are prepared to incur costs to secure relevant benefits

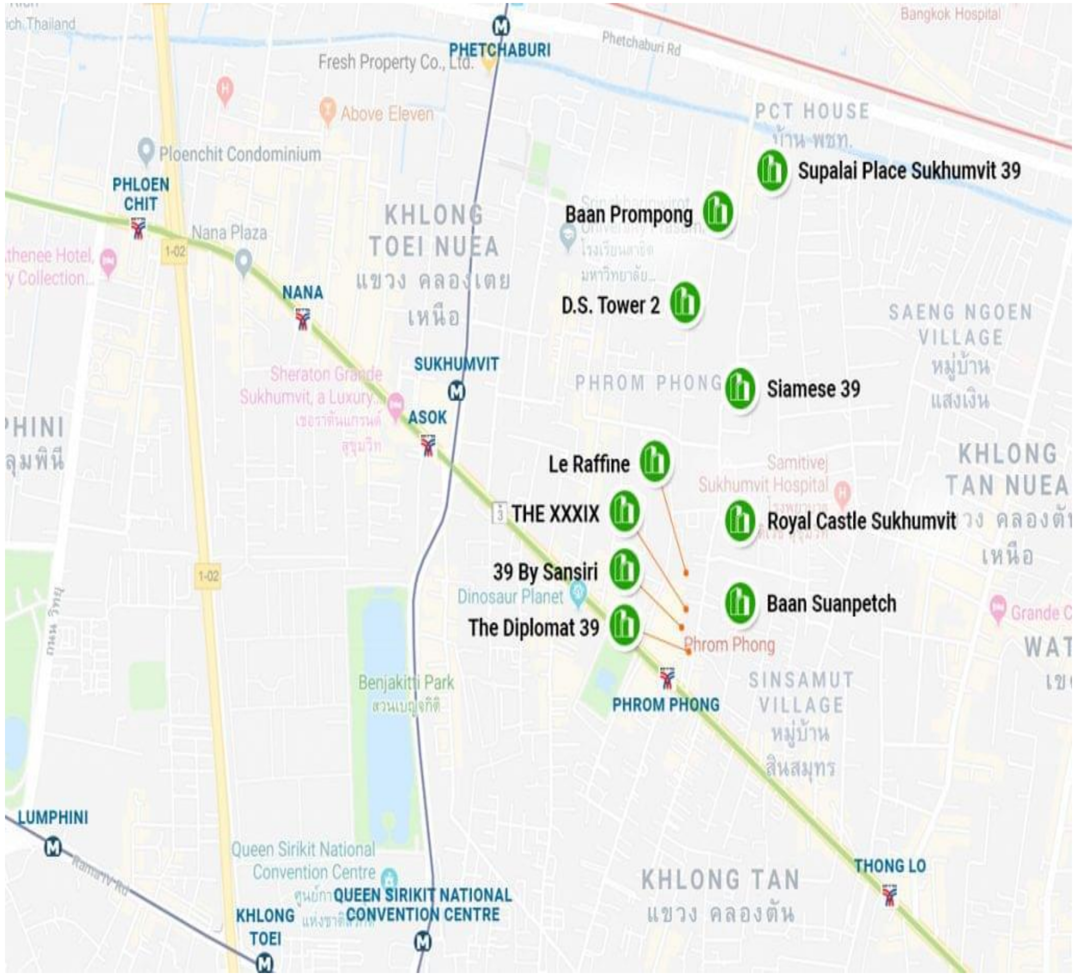
Source: Adapted from Bishop (1999).

Hedonic pricing method

- Hedonic price analysis is a revealed preference method
- the method seeks to isolate the contribution that environmental quality makes to the total market value of an asset (but could also be used for analysis impacts on wages)
- A limitation of the hedonic pricing method is that it focuses on direct use values and not on non-use values of the environment.

