Chapter 4
The Use and Development of Benefit Transfer in Europe

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Abstract This chapter provides an overview of benefit transfer in Europe. It does so by linking demand for transfer values to important pieces of European regulation and legislation. We also discuss national and European projects that have further developed benefit transfer guidelines and applied the resulting benefit estimates to specific environmental issues. The goal is to provide a general perspective on the use and continual improvement of benefit transfer within European policy making, focusing on applications within the last two decades.

Keywords Benefit transfer · European Union · Value function transfer · Air pollution · Noise · Forest non-market benefits · Water resources · Ecosystem services and biodiversity

4.1 Introduction

Benefit transfer, or more generally "value transfer" as both a benefit and cost estimate can be transferred in space and time (Brouwer 2000; Navrud and Ready 2007), has been used and researched extensively in Europe. One of the longest-running and best-known examples is the External Costs of Energy (ExternE) project funded by the European Commission from the early 1990s until 2005, with contributions from numerous scientists from European universities and research

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institutes (www.externe.info). The methodology for calculating the external environmental costs of different types of non-renewable (oil, coal, gas, nuclear) and renewable (wind, hydro, biomass) energy sources and fuel cycles was developed in a series of projects based on the damage function approach. This methodology was later incorporated in integrated assessment models, including web-based applications like the EcoSense model. Monetary valuation was an integral part of the methodology and focused on health endpoints (morbidity and mortality) due to air pollution, amenity losses from noise, corrosion of materials in buildings (including cultural heritage), visibility, transmission lines and crop losses. The available valuation results were summarized and, based on expert judgment, synthesized into what were considered reliable estimates, appropriate for policy use in cost-benefit analysis (Bickel and Friedrich 2005).

Despite the inaccuracies involved, benefit transfer remains one of the most attractive valuation methods in Europe, particularly for the estimation of market and non-market values for use within cost-benefit analysis (CBA) of environmental policy. Although it is generally acknowledged that the transfer of a constant unit value may lead to large errors in some cases, and more sophisticated adjustment procedures than these "unadjusted value transfers" have been proposed, unit value transfer remains the most widely applied approach in Europe. In fact, some countries have developed lists of "indicator values" for different ecosystem services, i.e. constant unit values (e.g. per hectare). These are updated to account for price-level changes but without consideration of important spatial characteristics of the ecosystem services or the population of beneficiaries. This is in contrast to academic efforts to develop spatially sensitive values for ecosystem services using geographical information systems (GIS) (e.g., Brander et al. 2012). The rapid emergence of numerous projects in the context of The Economics of Ecosystems and Biodiversity (TEEB), which aims to demonstrate to national and local policy makers the economic value of the benefits of ecosystems through the concept of ecosystem services, has further increased the demand for transfer values, especially in European member states (Brouwer et al. 2013).

Although unit value and other rudimentary benefit transfer methods remain commonplace, there have been multiple high-profile, collaborative efforts to develop more valid and flexible mechanisms to support benefit transfer for European policy analysis. Unlike most efforts to develop benefit transfer methods in the U.S. and Australia, many of the efforts in Europe have involved major international, inter-agency collaborations. These efforts have sought to bridge the gap between the sophisticated methods proposed in the academic literature and the data and expertise available for applied policy analysis. Although these efforts have advanced benefit transfer methods available for application in Europe, they still face challenges. These include a shortage of available valuation studies (particularly for some areas and types of environmental changes) and the assumptions required to generate broadly applicable benefit functions. Other challenges include the need to regularly update benefit functions to account for the temporal instability of values over longer periods of time.

This chapter provides a more or less chronological overview of benefit transfer in Europe. It does so by linking demand for transfer values to important pieces of European regulation and legislation. We also discuss national and European projects that have further developed benefit transfer guidelines and applied the resulting benefit estimates to specific environmental issues. We do not pretend that the overview is complete and covers all efforts. The goal is to provide a general perspective on the use and continual improvement of benefit transfer within European policy making, focusing on applications within the last two decades.

