Valuation of ecosystem services and ecosystem assets

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Outline

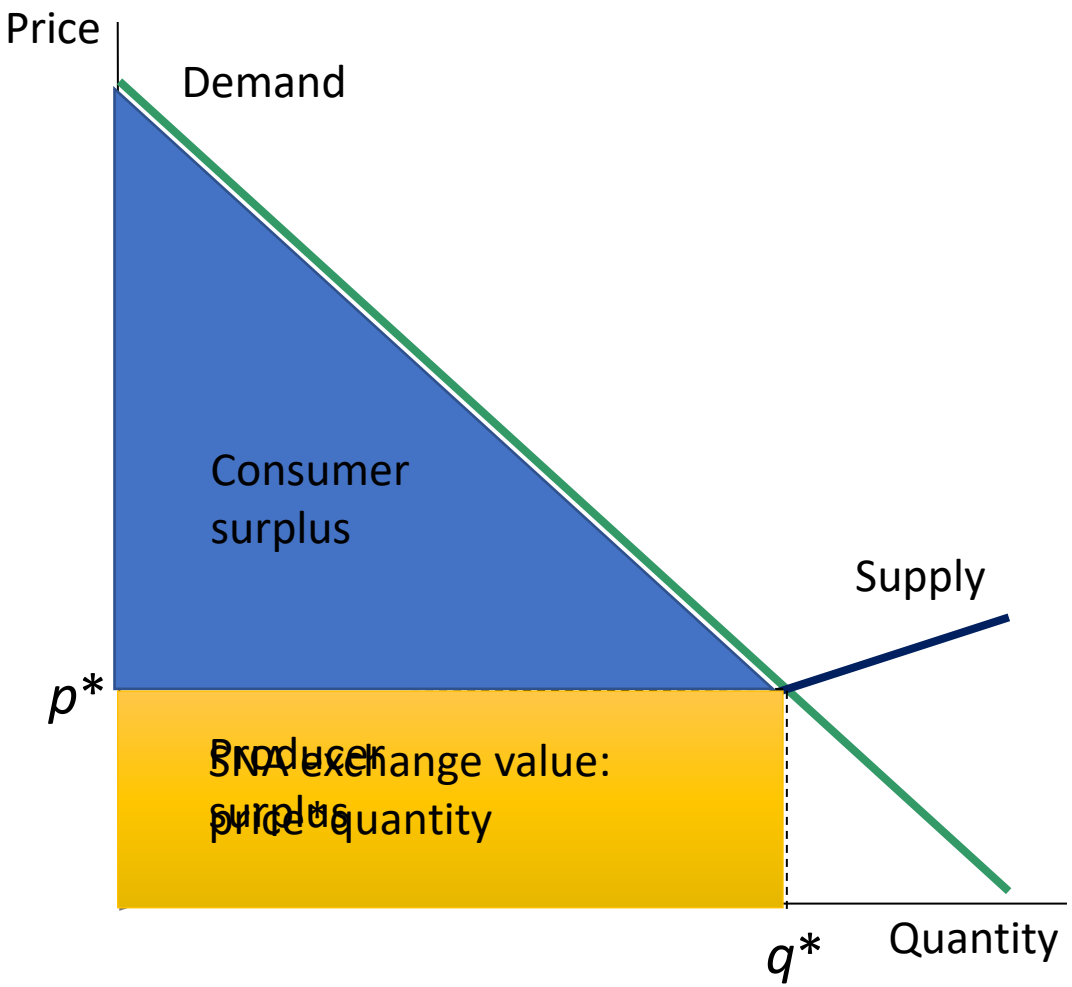
1. Why is valuation important?
   - Is any number better than no number?
2. Consumer surplus and exchange values
   - Consumer surplus as a measure of welfare
   - Consumer surplus and the SNA, comparing apples and oranges
   - Extending the SNA, looking for “uncontroversial” values for nature
3. Monetary valuation for ecosystem services in the SEEA
   - Focus on use and the contribution of nature
   - Methods proposed in SEEA to value ecosystem services
4. Monetary valuation of ecosystem assets in the SEEA
   - Discounting

Why is valuation important?

