Applying Value Transfers in Ecosystem Accounting

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Joint Research Centre

Outline

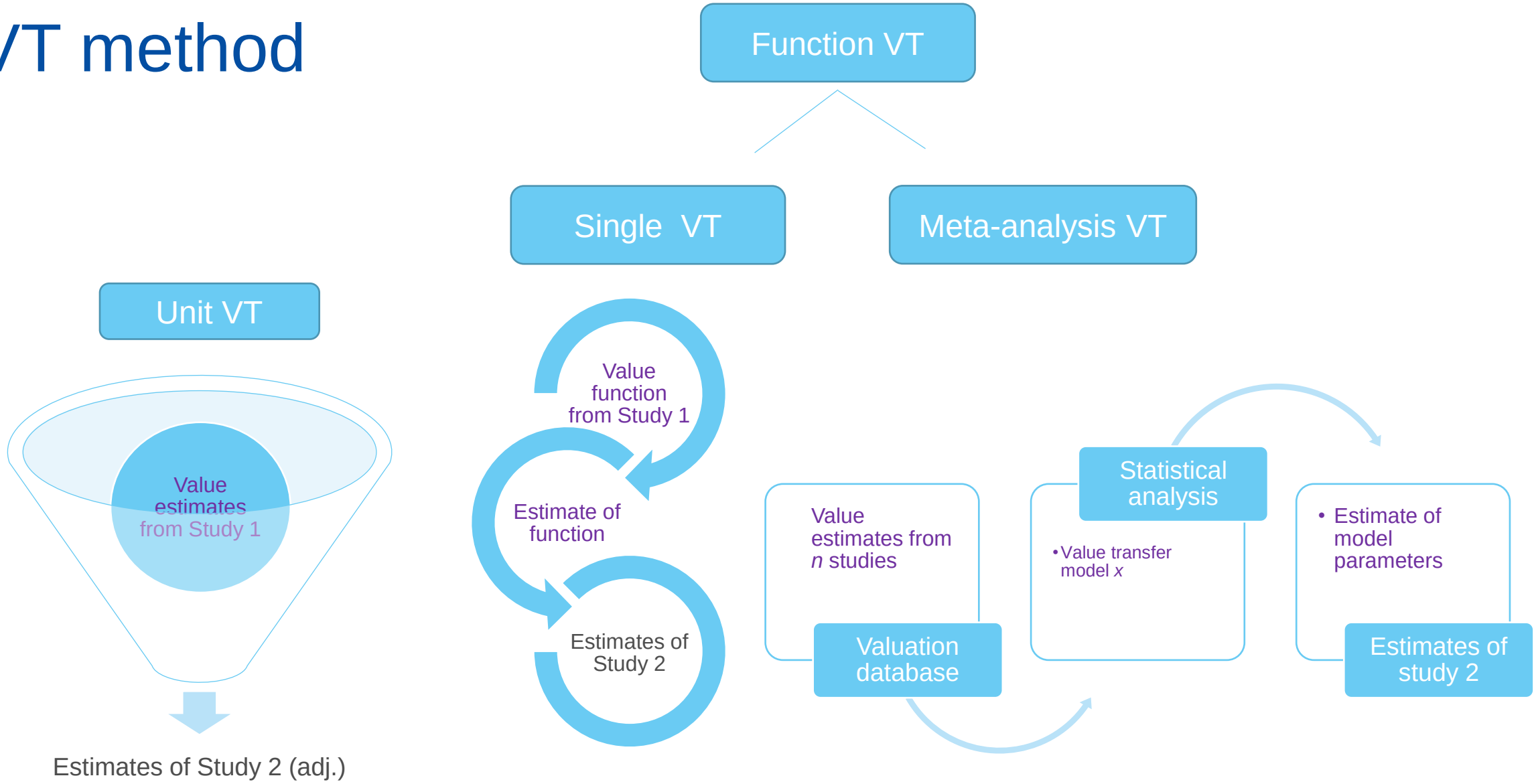
- The Value Transfer (VT) method
- VT and Ecosystem Accounting
- Empirical applications
  - Carbon sequestration
  - Air filtration
- Discussion