4.2 Air Pollution and Mortality Risk Valuation in Europe

One of the major areas in which benefit transfer has been used is in the valuation of health impacts. Value of Statistical Life (VSL) unit values were established and used in the early 1990s as part of the European Commission ExternE project (www.externe.info) introduced above. Based on a review of existing valuation studies, mainly hedonic wage (HW) studies from the U.S. and expert assessment, external health damage costs (the basis of VSL estimates) were estimated from air pollution due to the combustion of fossil fuels. Many European countries had already advocated VSL estimates in general CBA guidelines, and CBA guidelines for transportation projects in particular. However, most of these VSL estimates were based on the human capital method (HCM), which accounts for productivity losses only. In contrast, HW studies and stated preference (SP) studies of mortality risk provide estimates of the total loss in welfare (Jones-Lee et al. 1985).

In response to this situation, the Directorate-General (DG) for the Environment of the European Commission organized an expert workshop in 2000 in order to establish a unit value for VSL to be used in CBA of new EU directives and programs with impacts on environmentally related mortality risks, such as the CBA of the Clean Air For Europe (CAFE) program (Holland et al. 2005). An expert assessment based mostly on valuation studies of transport-related mortality risks led to adjustments of these estimates. These adjustments accounted primarily for differences in age at death in car accidents versus air pollution (i.e., people on average lose less than one year of their life expectancy due to air pollution as opposed to more than thirty years in traffic accidents).

The identified lack of SP studies for environmentally related mortality risk motivated the EU-project NewExt within ExternE. Here, identical SP studies, based on state-of-the art contingent valuation (CV) studies of mortality risks, conducted initially in North America (Krupnick et al. 2002), were performed in three European countries (France, Italy and the U.K.). The resulting VSL estimates supported an expert VSL estimate of about one million euro, which was about one-third of the estimate used in the initial ExternE projects and about twice the estimates based on the HCM. The initial ExternE estimates were based mainly on HW studies focusing on workers' acceptance of compensation for mortality risks rather than willingness to pay (WTP) of the general population for risk reductions.

During the last decade several subsequent SP studies have been carried out in Europe in this field, and in 2011 the OECD initiated a global meta-analysis of SP studies of mortality risks related to the environment, transport and health (Lindhjem et al. 2011; OECD 2012). This project suggested the use of meta-regression functions for value transfer of VSL estimates. Contrary to Dekker et al. (2011), who found limited overlap in the set of context-specific predictive VSL distributions from road safety, air pollution and general mortality risk, these latter benefit transfer procedures suggested simple unit value transfer with adjustments for differences in purchasing power parity (PPP) and adjusted gross domestic product (GDP) per capita across countries. These adjusted values have recently been used, together with World Health Organization (WHO) estimates of the number of premature deaths due to air pollution, to assess the social costs of air pollution from road traffic in European countries as well as other OECD countries such as China and India (OECD 2014).

4.3 Transportation Noise Valuation in Europe

Another area in which benefit transfer has played a significant role in policy analysis is the valuation of transportation noise impacts. The European Commission's DG Environment initiated work in 2001 to provide a state-of-the-art review of all valuation studies of transportation noise in order to establish unit values per A-weighted decibels (dBA) for amenity loss due to noise from road traffic, railways and aircrafts. The resulting review (Navrud 2002) identified many hedonic pricing (HP) studies, mainly from the U.S., carried out in the 1970s and 1980s, but also some conducted in Europe in the early 1990s. In addition, the review found a few European SP studies. Navrud (2002) provided a preliminary unit value for WTP per decibel per household per year based on the SP studies of amenity loss from road traffic noise. SP studies were preferred to HP studies as the latter provide estimates of loss in house prices from noise, which capture welfare losses from *all* disamenities related to road traffic, measured through noise as an indicator of all these disamenities. In contrast, SP studies could target WTP for noise reductions alone.