House is a composite good

- The composite good has a price, but there is no explicit price for each characteristic that compose the good.
- Hedonic prices are identified through a comparison of similar goods that differ for the quality of one characteristic
- The price difference between houses that have different levels of environmental quality, keeping constant all other characteristics, reflects the WTP for the different level of environmental quality
  - variation in environmental quality affects the price of housing
  - we can assess the value of an environmental quality, according to market prices of residential properties



Example: Air quality

THE DETERMINANTS OF RESIDENTIAL PROPERTY VALUES
WITH SPECIAL REFERENCE TO AIR POLLUTION

Ronald G. Ridker and John A. Henning *

- Ridker, Henning (1967) “The determinants of property values with special reference to air pollution” Review of Economics and Statistics.
- No residential properties sale prices, but census tract data from St. Luis, 1960.
- Dependent variable: median value of property prices
- Independent variables: median characteristics of houses in a census tract, quality of schooling, access to highway, neighbourhood characteristics, tax levels, public services
- Air quality measured by index indicating the presence of (SO_2)

Results (some variables)

Variables	Coefficient	Standard Error
Air pollution	**-245.0**	88.1
Rooms	488.5	41.1
Distance from city centre (minutes)	320.2	138.7
New buildings (%)	48.36	7.20
Access to highway (dummy)	922.5	278.9
Number of persons in a house	-3210.0	548.7
Median income per family	0.937	0.1057

Linear model

$$p_i = \alpha + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki} + \varepsilon_i \qquad \frac{\partial p}{\partial x_1} = \beta_1$$

- House price falls by 245US$ if pollution is present
- Ridker and Henning estimate the environmental damage of air pollution in St. Louis to be 82 million dollars ➔ need to compare this estimate with the cost of a public program to clean pollution

Example : Water quality

Evidence of the Effects of Water Quality on Residential Land Prices[1]

Christopher G. Leggett and Nancy E. Bockstael[2]

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Received June 2, 1998; revised July 27, 1999

- Leggett and Bockstael (2000) Journal of Environmental Economics and Management
- Effects of Chesapeake Bay water quality on prices of houses located along the bay
- Rather than using the characteristics of houses (rooms, bathrooms, etc.), Leggett and Bockstael use the appraised value of houses.
- Water quality is measured using information on the level of pollution of the bay publicly given by the Department of Health of Maryland

Descriptive Statistics

Variable	Description	Units	Min	Max	Mean	Std. Dev.
PRICE	Market price	$(1,000s)[a]	66.26	2081.98	378.54	263.01
VALSTRUCT	Assessed value of structure	$(1,000s)[a]	1.01	1187.29	125.29	103.55
ACRES	Lot size	acres	0.05	14.25	0.68	1.06
DISTBALT	Distance to Baltimore	miles	8.66	51.88	26.82	8.28
DISTANN	Distance to Annapolis	miles	0.31	28.98	12.27	7.04
%HIDENS	Percentage of land within 3/4 mile that is densely developed		0.00	0.41	0.04	0.07
%LODENS	Percentage of land within 3/4 mile that is developed at very low density		0.00	0.62	0.18	0.13
%WATER	Percentage of land within 3/4 mile that is water or wetlands		0.02	0.79	0.34	0.18
%OPEN	Percentage of land within 3/4 mile that is open space or forests		0.00	0.72	0.20	0.13
%COMMUTE	% of residents in census block group who commute out of county		0.08	0.55	0.29	0.10
PUBSEWER	= 1 if residence served by public water and sewer		0	1	0.48	0.50
DISTNPDES	Distance to nearest industrial NPDES site	miles	0.54	27.16	11.13	6.04
DISTMARINA	Distance to nearest marina with at least 20 boat slips	miles	0.00	3.04	0.83	0.67
DISTSEWAGE	Distance to nearest sewage treatment plant	miles	0.14	7.53	3.10	1.73
FECAL	Median fecal coliform concentration in year of sale[b]	counts per 100mL	10.48	1762.10	107.66	148.00

Parameter Estimates with (a) Market Price as Dependent Variable (in $1000s) and (b) Market Price Minus Value of Structure as Dependent Variable (in $1000s)[a]

