

Research in Applied Econometrics

Chapter 2. Valuation Theory

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M1 APE Analyse des Politiques Économiques
M1 RISE Gouvernance des Risques Environnementaux

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Outline

Economic Theory of Value

Social Use of Economic Values

Utility

- ▶ **Value** is a word heavy with multiple meanings
 - ▶ In economics, there is a meaning as “price”
 - ▶ But also, when it refers to individuals, a formal meaning :
 - ▶ The difference in expenditures to reach a certain “welfare” with or without the thing we intend to value
- ▶ There are 2 approaches, that are dual
 - ▶ That is, 2 sides of the same idea
 - ▶ Utility-based and Expenditure-based

Utility theory

- ▶ Recall that individual's preferences
 - ▶ For anything from apple to social justice
 - ▶ Can be represented by a Utility function $U(\cdot)$
 - ▶ That has certain properties
 - ▶ and depends on quantities x of goods & services
- ▶ Individuals behave as if they are maximizing such function
 - ▶ Under a budget constraint $px \leq y$
 - ▶ p is the vector of prices (some of these prices are fictitious)
 - ▶ y is income (that comes, among others, from labour, so it is endogenous, but we take y as exogenous)
- ▶ Individual's choices lead to "optimal" demands $x(p, y)$
 - ▶ That have mathematical properties

Duality theory

- ▶ Plugging such demands in the utility function
 - ▶ Leads to the **Indirect Utility Function**

$$V(p, y) = \max U(x) \mid px \leq y$$

- ▶ But we can also look the income that would be needed
 - ▶ to achieve such utility level
 - ▶ given preferences $U(\cdot)$ and prices p
 - ▶ This is the **Expenditure Function**

$$E(p, U) = \min px \mid U(x) \geq U$$

- ▶ The Duality Identity

$$y \equiv E(p, v(p, y))$$

shows that the 2 approaches are equivalent

Values from Prices

- ▶ John Hicks, a famous economist,
 - ▶ asks a straightforward question
 - ▶ *What change in income would be equivalent to a given change of the vector of prices p ?*
- ▶ “Equivalent” means here “at the same level of utility”
 - ▶ Clearly the answer(s) must depend on individual preferences
 - ▶ So on $U(\cdot)$
 - ▶ But it also depends on the **reference point**
 - ▶ Before or after the prices change?

Hicksian Measures of Value

COMPENSATING VARIATION of a **price change** from p_0 to p_1

- ▶ Reference Utility : *initial* p_0
- ▶ $CV(p_0, p_1)$
 - ▶ $= E(p_1, V(p_0, y)) - E(p_0, V(p_0, y)) = E(p_1, V(p_0, y)) - y$
 - ▶ s.t. $V(p_1, y + CV) = V(p_0, y)$

EQUIVALENT VARIATION

- ▶ Reference Utility : *final* p_1
- ▶ $EV(p_0, p_1)$
 - ▶ $= E(p_1, V(p_1, y)) - E(p_0, V(p_1, y)) = y - E(p_0, V(p_1, y))$
 - ▶ s.t. $V(p_1, y) = V(p_0, y - EV)$

Hicksian Measures of Value

- ▶ Are the standard notions of value in applied economics
 - ▶ Other measures lack a similar fundamental construction
- ▶ So economic value
 - ▶ is about (individual) utility
 - ▶ the value is the (individual) conversion of a price change in an income change
 - ▶ is NOT a price or a cost
 - ▶ is NOT financial or accounting
 - ▶ May be purely immaterial, no actual (or future) transaction is required to define a value

Non-market Values

Hicksian Measures of an environmental change

- ▶ Let z the “level” of environment (quality...)
 - ▶ Public good, pollution, externality
 - ▶ States of the world : wealth distribution, justice, equity...
 - ▶ All that is non-market
- ▶ Issues
 - ▶ Commensurability
 - ▶ Is the environment really amenable to a single quality index measure ?
 - ▶ e.g. what is air “quality” what pollutants? How do you combine them ?
 - ▶ Measurement, actually getting proper data
 - ▶ Substitutability : can people actually compare coffee and whales ?