For aircraft and railroad noise, there were not enough SP studies to determine similar unit values that could be recommended for use in CBA. The unit value for road traffic noise was adopted by the DG Environment for use in CBA, and also provided the basis for unit value estimates in national CBA guidelines for road transportation projects (e.g., in Norway). These preliminary unit values were later updated based on new SP studies in other European countries financed by national authorities, and a six-country study using the same CV survey to estimate WTP for avoiding different levels of road traffic and railroad noise annoyance as part of the EU-project HEATCO (Developing Harmonized European Approaches for

Transport Costing and Project Assessment) provided another update. Detailed results for the Norwegian study are presented in Navrud (2010), while Navrud et al. (2005) present a summary of the results for all six countries.

4.4 The Economic Benefits of Natura 2000 in Europe

Natura 2000 is the most important European legislation related to nature and biodiversity protection. It is a network of nature protection areas designed to conserve Europe's most valuable and threatened species and habitats. It comprises 26,000 sites, including Special Areas of Conservation designated by European member states under the Habitats Directive and Special Protection Areas designated under the Birds Directive. Together these cover almost 20 % of the EU territory. Natura 2000 also includes an increasing number of marine protected areas. It is not a system of nature reserves in which all human activities are excluded. Most of the land continues to be privately owned and the emphasis is on ensuring that future management is sustainable, both ecologically and economically. In addition to its biodiversity benefits, the Natura 2000 network provides a range of co-benefits to society and the economy through the flow of ecosystem services associated with protected areas. This includes provisioning services such as timber, fish and crops, regulating services such as water purification, and cultural services such as recreation.

In order to help policy makers understand the benefits of protected areas and the important role of ecosystem services these protected areas provide, ten Brink et al. (2011) applied unit values from the existing literature to estimate the total economic value of implementing Natura 2000 in the whole of Europe. Their assessment of the network's economic value from the flow of terrestrial ecosystem services in Europe amounts to 200–300 billion euros annually. This value was derived by scaling up from a limited number (34 values from 20 studies) and limited geographic focus of site-based assessments of the value of Natura 2000, with most valuations coming from the EU-15, in particular the United Kingdom, Netherlands, and Belgium. The study recommends that more values from Natura 2000 case studies be developed under a comparable valuation protocol. Despite the potentially serious concerns with scaling up ecosystem service benefit estimates in this way (see Chaps. 2 and 12), this example shows yet another way in which benefit transfer has been used to help influence European policy decisions.

4.5 The UK National Ecosystem Assessment

One of the most detailed examples of the application of benefit transfer at a national level is the UK National Ecosystem Assessment (UK NEA) (Watson et al. 2011). The UK NEA was funded over several years by the Department for Environment, Food and Rural Affairs (Defra), the Natural Environment Research Council (NERC), the Economic and Social Research Council (ESRC), Northern Ireland Environment Agency (NIEA), the Scottish Government, the Countryside Council for Wales (CCW), and the Welsh Assembly Government (WAG), and resulted in one of the most extensive benefit transfer valuation exercises of natural capital and ecosystem services in Europe in recent years.

As part of the UK NEA, a wide variety of market and non-market valuation methods were applied to estimate the economic value of the identified flows of ecosystem services. The study focused both on past trends in ecosystem services provision and associated economic values and future flows of ecosystem services based on policy scenario simulations. The authors of the study acknowledge that there are limits to the ability of economists to capture all values associated with ecosystem services and argue that this applies in particular to certain shared social values, especially those which are not evident in observable behavior, such as the spiritual value of the environment. Moreover, the ability to derive robust monetary estimates for the nonuse value of biodiversity may be debatable. Nonetheless, the study represents one of the most ambitious efforts to quantify ecosystem service values over a large scale, using existing studies.

The main valuation methodology is outlined in Bateman et al. (2011). Where possible, use was made of available benefit estimates; these included existing values of multi-purpose woodland, maintenance of agricultural productivity, recreation, peace and quiet, and water quality. In cases where no benefit assessments were available, avoided cost estimates were used, for instance to estimate the avoided damage costs by not allowing ecosystems to degrade or the costs of clean water supply. Market prices were adjusted for market distortions such as taxes and subsidies, while production function approaches tried to adjust for the costs of other inputs in order to isolate the marginal effect of ecosystem services as inputs into production processes. For less tangible benefits, such as biodiversity, both available use and nonuse values were used to estimate the economic value of U.K. biodiversity. In the latter case, use was also made of available information about fundraising and legacy income of environmental charities as a revealed preference proxy for nonuse values.