- Zero is a particularly poor estimation of the “monetary value of nature”, or the contribution of nature (ecosystem service)
- Is any number better than no number?
  - “Any” number can be worse
- Look of “relatively uncontroversial numbers”
  - Based on well-established methods
  - Provide “minimum” values
  - Focus on ‘use’, not ‘potential’
  - Focus on use and ‘exchange values’

Consumer surplus

- Welfare economics evaluates the benefits realised by two agents from participating in an exchange by adding up the buyer's *consumer surplus* (that is, the difference between her maximum WTP and the price) and the seller's *producer surplus* (that is, the difference between the price and her minimum WTA).
- As in a real economy there are many buyers and sellers, the needs and wants of the buyers are represented through a demand curve. The compensations required by sellers are represented by a supply curve,



Ecosystem services

- Ecosystem services as contribution of nature
- Irrespectively of the method used, man-made inputs need to be deducted to arrive at the ecosystem service (as resource rent).
- Following the SEEA Central Framework:

Output (consumption final products)`
less intermediate consumption
less compensation of employees
less other taxes on production
plus other subsidies on production
less consumption of fixed capital (depreciation)
less return on produced assets
less labour of self-employed persons
Equals resource rent

Monetary valuation in SEEA EA

- SEEA Ecosystem Accounting adopted in March 2021
  - Chapters 1-7 with conceptual framework and physical accounts as *statistical standard*
  - Chapters 8-11 recognized as describing *internationally recognized statistical principles and recommendations* for the valuation of ecosystem services and assets in a context that is coherent with the concepts of System of National Accounts
  - Requested the Committee to resolve the outstanding methodological aspects in chapters 8–11 as identified in the research agenda:
    - Connections to complementary valuations of ecosystem services and ecosystem assets
    - Ongoing alignment with the SNA …

Valuation ES: Methods proposed in SEEA EA

- Prices are directly observable
  - Market prices for apples, but also for PES
- Prices from similar markets
  - Similar markets, mushrooms or carbon sequestration
- Prices embodied in market transactions
  - Residual valued
  - Hedonic pricing
  - Productivity change
- Prices from revealed expenditure or related goods and services
  - Averting behaviour
  - Travel cost method
- Prices from expected expenditures and simulated markets
  - Replacement costs
  - Avoided damage costs
  - Simulated exchange values

Directly observed values

- SNA: observed price for apples, tomatoes
- Payments for ecosystem services (PES) may provide a direct measure of the value of ecosystem services
- Prices from emission trading systems which may be used to estimate prices for global climate regulation services based on carbon retention.
  - The number of countries with such trading systems is increasing, as is the quantity of carbon being traded and hence these markets may provide suitable price data.
  - If the trading system is not considered sufficiently mature, an alternative is to use data on the marginal costs of abatement or data on the social cost of carbon when derived from models that are consistent with the exchange value concept, i.e., limited to assessment the effects on measures of output.

Prices from similar markets

- Following the SNA, *"Generally, market prices should be taken from the markets where the same or similar items are traded currently in sufficient numbers and in similar circumstances. If there is no appropriate market in which a particular good or service is currently traded, the valuation of a transaction involving that good or service may be derived from the market prices of similar goods and services by making adjustments for quality and other differences"* (2008 SNA, para. 3.123).
- For example, when non-wood forest products (e.g., mushrooms) from one forest are marketed but those from a similar forest are not, the prices observed in the former can be used to value the non-wood forest products from the latter, allowing for differences in products and other factors.
  - In applying this method, the price from the similar market will need to be adjusted for any costs incurred to supply the good or service to ensure the price used refers to the ecosystem service.
  - It is assumed that the flows of (non-marketed) ecosystem services (in this example the harvest of mushrooms) are not significant enough such that they would alter the observed price of, and demand for, the good or service from the similar market.
  - *"Note also that prices from similar markets will reflect prices of the existing institutional context in the same way as the directly observed values method."*

Prices embodied in market transactions

- Residual value and resource rent methods
  - In most cases, combined with market prices and markets from similar markets
  - “Ecosystem service” is generally not traded, thus need to deduct man-made inputs