Non-market Values

- ▶ Insert z in the previous functions
 - ▶ $V(p, z, y)$ Indirect Utility & $E(p, z, U)$ Expenditure
 - ▶ Simplify notation : remove p
 - ▶ Since we will not discuss changes of prices
 - ▶ $V(z, y)$ Indirect Utility & $E(z, U)$ Expenditure

Non-market Values : definitions

- ▶ COMPENSATING VARIATION (Reference Utility = *initial* z_0)
 - ▶ $CV(z_0, z_1)$
 - ▶ $= E(z_0, V(z_0, y)) - E(z_1, V(z_0, y)) = y - E(z_1, V(z_0, y))$
 - ▶ s.t. $V(z_1, y - CV) = V(z_0, y)$
 - ▶ Improvement z_0 to $z_1 \Rightarrow$ Willingness To Pay to secure it (+)
 - ▶ Deterioration z_0 to $z_1 \Rightarrow$ Compensation To Support it (-)
- ▶ EQUIVALENT VARIATION (Reference Utility = *final* z_1)
 - ▶ $EV(z_0, z_1)$
 - ▶ $= E(z_0, V(z_1, y)) - E(z_1, V(z_1, y)) = E(z_0, V(z_1, y)) - y$
 - ▶ s.t. $V(z_1, y) = V(z_0, y + EV)$
 - ▶ Improvement z_0 to $z_1 \Rightarrow$ Compensation To Support it (+)
 - ▶ Deterioration z_0 to $z_1 \Rightarrow$ Willingness To Pay to avoid it (-)

Compensating or equivalent : Which one to use ?

- ▶ Property rights
- ▶ Compensating Variation : right to level z_0
 - ▶ Improvement z_0 to $z_1 \Rightarrow$ Willingness To Pay to secure it (+) :
The person must “buy” z_1
 - ▶ Deterioration z_0 to $z_1 \Rightarrow$ Compensation To Support it (-) :
Compensate the person for the deterioration
- ▶ Equivalent Variation : right to level z_1
 - ▶ Improvement z_0 to $z_1 \Rightarrow$ Compensate the person to forfeit the improvement (-)
 - ▶ Deterioration z_0 to $z_1 \Rightarrow$ To avoid the deterioration, the person must “buy” z_0 (+)

Nonmarket Values

- ▶ As for the change in prices : the values are not limited to “financial” ones (price, cost, flows...)
- ▶ In a public sector context, no transaction is necessary
 - ▶ e.g. a collectivity decides to set aside part of its forests w/o exploitation
 - ▶ Since the owner is the collectivity, it does not have to pay itself for the un-realized sale of wood
 - ▶ its members do not have to “buy” the ecological services that they obtained in return
 - ▶ It is true that they forfeit the revenue from the sale of woods, this indicates that their value is at least as high
- ▶ Nonmarket Values are also not opportunity costs
 - ▶ Or differences of commercial / industrial / agricultural yields

Nonmarket Values

- ▶ WTP are limited by the individual budget
 - ▶ \implies in this sense, they represent a capacity to pay
 - ▶ There is an interpretation in terms of public finance : the budget that a collectivity could levy to finance the environmental corresponding to the WTP
 - ▶ \implies Other things equal, with the utility function, a rich person's WTP will be higher than a poor's
 - ▶ So that the rich person's "opinion" will weight more in the collectivity budget
- ▶ WTP and compensations are expressed in money
 - ▶ They are thus comparable between individuals and can be added
 - ▶ Usually not the case w/ non-economic notions of value

Understanding the sources of economic value : a typology

| Source | Example in a forest context |
|---|--|
| Direct Consumptive Use (private goods) | Hunting and gathering products Wooden products / Cultivation |
| Direct Recreational Use (public goods) | Hunting and gathering practices Hiking / Nature watching |
| Indirect/functional Use | Water : Filter / Flood protection Air : Filter / Fixing carbon Soil : Erosion / Desertification Landscape |
| Option | Use : Preserve future / 3rd party use Quasi-use : Value of information |
| Non-use | “Patrimonial” : Existence & Heritage “Moral” : Role of humanity wrt nature, Non-human rights |