In some cases the results from prior meta-analyses, synthesizing the economic values of ecosystem services, were applied. Examples include meta-analyses of ecosystem service values provided by wetlands and urban green space. Where possible the valuation accounted for spatial characteristics of ecosystem services delivery (supply) and beneficiaries (demand), such as recreational values based on travel cost models. In the case of local green urban space, the geographical distribution of environmental amenity values captured in house prices was mapped for the whole of England, based on HP models. However, in many cases the authors had to rely upon a transfer of simple average point values.

In the case of water quality, for example, figures compiled by the Environment Agency were used to estimate the benefits of improvements in water quality per kilometer for the main river basins in England and Wales. Average benefit estimates were £15.6/km, £18.6/km and £34.2/km for water quality improvements from low to medium, medium to high and low to high, respectively. Similar unit values are supplied in the study by Morris and Camino (2010). An example is the value of water quality improvements provided by inland and coastal wetlands in the U.K., measured in £ per hectare per year. Aggregated across the U.K., economic values range between just under £100 million per year for timber or marine-based raw biotic materials to £430 million per year for biodiversity pollination services, £600 million per year for fish landings, £680 million per year for carbon sequestration by U.K. woodlands, to £1.3 billion per year for the economic amenity value of all wetlands in the U.K. Planned river quality improvements may generate values up to £1.1 billion per year.

4.6 Benefit Transfer Guidelines for Non-market Forest Benefits

Concerned by the lack of common protocols for primary valuation studies and benefit transfer of non-market forest benefits, a group of European scientists with diverse disciplinary backgrounds took the initiative of discussing, and eventually agreeing upon good practice protocols for revealed preference (RP) and SP methods, as well as benefit transfer procedures for use and nonuse values of non-market forest benefits. The work was performed within the framework of the Cooperation in Science and Technology (COST) action, a European Union framework program instrument supporting cooperation among scientists and practitioners across Europe, called EUROpean FORest EXternalities (EUROFOREX).

Prior to EUROFOREX, there was no equivalent in Europe to the list of unit values of the U.S. Forest Service of the Department of Agriculture for recreational values per activity day for recreational activities, which have been used in CBA of measures which improve accessibility and quality of recreational sites. The EUROFOREX project showed that for forest recreation in Europe there are now sufficient valuation studies available to establish similar preliminary unit values. The same is true for nonuse values of forests (Lindhjem 2007; Elsasser et al. 2009). However, current valuation databases, including EVRI (Environmental Value Reference Inventory—now containing 3800 studies), currently provide insufficient coverage of these studies to enable valid benefit transfer. Hence, additional information on these studies must be added to EVRI to enable benefit transfers of this type. Alternatively, a new, more detailed database of forest recreational use and nonuse values must be developed to support benefit transfer on a wider scale in Europe.

4.7 Non-market Values Related to the Water Framework Directive

The development and application of similar valuation protocols for ecosystem services was also used within the European project AquaMoney. This project was funded by the European Commission to support implementation of the European Water Framework Directive (WFD), in particular the valuation of water resources and the services they provide across European member states. The WFD is the first European Directive in the domain of water, which explicitly recognizes the role of economics in reaching environmental water quality objectives. The Directive calls for the application of economic principles (e.g., polluter pays principle), methods and tools (e.g., cost-effectiveness analysis) and for the consideration of economic instruments (e.g., water-pricing methods) for achieving good chemical and ecological water status for all European water bodies. Although water resources are often unpriced or underpriced due to their public good characteristics, they generate important socioeconomic costs and benefits. Recognition of these costs and benefits within policy analysis is required to ensure policies are developed and implemented that maximize social welfare.