Objectives

- Compilation of regular accounts under the upcoming legislation
- Need for a methodology that can facilitate and accelerate empirical applications
- Practitioners will confront with certain challenges
- Value Transfer is a method that can facilitate practitioners' work

  - Low-cost valuation approach
  - Well-studied
  - Able to provide periodic estimates

VT method



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Application

- Two ecosystem services

1. Carbon sequestration
2. Air filtration

- Approach: Meta-analysis

Carbon sequestration

Carbon sequestration_Reference model

- Approach behind the VT: Integrated Assessment Models (IAMs) for estimating the Social Cost of Carbon
- Newbold et al.2013: steps of IAMs (uncertainly of climate change function)
- Howard and Sterner, 2017: Determinants of global WTPs to avoid impacts of climate change (% of GDP)
- Meta-analysis VT to estimate the relation of T and climate damages (damage impact assessment model)
    - 41 studies
    - 22-27 models

Carbon sequestration_Example of application

Table 1: MA models for assessing SCC

Variables	Definitions	Specification 4: Damages for temp. increases < 4ºC. Exclude duplicates	Specification 8: Damages for all temp. increases. Exclude duplicates
Dependent			
D_new	Climate Damage as a % of GDP		
Independent		**Coef.**	**Coef.**
t2	Original temperature change (°C) squared	0.595***	0.318***
mkt_t2	Interaction of Market[1] with t2	-0.622**	-0.345
cat_t2	Interaction of Catastrophic[2] with t2	0.26	0.362***
prod_t2	Interaction of Production[3] with t2	0.113	0.398
Cross	Dummy equal to 1 if study uses cross-sectional data without country fixed effects	1.7***	1.7***
Obs		21	26
R2		0.722	0.869
Adjusted R2		0.635	0.837

[1]: Market is coded as a dummy variable that is equal to 1 if estimate includes only market damages
[2]: Catastrophic is coded as a dummy variable that is equal to 1 if estimate includes catastrophic damages
[3]: Production is coded as a dummy variable that is equal to 1 if estimate captures the impacts of climate change on GDP through economic productivity

Carbon sequestration_Example of application

Table 2: Application of model specification 8

Variables	A: Coef.	B1: Mean of the database	B2: Free selection	A*B1	A*B2
t2	0.318	14.510	4.000	4.614	1.272
mkt_t2	-0.345	6.094	4.000	-2.102	-1.380
cat_t2	0.362	3.918	4.000	1.418	1.448
prod_t2	0.398	2.757	4.000	1.097	1.592
Cross	1.7	0.120	1.000	0.204	1.700
Dependent estimate: % change of GDP				**5.231**	**4.632**

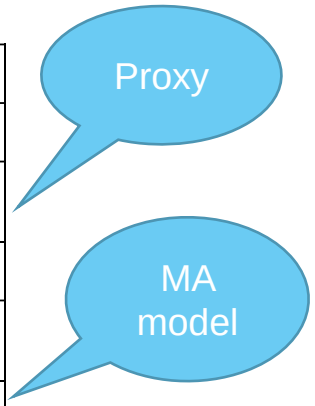
% change in GDP ⇨ GDP loss in tC/year

From Newbold et al., 2013: 2ºC will be a result of 20GtC/year

Carbon sequestration_Example of application

Table 3: Translating % change of GDP in euros per tC per year

Variable	Definition	Value
GDP_EU	EU -27 GDP per capita (in Euros current prices)	31,310
GHG_total	Corresponding GHG emissions in case of a 2°C temperature change (in GtC/year)	20
Pop	EU-27 population 2021(in million)	447
GHG_capita=GHG_total*10^9/ Pop*10^6	GHG emission per capita	44.743
GDP_estim	% change of GDP	4.632
GDP_ch=(GDP_EU*GDP_estim)/100	Change of GDP in year 2019	1450.28
GDP_em=GDP_ch/GHG_capita	Change of GDP per unit of emission at year 2019 (in euros per tC/year)	**32.41**