Outline

Economic Theory of Value

Social Use of Economic Values

Public **Cost-Benefit Analysis** CBA

- ▶ Should a certain public project should be pursued ?
 - ▶ e.g. should we renovate Part-Dieu ? build a dam ?
 - ▶ What are the indirect or non-market benefits/cost ?
- ▶ This can be very difficult
 - ▶ The project may span many years, have many uncertainties
 - ▶ There maybe losers and gainers
- ▶ This is currently a burgeoning industry
- ▶ CBA is frequently used in business
 - ▶ But a business measures project according to the net revenue they generate
 - ▶ In the end, this is about sales generated
 - ▶ So the question of eliciting non-market values does not exist

CBA as a Social Decision Rule

- ▶ Inform (public) decision-makers
 - ▶ By quantifying benefits & costs
 - ▶ Associating them to socio-economic profiles
 - ▶ e.g. is a certain project beneficial to the poor or to the rich people?
 - ▶ via econometric analysis
- ▶ Legal Contexts
 - ▶ Western countries legislation require evermore often that large public projects demonstrate that their benefits $>$ their costs
 - ▶ Including all non-market benefits (or costs)
 - ▶ EU Directives
 - ▶ e.g. Water Framework Directive (“Cadre Eau”)
 - ▶ US “Acts”
 - ▶ e.g. Clean Air Act epa.gov/oar/sect812/

French Guidelines (Valeurs tutélares) for Transport ¹

- ▶ Context of road infrastructure, mainly
- ▶ Value of Statistical Life VSL (VVS) : 3 M€ 2010
 - ▶ Value of a Year of Life VYL (VAV) : 115 000 € 2010
 - ▶ Value of a seriously injured : 15 % of VSL, 450 000 € 2010
 - ▶ Value of a lightly injured : 2 % of VSL, soit 60 000 € 2010
- ▶ Value of carbon
 - ▶ Value 2013 : 32 € 2010/tCO₂
 - ▶ Value 2030 : 100 € 2010/tCO₂
- ▶ Value of time depends on
 - ▶ Motive (professional, holiday...)
 - ▶ Distance (urban, <20km, 20-80km, ...)
 - ▶ Mode
- ▶ Multiples values in transport sector : Environment, noise...

1. Commissariat général à la stratégie et à la prospective, L'évaluation socioéconomique des investissements publics , www.strategie.gouv.fr, sept. 2013

French Guideline Values for Water

| | Min-Max de la Valeur économique (en € ₂₀₀₈ /ha/an) issue des 15 études françaises ¹ | Nombres d'études concernées | Valeur économique moyenne (en € ₂₀₀₈ /ha/an) selon la méta-analyse de Brander et al. (2003) à partir de 89 sites |
|---|---|-----------------------------|---|
| | | | |
| Epuration de l'eau | 15-11300 | 4 | 272 |
| Soutien des étiages | 45-150 | 3 | 42 |
| Lutte contre les inondations | 37-617 | 6 | 438 |
| Activités récréatives pêche, chasse..) | | | |
| • Pêche | 80-120 | 2 | 353 |
| • Chasse | 230-330 | 2 | 116 |
| • Navigation/plaisance | 15 | 1 | pas évalué |
| • Canoë/kayak | 28 | 1 | pas évalué |
| Valeur sociale | 200-1600 | 7 | 392 |
| Total des services rendus (en euros 2008/ha/an) | <i>(650-14160)</i> 907-3132 | | 1613 |

Commissariat général au développement durable, Service de l'économie, de l'évaluation et de l'intégration du développement durable. Études & documents n°23 juin 2010

Environmental Public Goods Examples

- ▶ Improve air or (surface) water quality
- ▶ Risks reduction
 - ▶ Contaminants in tapwater, in food (incl. GMO)
 - ▶ Transports
 - ▶ Job-related accidents
- ▶ Protect/restaure natural areas (wetlands, forests, rivers, beaches...), endangered species

Non-environmental Examples

- ▶ Improve public education, health services quality
- ▶ Basic services in developing countries
 - ▶ Water or electricity distribution, garbage collection de déchets...
- ▶ Medical and health care research
- ▶ Food research e.g. WTP for new food
- ▶ Culture
 - ▶ Protect / restaure cultural heritage sites
 - ▶ Value of a museum, an art company,...