Variable	Linear	Double-log	Semi-log	Inverse semi-log
		(a)		
Intercept	314.3462***	6.9587***	5.8256***	1077.8241**
	(7.1726)	(8.2533)	(50.0512)	(2.5647)
VALSTRUCT	1.7049***	0.4633***	0.0033***	185.7188***
	(41.4026)	(32.8698)	(29.7540)	(26.4339)
ACRES	84.3291***	0.1876***	0.2000***	112.6566***
	(9.9447)	(12.3270)	(8.8815)	(14.8492)
$ACRES^2$	−5.2583***	0.0121	−0.0148***	27.0001***
	(−5.7802)	(1.4662)	(−6.1383)	(6.5443)
DISTBALT	−7.7216***	−1.0196***	−0.0120***	−498.7033***
	(−4.5047)	(−4.0679)	(−2.6319)	(−3.9918)
DISTANN	−14.1511***	−1.0546***	−0.0369***	−426.6366**
	(−5.3605)	(−3.1244)	(−5.2570)	(−2.5360)
DISTBALT × DISTANN	0.4927***	0.2716***	0.0009***	118.7157**
	(5.0992)	(2.6694)	(3.5188)	(2.3408)
DISTBALT × %COMMUTE	−12.6627***	−0.1747***	−0.0330***	−54.4763***
	(−6.4048)	(−4.1389)	(−6.2815)	(−2.5891)
%HIDENS	361.0751***	0.4177**	0.4609**	324.4381***
	(4.5958)	(1.9992)	(2.2089)	(3.1150)
%LODENS	46.2638	0.1485	−0.0424	85.1355*
	(1.2598)	(1.6332)	(−0.4352)	(1.8785)
%WATER	262.1082***	0.6480***	0.5244***	296.6985***
	(8.0089)	(7.9240)	(6.0332)	(7.2793)
%OPEN	74.0476*	0.2927***	0.0932	92.9062*
	(1.8138)	(2.8627)	(0.8592)	(1.8232)
PUBSEWER	−1.6808	−0.0226	−0.0270	−4.6720
	(−0.1812)	(−1.0327)	(−1.0952)	(−0.4283)
Inv(DISTNPDES)	−135.6700***	−0.1359***	−0.5050***	−55.8996***
	(−4.4614)	(−3.4487)	(−6.2531)	(−2.8460)
Inv(DISTMARINA)	0.2612	0.0266***	0.0008	6.7999
	(1.1698)	(2.8683)	(1.3007)	(1.4684)
Inv(DISTSEWAGE)	5.4157	−0.0409**	−0.0072	6.5000
	(0.5819)	(−2.2054)	(−0.2911)	(0.7036)
FECAL	−0.0511*	−0.0002***	−0.0002**	−0.0803**
	(−1.8160)	(−2.6755)	(−2.4959)	(−2.1265)
N	1183	1183	1183	1183
R^2	0.7581	0.7333	0.6894	0.6362

WTP

Evidence of the Effects of Water Quality on Residential Land Prices[1]

Christopher G. Leggett and Nancy E. Bockstael[2]

Department of Agricultural and Resource Economics, University of Maryland, College Park, Maryland 20742

Received June 2, 1998; revised July 27, 1999

- Using linear model estimates. the presence of fecal coliform is equal to -0.052 dollars per 1,000 dollars of the value of the house
- Suppose fecal coliform increase from 109 (average value) to 159:
- The welfare change is equal to: (159-109)*(-0.052) = -2.6
- This means that a person that is buying a house is willing to pay $2,600 more to avoid the increase in the concentration of fecal coliform.