Discussion

- SCC estimates variation-MA accommodates this variation
- National vs regional estimates (Ricke et al., 2018 and Tol 2019)
- For accounting purposes use of regional or global estimates
- Choice: Function transfer (as in here) or design MA tailored to EA needs
- Open discussion: How carbon sequestration should be assessed? Which damages or SCC represent suitable exchange value for accounting purposes

Air filtration

Air filtration_Reference model

- OECD report (2012): Mortality risks related to environmental, transport and health factors
- Approach: Value of Statistical Life (VSL)

VSL= $\frac{\delta WTP}{\delta R}$

VSL=Total WTP revealed by N people that experience a uniform reduction of 1/N in their risk of dying

- VSL estimates (in million USD, 2015) available: in the OECD database (https://stats.oecd.org/)
- Database: www.oecd.org/env/policies/vsl.
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Air filtration_Reference model

Table 5: Results of first-level screening model

Independent variables	**Coef. (std.errors)**
lngdp ⟸	0.783*** (0.193)
lnchrisk ⟸	-0.577***(0.0849)
tunbull	-0.0774 (0.677)
envir ⟸	-0.606* (0.335)
traffic	-0.288 (0.231)
public	-0.913*** (0.249)
household	-0.0519 (0.225)
cancerisk	0.475(0.308)
latent	-0.326 (0.371)
noexplan	0.688***(0.214)
constant	1.846 (2.386)
Estimates	405
R-squared	0.833
Root mean squared error	0.691

***p<0.001, **p<0.05, *<0.1

Air filtration_Example of application

Tables 7: Results of the case study example, based on first level screening model

	A1: Values of variables_risk at mean	**A2: Value of variables_ risk at baseline**	**B: Model coefficient**	**A1*B**	**A2*B**
lngdp	10.576	10.576	0.783	8.281	8.281
lnchrisk	-8.266	-9.210	-0.577	4.769	5.314
tunbull	0.000	0.000	-0.077	0.000	0.000
envir	1.000	1.000	-0.606	-0.606	-0.606
traffic	0.000	0.000	-0.288	0.000	0.000
public	0.300	0.300	-0.913	-0.274	-0.274
household	0.290	0.290	0.016	0.005	0.005
cancerisk	0.130	0.130	0.475	0.062	0.062
latent	0.140	0.140	-0.326	-0.046	-0.046
noexplan	0.000	0.000	0.668	0.000	0.000
lnyear	0.000	0.000	0.000	0.000	0.000
constant	1.000	1.000	1.846	1.846	1.846
Sum				14.037	14.582
VSL=exp(sum)				1,248,361.333	2,152,916.302
WTP= VSL*R_b				321.028	215.292
Aggregated benefits:					
VSL*N_d (in million USD)				30,792.08	53,103.83
or					
WTP*R_r*Pop*1000 (in million USD)				30,792.08	53,103.83

Rb: Risk change

Nd:Number of premature deaths

Rc: Ratio of change given the policy context

Air filtration_Example of application

- Accommodating different risk levels
  - Premature deaths is related to the exposure to pollution levels
  - The risk change can be adjusted to this exposure
  - Response functions HRAPIE project
- Adjusting VSL welfare values to exchange values
  - Use of cost of illness approach: Reference paper Alberini and Krupnick (2000)
  - $\frac{WTP}{COI}$ =1.48 (for a level of PM10 concertation that is up to 20µg/m3)

Discussion

- VSL country specific estimates through unit value transfers with income adj.
- Or apply MA model as illustrated here
- For EA purposes: national level VSL estimates calibrated based on COI estimates
- Open question: the type of values that are suitable for use within the EA
  - MA designed for market exchange values

Thank you

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