Damages (dommages & intérêts) : Accidental Pollution

- ▶ The other domain in which economic values are used
- ▶ French “dommages environnementaux”
 - ▶ Fairly new, relatively small amounts
- ▶ US Damages
 - ▶ Routine, the EPA sues several times a year

Database of valuation studies : www.evri.ca

4000+ records
Benefit Transfert



Department
for Environment
Food & Rural Affairs



Australian Government
Department of Sustainability, Environment,
Water, Population and Communities



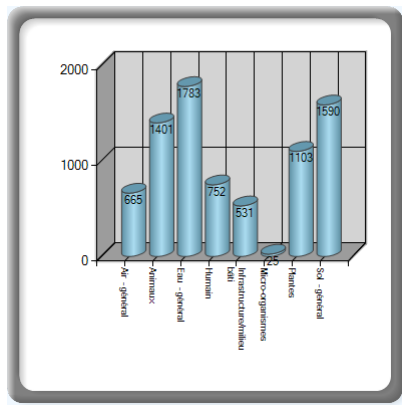
Ministry for the
Environment
Manatū Mō Te Taiao



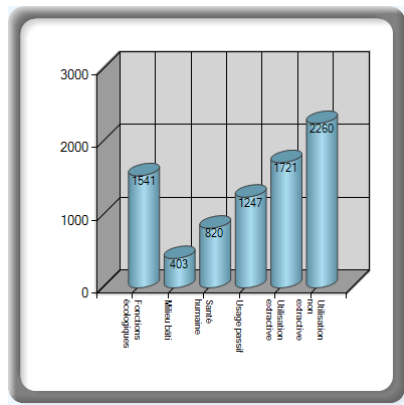
Environment
Canada

Environnement
Canada

EVRI by asset and by use

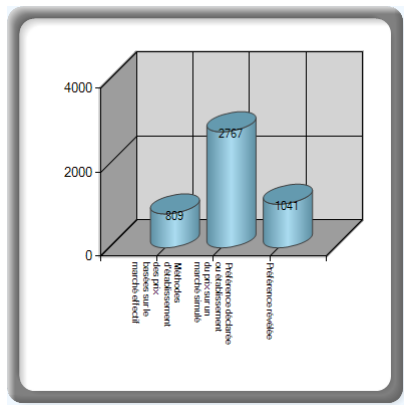


By environmental asset

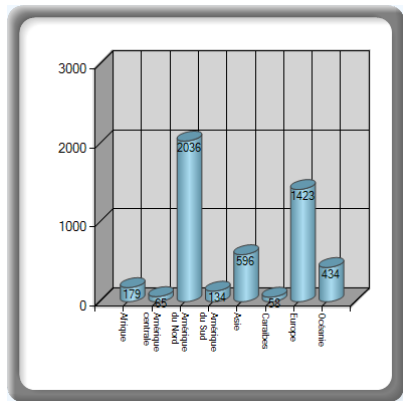


By environmental use

EVRI by technique & area (older data)



By valuation technique



By continents

To conclude on economic value

- ▶ Economic value
 - ▶ Defined for market and non-market goods and services
 - ▶ Following ecological or social functions (see the Forest example)
 - ▶ Individualistic (depends on preferences)
 - ▶ in a public finance context
 - ▶ Quantitative
 - ▶ But we will see that estimation may suffer many biases
- ▶ Its context is
 - ▶ CBA, to inform decision-makers
 - ▶ Damages