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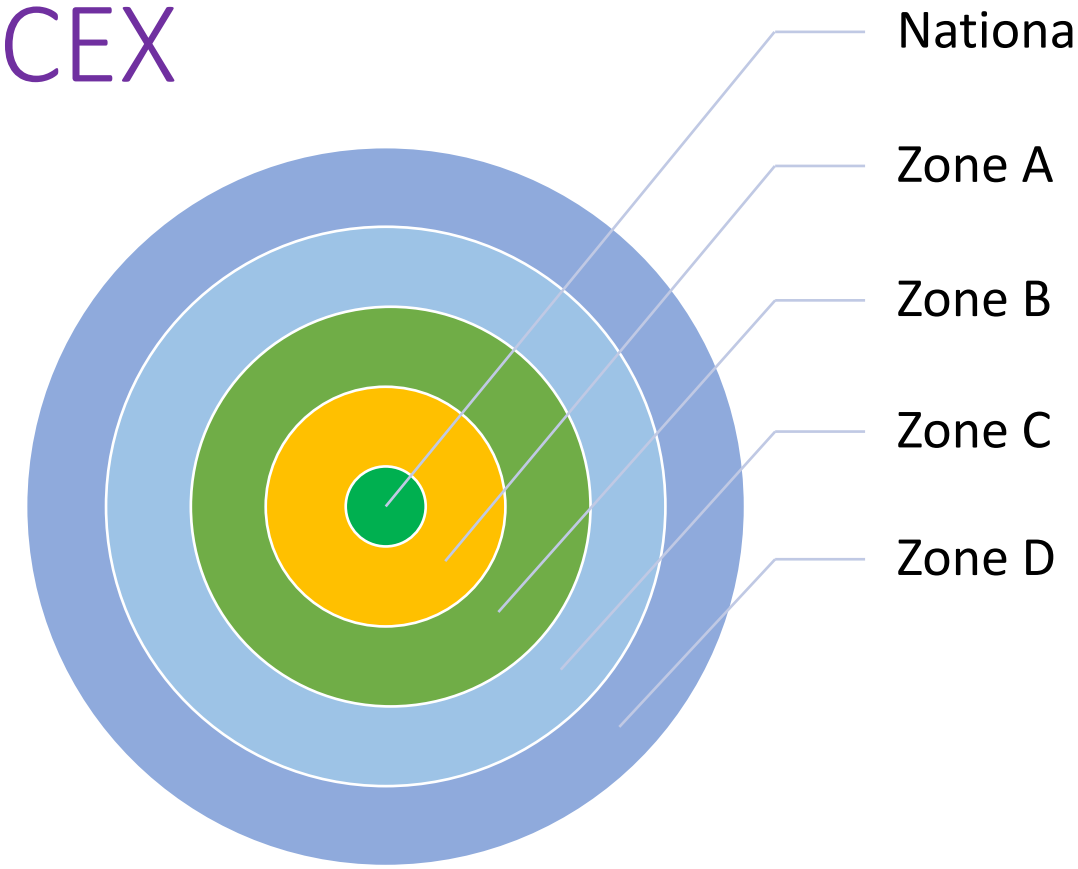
- Hedonic pricing:
  - Contribution of nature to house prices

Example: nature based recreation

Prices from revealed (expected) expenditure on related goods and services and simulated markets