The project AquaMoney developed practical guidelines for the assessment of non-market values of water resources (Brouwer et al. 2009a). It did so by focusing on some of the key water policy issues in EU member states. Case studies were grouped around some of the main water management issues in Europe, such as the ecological restoration of heavily modified water bodies in the international Danube river basin in central and eastern Europe (Austria, Hungary, Romania) (Brouwer et al. 2009b), chemical and ecological water quality improvement in northern Europe (U.K., Denmark, Norway, Belgium, Netherlands, Lithuania) (Bateman et al. 2011), and water allocation and conservation in southern Europe (Spain, Italy, Greece) (Brouwer et al. 2015). By developing standardized water quality scales or "ladders" and employing identical valuation procedures, the transferability of the estimated non-market values was tested across member states. Guidance was also offered on the appropriate specification of transferable value functions, based on theoretical considerations such as the role of income (ability to pay) and distance decay, replacing previous ad hoc approaches. Special attention was paid to spatial heterogeneity in value transfer functions in view of the fact that many valuation studies involve spatial choices among environmental improvements at different locations within a confined geographical area, such as a watershed or river basin (e.g., Schaafsma and Brouwer 2013; Schaafsma et al. 2013).

4.8 Online Benefit Transfer Tool for Ecosystem Services in Flanders

We end our overview with a discussion of a practical online benefit transfer tool developed for the Flemish Government. In 2011 the Department of Environment, Nature and Energy (LNE) of the Flemish Government launched an online benefit transfer tool to support the economic valuation of ecosystem services. The goal of this effort was to support spatial planning related to the creation, restoration and design of natural areas. The online tool was developed to estimate, among others, the economic value of cultural services such as landscape amenity, biodiversity and recreation. The tool was officially launched in December 2011 by the Flemish Minister for the Environment in Brussels during a one-day workshop in which about thirty Flemish policy advisors participated as potential users. The tool is available at http://natuurwaardeverkenner.be/nwv2/.

Among other components, the tool includes a value function for the non-market benefits associated with the conversion of agricultural land use into natural areas. This value function is based on a choice experiment conducted among a representative sample of 3000 Flemish households in 2010 (Liekens et al. 2013). Although hypothetical, the choice experiment has several advantages compared to other stated preference methods, including the fact that it allows for the inclusion of ecosystem service and site characteristics and accounts for important trade-offs and substitution effects between alternative policy scenarios. The policy scenarios in this case concerned land use change, in which existing agricultural land is converted into nature areas, such as natural grasslands, forests, wetlands and marshes. The different nature types included in the choice experiment are based on the Flemish Biological Value Map. Important spatial characteristics include area size, accessibility, species richness, adjacent land use of the area, and the distance from a household's place of residence to the location of the proposed land use change. The distance measure is included to account for distance-decay effects in demarcating the size of the economic market of beneficiaries, i.e., that values typically decline with distance from an affected area.

The value function provides a value estimate for any additional hectare of nature area or restoration of lost habitat, and is used in combination with available GIS data on population density, population characteristics, and surrounding land use. Application of the function demonstrates that the average value per hectare of land for specific nature types differs significantly depending on size, distance and other site and population characteristics. Not controlling for these influencing factors, which is common practice in many benefit transfer exercises in practice, can result in severe under- or over-estimation of the non-market values of the proposed land use changes, leading to misguided policy and decision making.

The economic valuation tool aims to support decision making in local and regional spatial planning, including the creation, restoration and compensation of nature areas. Specifically, it enables cost-benefit analysis in which the ecosystem service values generated by land use plans can be compared with the financial costs of the plans. In densely populated countries such as Belgium and the Netherlands, nature areas are under increasing pressure from urban and infrastructure development. In order to compensate for these developments, the Government of Flanders has designated almost 10 % of its total land cover as protected areas such as Special Protection Areas and Special Areas of Conservation, comprising around 105 thousand ha. However, the Flemish Decree for Nature Conservation requires that the government delineates an area of 125 thousand ha of natural area as part of the Flemish Ecological Network and an additional 150 thousand ha as part of the Integral Interrelation and Support Network. Hence, further expansion of nature areas and buffer areas is required.