Example: Green spaces

Table 3: Property prices and areas of green and blue spaces within 200 meters

	Log(Price)			
	(1)	(2)	(3)	(4)
Small functional green space within 200m	-0.0409***	0.0059***	0.0066***	**0.0053***
	(0.0024)	(0.0012)	(0.0012)	(0.0010)
Medium functional green space within 200m	-0.0440***	0.0059***	0.0069***	0.0060***
	(0.0026)	(0.0013)	(0.0013)	(0.0011)
Large functinoal green space within 200m	-0.0335***	0.0116***	0.0127***	0.0107***
	(0.0028)	(0.0014)	(0.0014)	(0.0011)
Very large functional green space within 200m	-0.0102***	0.0161***	0.0170***	**0.0145***
	(0.0034)	(0.0017)	(0.0017)	(0.0014)
Small blue space within 200m	0.0269***	0.0097***	0.0091***	0.0093***
	(0.0029)	(0.0015)	(0.0015)	(0.0012)
Medium blue space within 200m	0.0262***	0.0104***	0.0099***	0.0102***
	(0.003)	(0.0016)	(0.0016)	(0.0013)
Large blue space within 200m	0.0113***	0.0107***	0.0106***	0.0126***
	(0.0034)	(0.0017)	(0.0017)	(0.0014)
Very large blue space within 200m	-0.0069	0.0269***	0.0269***	0.0358***
	(0.0045)	(0.0025)	(0.0025)	(0.0023)
Small area of natural land cover within 200m	-0.1127***	-0.0373***	-0.0365***	-0.0335***
	(0.0176)	(0.0139)	(0.0137)	(0.0093)
Medium area of natural land cover within 200m	-0.1171***	-0.0464***	-0.0471***	-0.0411***
	(0.0177)	(0.0139)	(0.0138)	(0.0094)
Large area of natural land cover within 200m	-0.1157***	-0.0489***	-0.0498***	-0.0418***
	(0.0178)	(0.0139)	(0.0138)	(0.0094)
Very large area of natural land cover within 200m	-0.1077***	-0.0494***	-0.0506***	-0.0439***
	(0.0179)	(0.014)	(0.0138)	(0.0094)
MSOA	Yes	Yes	Yes	Yes
Acorn	No	Yes	Yes	Yes
Distance to other amenities	No	No	Yes	Yes
House characteristics	No	No	No	Yes
Observations	2,628,660	2,628,660	2,628,660	2,626,103
R2	0.3667	0.7199	0.7231	0.8048
Adjusted R2	0.3666	0.7199	0.723	0.8047
Residual Std. Error	0.5010 (df = 2628423)	0.3332 (df = 2628361)	0.3313 (df = 2628344)	0.2781 (df = 2625781)

* p less than 0.1.
** p less than 0.05.
*** p less than 0.01.

$$\ln\left(\text{price}_{i,t}\right) = \text{env}_i \beta + hc_{i,t} Y + n_i \delta + year_{i,t} \lambda + \varepsilon_i$$

- env_i is a vector of environmental characteristics, and in our main specification includes area of natural cover, blue spaces and functional green spaces within a 200 metre radius of the property
- $\text{hc}_{i,t}$ contains structural characteristic variables
- n_i include distance to amenities other than green and blue spaces such as transport

- Our primary focus is on the estimation of β , a vector of coefficients indicating how areas of green and blue spaces are associated with the log of house prices. The coefficients can be interpreted as semi-elasticities and represent the percentage change in property prices associated with the presence of green space, natural land cover or bluespace within a certain radius of the property and its size.
- E.g. (4) that the presence of a small FGS within 200 metres is associated with a rise in property price of 0.5%. The presence of a very large FGS within 200 metres is associated with a rise in property price of 1.5%.

Example

- Using model (4), we conclude that in the absence of green and blue spaces property prices in Great Britain would be £4,813 lower and this reflects the value of services provided by green and blue spaces.
- By multiplying this figure by the number of residential properties (27.2 million), we obtain an estimate of £130.9 billion for the stock value of blue and green spaces.
- It must be noted however that this estimate relies on the assumption that the sample used is representative of the property stock, which may not be the case. For example, small starter homes sell much more frequently than other types of property and therefore will be over-represented in the data. It also assumes that the value implicit in property price is the same in Northern Ireland.

Value of Statistical Life

- Suppose that the amount people are willing to pay to eliminate a risk of death of 1/10,000 is $700. This amount can be converted into a value of statistical life estimate in one of two ways.

1. First, consider a group of 10,000 individuals facing that risk level. If each of them were willing to contribute $700 to eliminate the risk, then one could raise a total amount to prevent the statistical death equal to ten thousand people multiplied by $700 per person, or $7 million.
2. An alternative approach to conceptualizing the risk is to think of the amount that is being paid per unit risk. If we divide the willingness to pay amount of $700 by the risk probability of one in ten thousand, then one obtains the value per unit risk. The value per statistical life is $7 million using this approach as well.

Estimating the VSL

$$\ln\left(w_{i,j,k}\right) = \alpha + \beta p_{i,j,k} + X_{i,j,k}\Gamma + u_{i,j,k}$$

- for worker i in industry j and occupation k
- Dependent var is the natural logarithm of the real wage,
- p is the work-related fatality rate, and
- X is a vector with both demographic control variables (such as age and education) and other job characteristic variables (such as non-fatal injury risk, workers' compensation insurance coverage, and industry and occupation indicators) with associated coefficient vector Γ.
- $u_{i,j,k}$ is an error term whose stochastic properties are reflected in regression coefficients' estimated standard errors.