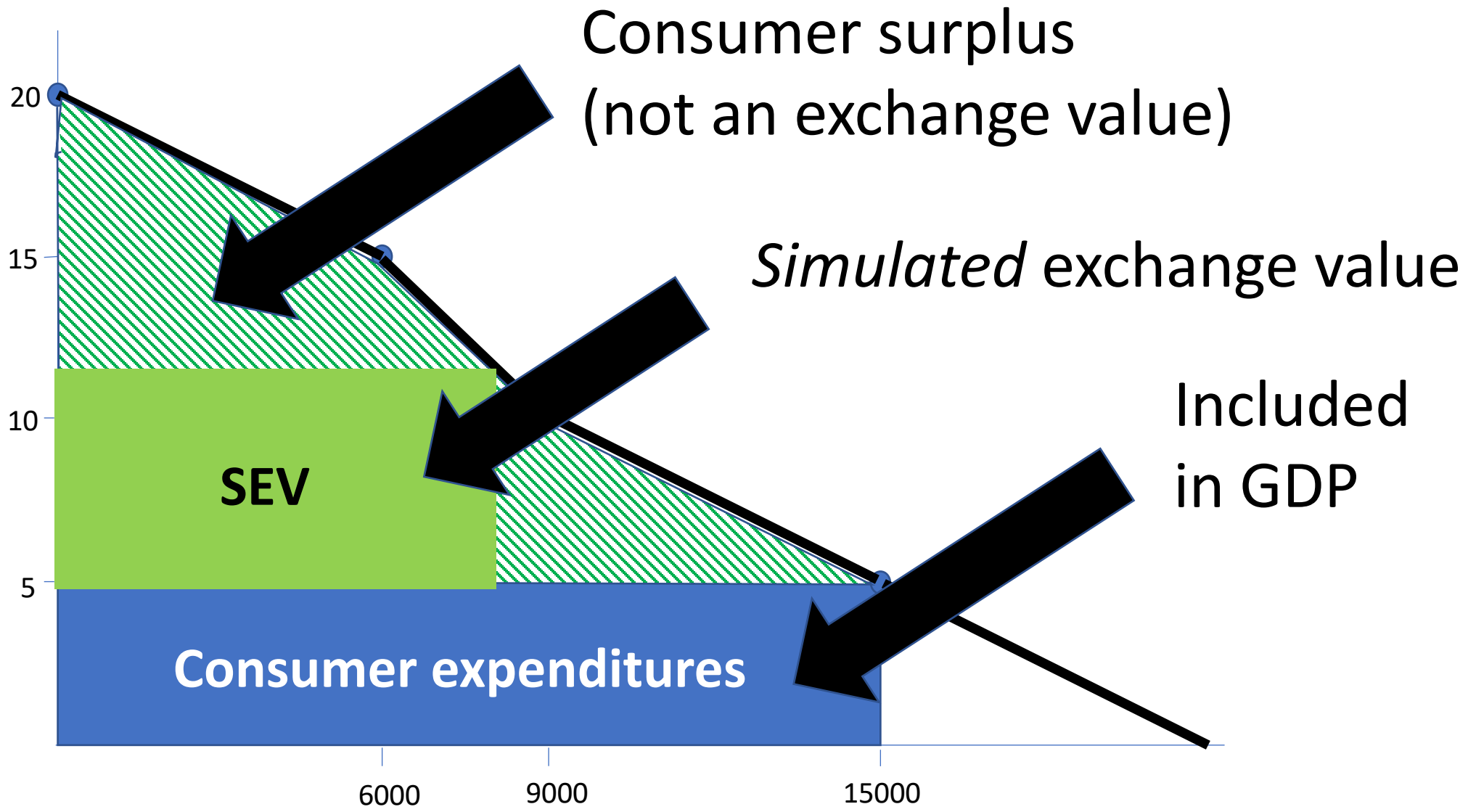
- Travel cost method (TCM), contingent valuation and choice experiments all estimate a demand function. Typically, this is used to estimate the consumer surplus.
  - These estimates are not exchange values
- “Exchange values can be approximated based on aggregated travel cost data (e.g., fuel). Where travel cost data are not available, an alternative method to obtain the exchange value of recreation related services is to sum relevant consumption expenditures. This is sometimes referred to as the Consumer Expenditures method (CEX)
- The Simulated Exchange Value (SEV) method uses the estimated demand to calculate the price that would occur if the ecosystem service were actually marketed (Caparrós et al., 2003, 2017).
  - Extension of “Prices from similar markets”

TCM, SEV and CEX

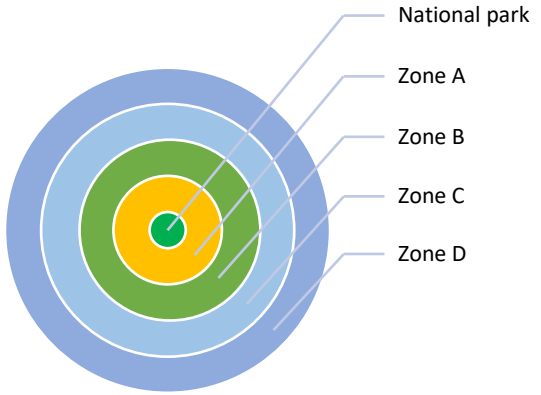


Zone	Travel cost	Population	Visitors from zone …
A	5	25000	15000
B	10	25000	9000
C	15	25000	6000
D	20	25000	0
Total		**100000**	**30000**