To evaluate the robustness of this value function over time, the estimated transfer parameters were tested for temporal stability using a test-retest study. As part of this study, the same choice experiment used to estimate the original value function was implemented one year after the original choice experiment, using the same sample of households (Schaafsma et al. 2014). The results were then compared to those of the original choice experiment. The results of the retest study show that the estimated value function one year later is slightly different, but does not result in significantly different WTP values, suggesting that the originally estimated value function is robust over the one-year time period. The value function will need regular testing to evaluate the robustness of the results over a longer period of time, and to enable updating as necessary.

4.9 Conclusions

In Europe, work to improve benefit transfer procedures and develop benefit transfer guidelines has been initiated by both national environmental protection agencies (EPAs) like the UK Defra (Bateman et al. 2010) and the Danish EPA (Navrud 2007), national research councils, and European agencies such as the European Environment Agency (Brander et al. 2012) and DG Environment and DG Research of the European Commission (see above). Some European countries, mainly the United Kingdom and France, have focused on the development of an updated web-based database of valuation studies, the Environmental Valuation Reference Inventory (EVRI). The information on primary valuation studies provided by such databases, together with the benefit transfer guidelines and methods and guidelines for evaluating the quality of available primary valuation studies (e.g. Söderquist and Soutukorva 2006 for the Swedish EPA), are prerequisites for valid benefit transfer.

Work is currently progressing to improve the basis for benefit transfers used to inform policy in various European countries and the continent as a whole. For example, the online tool presented in the previous section is an important step forward compared to existing attempts to inform environmental policy and decisionmaking on the basis of so-called indicator values for different ecosystem services. These indicator values are included in CBA of environmental policy interventions as constants, without consideration of important spatial characteristics of the ecosystem services or population of beneficiaries. The scaling up of such constant values was considered one of the primary flaws of Costanza et al. (1997), which sought to quantify the value of the world's ecosystem services and natural capital. Revisiting the estimated economic value of wetland ecosystem services in Costanza et al. (1997), Brander et al. (2013) use a meta-regression model instead of a constant unit value per hectare for wetland ecosystem services, accounting for spatial characteristics related to the service and population of beneficiaries in GIS. Predicting the global value of one particular wetland ecosystem service (regulating services) based on this more sophisticated approach, the economic value is only 10 % of the value originally estimated by Costanza et al. (1997). This result suggests that the function approach to benefit transfer may not only produce better verifiable and validated results, but also produce more conservative and hence acceptable values for decisionmakers.

More than fifteen years later, European research projects such as AquaMoney provide improved guidelines for more reliable and valid benefits transfer, based on spatially sensitive (GIS-based) value functions. Similar functions provide the basis for the Flemish Government online tool summarized above. In these and other cases, ongoing research is seeking to replace simple unit value transfers and indicator values with more sophisticated benefit function transfers that are able to better account for differences in natural resources, populations and policy contexts (e.g., spatial characteristics, availability of substitutes, baseline environmental quality levels). At the same time, new work is seeking to identify cases in which unit value transfers provide acceptable approximations of true underlying values (e.g., Bateman et al. 2011). These and other efforts are helping to provide the cost and benefit estimates that are increasingly requested by European government agencies as a basis for policy decisions.

References

Bateman, I. J., Brouwer, R., Cranford, M., Hime, S., Ozdemiroglu, E., Phang Z., & Provins, A. (2010). *Valuing environmental impacts: Practical guidelines for the use of value transfer in policy and project appraisal.* London: Defra. https://www.gov.uk/government/publications/valuing-environmental-impacts-guidelines-for-the-use-of-value-transfer.

Bateman, I. J., Brouwer, R., Ferrini, S., Schaafsma, M., Barton, D. N., Dubgaard, A., et al. (2011). Making benefit transfers work: Deriving and testing principles for value transfers for similar and dissimilar sites using a case study of the non-market benefits of water quality improvements across Europe. *Environmental and Resource Economics, 50*, 365–387.