Estimating the VSL

THE VALUE OF A STATISTICAL LIFE: EVIDENCE FROM PANEL DATA

Thomas J. Kniesner, W. Kip Viscusi, Christopher Woock, and James P. Ziliak*

$$\ln\left(w_{i,j,k}\right) = \alpha + \beta p_{i,j,k} + X_{i,j,k}\Gamma + u_{i,j,k}$$

- In the typical semi-log wage equation above the estimated coefficients are the proportionate change in the wage per one unit change in the independent variable of interest, which means that $\hat{\beta}$ estimates $\left(\frac{\partial w}{\partial p}\frac{1}{w}\right)$.
- So, in the case of the typical fatality risk measure of deaths per 100,000 workers, a wage rate that is average hourly earnings, and a typical work year that is h hours, the value of a statistical life is calculated as VSL = $\left(\hat{\beta} \times w\right) \times h \times 100{,}000$ It is common to compute the average value of the VSL using $w = \bar{w}$ and h = 2000, the typical work year, or $h = \bar{h}$
- Using the formula for the VSL just presented the mean VSL for U.S. men is about $7 million to $8 million in $2001 (Kniesner, Viscusi, Woock, & Ziliak, 2012).

Southern Economic Journal 2002, 69(2), 266–289

The Market Value of Reducing Cancer Risk: Hedonic Housing Prices with Changing Information

Ted Gayer,* James T. Hamilton,† and W. Kip Viscusi‡

- Gayer, Hamilton, and Viscusi (2000) estimate a house price equation that reveals an implicit price of cancer avoidance by buyers. In particular, they use risk and individual house price data from an area surrounding a Superfund Hazard site near Grand Rapids, Michigan, to estimate the connection between house prices and environmentally based cancer risk. In the period following the EPA's release of the health hazard information, a 1.81/1,000,000 reduction in cancer risk (the mean level in their data) raised the average house price there by about \$34 (\$2017 based on Box-Cox estimates). Taking into account the average number of household members of about 2.6, the per person value of reducing one cancer is about \$7.2 million (\$2017), which is the implicit VSL.
- $34 \div \left(\frac{1.81}{1{,}000{,}000}\right) \div 2.6 = 7.2m$

Averting behaviour and defensive expenditures method

- Households installing double-glazed windows to decrease exposure to road traffic noise
- Jenkins, Owens and Wiggins (2001) look at the US market for bicycle helmets which significantly reduce the wearer's risk of death as a result of head injury.
- The authors use this insight as the basis for estimating the (implied) value of a statistical life for the typical helmet wearing bicycling child. This is defined as the (annualised) cost of the helmet divided by the change in the probability of death due to the purchase of the helmet.

VALUING REDUCED RISKS TO CHILDREN: THE CASE OF BICYCLE SAFETY HELMETS

ROBIN R. JENKINS, NICOLE OWENS, and LANELLE BEMBENEK WIGGINS*

- Jenkins et al.'s study estimated that the value of a statistical life for US children aged 5 to 9 years old was roughly USD 2.9 million in 1997.
- The annualised cost of a helmet is about USD 6.50.
- Wearing helmets when cycling most (but not all) of the time amongst this age group results in about 32 fewer deaths.
- Given that the 5 to 9 year old bicycle riding population was about 14.3 million in 1997, this gives an annual fatal risk reduction of 0.0000024: i.e. 32/14.3 million (or 1 in 446 875).
- The value of a statistical life for the typical 5 to 9 year old child of bicycle helmet purchasing parents is calculated as USD 6.50/0.0000024 or USD 2.9 million.

Averting behavior and air quality in Los Angeles

- Individuals might change their behavior in costly but perhaps less obvious ways in order to avoid an adverse impact on their well-being.
- Freeman et al. (2014) use the example of an individual who spends additional time indoors to avoid exposure to outdoor air pollution. In this case, the allocation of time to avoiding a non-market bad (i.e. the risk of adverse health impacts like asthma attacks, or coughing and sneezing episodes) is typically not observable and the substitute item is itself a non-market good (i.e. time that could have been used more productively).
- Nevertheless, the avoidance costs of spending time indoors could be evaluated by asking people directly about their time-use. Moreover, time use has a market analogue in the form of wages that would be paid to an individual if the time spent indoors could otherwise be spent working