TCM, SEV and CEX– Zone A



TCM, SEV and CEX



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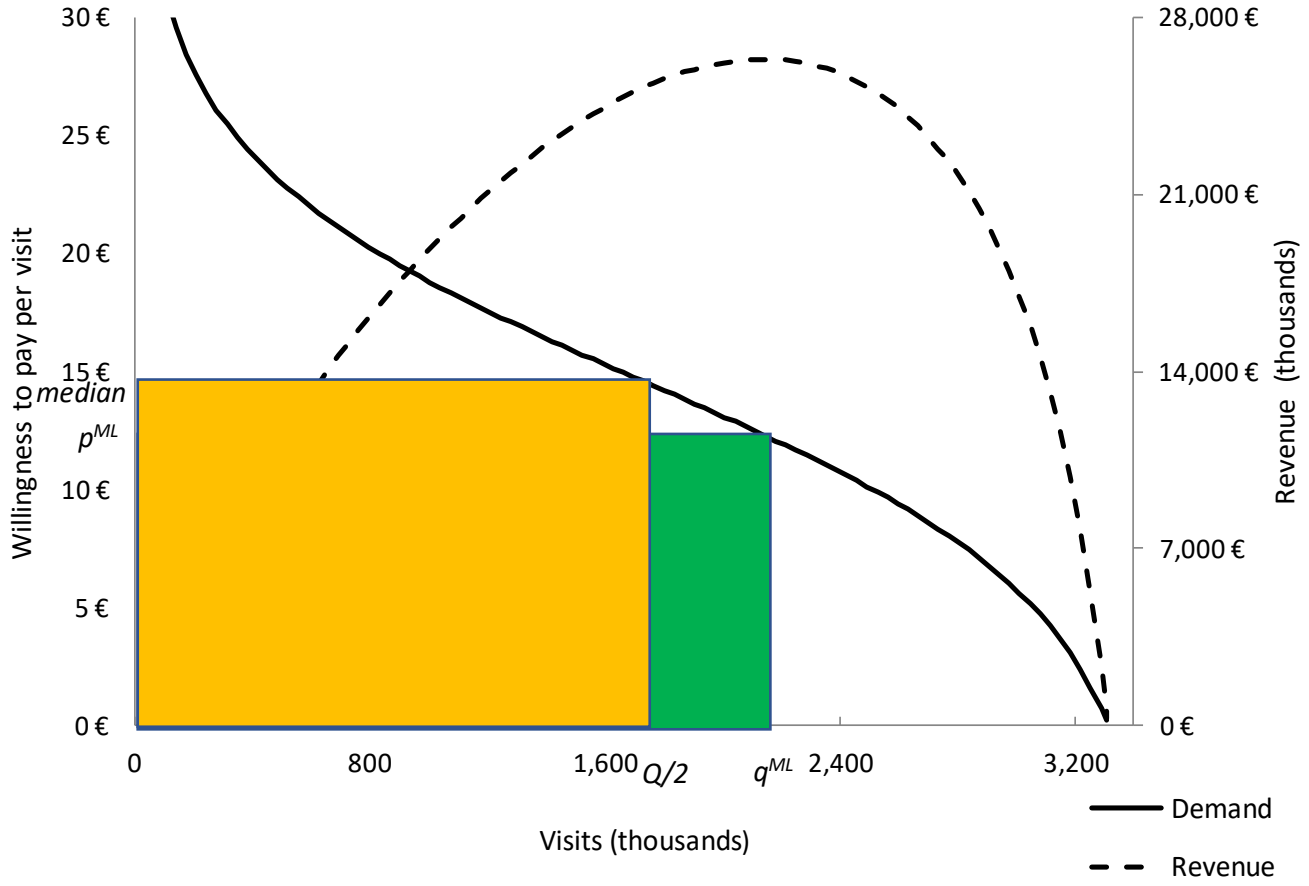
Zone	Consumer surplus	Consumer expenditures	Simulated exchange value
A	112500	75000	52000
B	52500	90000	26000
C	15000	90000	0
D	**0**	**0**	**0**
Total	**180000**	**255000**	**78000**