Bickel, P., & Friedrich, R. (2005). *ExternE—externalities of energy. Methodology 2005 update.* Brussels: Directorate-General for Research and Innovation, Sustainable Energy Systems, Report No. EUR 21951.

Brander, L., Bräuer, I., Gerdes, H., Ghermandi, A., Kuik, O., Markandya, A., et al. (2012). Using meta-analysis and GIS for value transfer and scaling up: Valuing climate induced losses of European wetlands. *Environmental and Resource Economics, 52*, 395–413.

Brander, L., Brouwer, R., & Wagtendonk, A. (2013). Economic valuation of regulating services provided by wetlands in agricultural landscapes: A meta-analysis. *Ecological Engineering, 56*, 89–96.

Brouwer, R. (2000). Environmental value transfer: State of the art and future prospects. *Ecological Economics, 32*, 137–152.

Brouwer, R., Barton, D., Bateman, I. J., Brander, L., Georgiou, S., & Martín-Ortega, J., et al. (2009a). *Economic valuation of environmental and resource costs and benefits in the water framework directive: Technical guidelines for practitioners.* AquaMoney (SSPI-022723). Deliverable D23 for DG Research of the European Commission, Institute for Environmental Studies, Vrije Universiteit Amsterdam, The Netherlands.

Brouwer, R., Bliem, M., Flachner, S., Getzner, M., Kerekes, S., Milton, S., et al. (2009b). *Ecosystem service valuation from floodplain restoration in the Danube River Basin: An international choice experiment application*. Paper presented at the Annual Conference of the Association of Environmental and Resource Economists, Amsterdam, June 2009.

Brouwer, R., Brander, L., Kuik, O., Papyrakis, E., & Bateman, I. (2013). *A synthesis of approaches to assess and value ecosystem services in the EU in the context of TEEB*. Brussels: Report for the Directorate-General for the Environment.

Brouwer, R., Martin-Ortega, J., Dekker, T., Sardonini, L., Andreu, J., Kontogianni, A., Skourtos, M., Raggi, M., Viaggi, D., Pulido-Velazquez, M., Rolfe, J., & Windle, J. (2015). Improving value transfer through socio-economic adjustments in a multi-country choice experiment of water conservation alternatives. *Australian Journal of Agricultural and Resource Economics, 59*, 1–21.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., et al. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387*, 253–260.

Dekker, T., Brouwer, R., Hofkes, M., & Moeltner, K. (2011). The effect of risk context on the statistical value of life: A Bayesian meta-model. *Environmental and Resource Economics, 49*, 597–624.

Elsasser, P., Meyerhoff, J., Montagné, C., & Stenger, A. (2009). A bibliography and database on forest benefit valuation studies from Austria, France, Germany and Switzerland: A possible base for a concerted European approach. *Journal of Forest Economics, 15*, 93–107.

Holland, M, Hunt, A., Hurley, F., Navrud, S., & Watkiss, P. (2005). *Methodology for cost-benefit analysis of CAFÉ (Clean Air for Europe)*. Volume 1: *Overview and methodology*. Report to DG for the Environment. Brussels: European Commission. http://ec.europa.eu/environment/archives/cafe/pdf/cba_methodology_vol1.pdf.

Jones-Lee, M. W., Hammerton, W. M., & Philips, P. R. (1985). The value of safety: Results of a national sample survey. *Economic Journal, 95*, 49–72.

Krupnick, A., Alberini, A., Cropper, M., Simon, N., O'Brien, B., Goeree, R., & Heintzelman, M. (2002). Age, health and the willingness to pay for mortality risk reductions: A contingent valuation survey of Ontario residents. *Journal of Risk and Uncertainty, 24*, 161–186.

Liekens, I., Schaafsma, M., De Nocker, L., Broekx, S., Staes, J., Aertsens, J., & Brouwer, R. (2013). Developing a value function for nature development and land use policy in Flanders. *Land Use Policy, 30*, 549–559.

Lindhjem, H. (2007). 20 years of stated preference valuation of non-timber benefits from Fennoscandian forests: A meta-analysis. *Journal of Forest Economics, 12*, 251–277.

Lindhjem, H., Navrud, S., Braathen, N. A., & Biausque, V. (2011). Valuing lives saved from environment, transport and health policies: A meta analysis. *Risk Analysis, 31*, 1381–1407.

Morris, J., & Camino, M. (2010). *Economic assessment of freshwater, wetland and floodplain (FWF) ecosystem services*. UK National Ecosystem Assessment, Working Paper. Cranfield, UK: Cranfield University, School of Applied Sciences.

Navrud, S. (2002). *The state-of-the-art of the economic valuation of noise*. Final Report to European Commission DG for the Environment. Brussels. http://ec.europa.eu/environment/noise/pdf/020414noisereport.pdf, April 14, 2002.

Navrud, S. (2007). *Practical tools for value transfer in Denmark: Guidelines and an example*. Working Report No. 28, Miljøstyrelsen (Danish Environmental Protection Agency). At http://www2.mst.dk/common/Udgivramme/Frame.asp? http://www2.mst.dk/Udgiv/publications/2007/978-87-7052-656-2/html/default_eng.htm.

Navrud, S. (2010). Economic valuation of transportation noise in Europe. *Rivista italiana di acustica, 34*, 15–25.

Navrud, S., & Ready, R. (Eds.). (2007). *Environmental value transfer: Issues and methods*. Dordrect: Springer.

Navrud, S., Trædal, Y., Hunt, A., Longo, A., Greßmann, A., Leon, C., Espino, R., Markovits-Somogyi, R., & Meszaros, F. (2005). Economic values for key impacts valued in the Stated Preference surveys. Deliverable 4. Brussels: EU-project HEATCO (Developing Harmonized European Approaches for Transport Costing and Project Assessment). 62 pp and appendices. http://heatco.ier.uni-stuttgart.de/internal/hd4704.pdf.

OECD. (2012). *Mortality risk valuation in environment, health and transport policies*. Paris: OECD Publishing. http://dx.doi.org/10.1787/9789264130807-en.

OECD. (2014). *The cost of air pollution: Health impacts of road transport*. Paris: OECD Publishing. http://dx.doi.org/10.1787/9789264210448-en.

Schaafsma, M., & Brouwer, R. (2013). Testing geographical framing and substitution effects in spatial choice experiments. *Journal of Choice Modelling, 8*, 32–48.

Schaafsma, M., Brouwer, R., Gilbert, A., van den Bergh, J. C. J. M., & Wagtendonk, A. (2013). Estimation of distance-decay functions to account for substitution and spatial heterogeneity in stated preference research. *Land Economics, 89*, 514–537.

Schaafsma, M., Brouwer, R., Liekens, I., & De Nocker, L. (2014). Temporal stability of preferences and willingness to pay for natural areas in choice experiments: A test-retest. *Resource and Energy Economics, 38*, 243–260.

Söderquist, T., & Soutukorva, A. (2006). *An instrument for assessing the quality of environmental valuation studies*. Report. Stockholm: Swedish Environmental Protection Agency. http://www.naturvardsverket.se/Nerladdningssida/?fileType=pdf&downloadUrl=/Documents/publikationer/620-1252-5.pdf.

ten Brink, P., Badura, T., Bassi, S., Daly, E., Dickie, I., Ding, H., Gantioler, S., Gerdes, H., Kettunen, M., Lago, M., Lang, S., Markandya, A., Nunes, P. A. L. D., Pieterse, M., Rayment, M. & Tinch, R. (2011). *Estimating the overall economic value of the benefits provided by the Natura 2000 network*. Final Synthesis Report to the European Commission, DG Environment, on Contract ENV.B.2/SER/2008/0038. Brussels: Institute for European Environmental Policy / GHK / Ecologic.

Watson, R., Albon, S., Aspinall, R. et al. (2011). *U.K. National Ecosystem Assessment: Understanding nature's value to society*. *Synthesis of key findings*. Oxford: Information Press.