SEV for Nature Based Recreation

- Contingent valuation
- Monopolistic competition
- 10 areas in Andalusia
- Costs are assumed to be constant
- Site-specific demand functions (Fig. Demand and revenue for recreation in Cazorla)

Median of WTP times 50% of current visitors is a good approximation



Source: Caparrós et al. (2017)

SEV for Nature Based Recreation (Andalucía)

Model and estimated values	Per visit (€)	Aggregated values (€)	€/ha
Logit (bid)			
Compensating variation	12.91	345,723,904	78.82
Simulated exchange value *(median as proxy)*	12.91	172,861,952	39.41
Simulated exchange value *(short-term monopolistic competition)*	11.38	177,865,907	40.55
Log-logit (log bid)			
Compensating variation	38.52	1,031,783,830	235.22
Simulated exchange value *(median as proxy)*	15.14	202,712,988	46.21
Simulated exchange value *(short-term monopolistic competition)*	25.31	216,934,005	49.46

Median is good approximation

More robust than consumer surplus (Hicksian variations)

Source: Caparrós et al. (2017)

Ecosystem assets: NPV

- Net present value

$$V_t(EA) = \sum_{i=S}^{S} \sum_{j=t+1}^{t+N} \frac{ES_t^{ij}(EA_t)}{(1+r_j)^{(j-t)}}$$

where ES_t^{ij} is the value of ecosystem service *i* in year *j* as expected in period *t* (e.g., 2022) generated by a specific ecosystem assetEA_t; *S* is the total number of ecosystem services; r_j is the discount rate (in year j) and *N* is the lifetime of the asset, which may be infinite for some ecosystems if used sustainably.

- In ecosystem accounting, an ecosystem asset generates a bundle of ecosystem services, each valued separately.
- The NPV formula is applied at the level of individual ecosystem services and the resulting discounted values are aggregated to derive the monetary value of the ecosystem asset.

Monetary ecosystem asset accounts

- The monetary ecosystem asset account records the monetary values of all ecosystem assets within an ecosystem accounting area at the beginning (opening) and end (closing) of each accounting period; as well as changes in the value of those assets over the accounting period.
- Changes in the monetary value of ecosystem assets are separated into five broad types:
  - ecosystem enhancement
  - ecosystem degradation
  - ecosystem conversions
  - other changes in the volume of ecosystem assets
  - revaluations as a result of price changes

Monetary ecosystem asset accounts

- **Ecosystem enhancement** is the increase in the value of an ecosystem asset over an accounting period that is associated with an improvement in the condition of the ecosystem asset during that accounting period.
  - Rise in the net present value of expected future returns of the ecosystem services supplied by that asset
  - Increases in asset value resulting from improvements in ecosystem condition that can be expected to increase the future flows of ecosystem services, based on expected patterns of ecosystem management
  - Not as enhancement:
    - Changes in the expected demand for ecosystem services (upward reappraisals)
    - Increases in value due solely to movements in the unit prices of ecosystem services (revaluations)
- **Ecosystem degradation** is the decrease in the value of an ecosystem asset over an accounting period that is associated with a decline in the condition …

Monetary ecosystem asset accounts

- **Ecosystem conversions** is a change in ecosystem type involving a distinct and persistent change in the ecological structure, composition.
- **Other changes in the volume of ecosystem assets.** E.g. catastrophic losses and reappraisals.
- **Revaluations** are changes in the value of ecosystem assets over an accounting period that are due solely to movements in the unit prices of ecosystem services

Conclusions

- Monetary valuation is key for natural resource management
- Monetary valuation in SEEA EA 2021: '*internationally recognized statistical principles and recommendations*'
- Focus on use, not 'potential'
- Focus on exchange values, not consumer surplus
- Man-made inputs need to be deducted to obtain the contribution of nature (ecosystem service)
- Other issues:
  - Prices from emission trading systems may be used to value carbon retention
  - Travel cost method, contingent valuation and choice experiments provide exchange values when combined with the simulated exchange value method