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EDITORIAL

Valuing environmental goods and services using benefit transfer: The state-of-the art and science

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ABSTRACT

The purpose of this special issue of *Ecological Economics* is to elucidate the state-of-the-art and science of environmental benefit transfer and to assist in the design and reporting of future benefit estimation research. Compiling the insights of thirty-two international experts from seven countries, the special issue reviews the latest developments in transfer techniques, as well as ongoing efforts to standardize and validate them. Taken together, the papers in this special issue provide fresh answers to some long-standing questions, offer original research insights on state-of-the-art issues and identify fruitful areas for future research. This introductory paper provides background and context for the issues addressed by the contributing authors. Its purpose is to place the interdisciplinary thinking contained here in a comparative context, highlighting the need for integration and collaboration to maintain the momentum that has propelled environmental benefit transfer into a widely used approach for estimating the economic value of environmental goods and services worldwide.

1. Introduction

This special issue of *Ecological Economics* examines the state-of-the-art and science of benefit transfer for valuing environmental goods and services. Benefit transfer[1] uses economic information captured at one place and time to make inferences about the economic value of environmental goods and services at another place and time. Using this approach, economic estimates are either transferred as monetary value units (e.g., means or medians) or as value functions conditioned on explanatory variables that define the attributes of an ecological and economic choice setting. Value functions may be estimated using original value data (Loomis, 1992), estimated using the meta analysis of summary value functions (Woodward and Wui, 2001), or derived from a process of econometric calibration as in structural benefit transfer (Smith et al., 2002). Each of these approaches is examined in this special issue.

Regulatory agencies and financial institutions worldwide are increasingly being called upon to assess the full economic benefits and costs of legislation and development projects that impact the natural environment (Millennium Ecosystem Assessment, 2003). Given the time and resource constraints faced by such institutions, it is perhaps not too surprising that the benefit transfer approach has spread steadily in the last few decades as decision makers have sought timely and low cost ways to assign monetary values to goods and services that are not commonly traded in the marketplace. Conducting original valuation research is time consuming and expensive. Policy analysts are often constrained in their ability to support

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[1] Benefit transfer involves economic values that may be either positive or negative. In the latter sense, the terminology refers to a process of transferring economic costs from one economic situation to another.

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new research studies within mandated deadlines. Thus, as more work is done by scientists to ascertain the economic value of environmental goods and services worldwide, this empirical stock of value knowledge increasingly tends to find its way through benefit transfer into the legal, financial and institutional decision making process.

Despite increased use of benefit transfer as a practical policy making tool, few benefit transfer practitioners seem fully satisfied with the state of the science and continue to strive for agreement on best practice standards (Abt Associates, 2005). One problem we have identified is that many of the innovative ideas and important breakthroughs that have recently taken place remain scattered and disconnected throughout the peer-reviewed literature. A key purpose of this special issue is to bring recent developments together in one common forum to stimulate dialogue and bring clarity to this rapidly developing area of interdisciplinary research.

Compiling the insights of thirty-two international experts from seven countries, this special issue allows us to bring readers up to date on many of the latest developments in transfer techniques, as well as ongoing efforts to standardize and validate them. Taken together, the articles represent a diverse set of perspectives and a unique synthesis of issues associated with benefits transfer ranging from pragmatic, policy-oriented concerns to more nuanced theoretical and methodological developments. Given the opportunity to explore what they see as the most pressing issues in the field today, the authors provide fresh answers to some long-standing questions, offer original research insights on state-of-the-art issues and identify fruitful areas for future research.

2. Background

Environmental benefit transfer came into being only once the non-market valuation literature itself grew large enough to allow comprehensive synthesis and cross-study comparisons. While non-market valuation can trace its roots to Hotelling's proposal for estimating travel demand (Hotelling, 1949) and Ciriacy-Wantrup's "willingness to pay" method (Ciracy-Wantrup, 1962), the first synthesis studies that might be called benefit transfers appeared in the mid to late 1980s (Sorg and Loomis, 1984; Walsh et al., 1988). In 1990, Smith and Kaoru published a first application of meta analysis[2] applied to the literature on recreation values (Smith and Kaoru, 1990). By 1992, benefit transfer had developed to the point where it became the focus of a special workshop co-sponsored by the Association of Environmental and Resource Economists (AERE) and the U.S. Environmental Protection Agency (USEPA). In that same year, Water Resources Research (WRR) published the first special research and commentary section dedicated to benefit transfer (Vol 28, issue 3, 1992).

As an important first step toward synthesis in the field, both the AERE-USEPA workshop and WRR special section elucidated the dependency of benefit transfer results on the quality of original valuation studies. As Brookshire and Neil note in their editorial introduction to the 1992 WRR special section:

> There exists an inextricable relationship between non-market benefit estimation and benefit transfer techniques. Benefit transfers can only be as accurate as the initial benefit estimates (Brookshire and Neill, 1992).

The key insight from this early editorial review is that the accuracy of benefit transfer is conditioned, in part, on the measurement errors contained in original studies. A portion of measurement error is inevitably 'passed through' from original value estimation and may even be amplified by benefit transfer if care is not taken to minimize such effects. Benefit transfer is also conditioned on original studies insofar as the transfer may need to adjust for conditions or assumptions found in the original studies that may differ from the targeted policy site. For instance, adjustment for population income level is often critical to benefit transfer to satisfy economic theoretic requirements (Bergstom and Taylor this volume; Smith et. al., this volume), yet this basic socio-demographic information may not be measured uniformly or reported in original benefit estimation studies. Similarly, biophysical context and the presence of resource substitutes may differ considerably from one site to another (Bateman et. al., this volume; Troy and Wilson this volume). When such conditions and assumptions are not reported or adjusted for, an important source of error may be transferred from original studies to the target policy site.

Building on this insight, several papers in this special issue note that a critical limiting feature of contemporary benefit transfer practice is that it uses non-market value estimates in ways that were often not intended by the original researchers (see Loomis and Rosenberger, this volume; McComb et al, this volume; Rosenberger and Stanley, this volume). Empirical valuation research typically focuses on testing new concepts and hypotheses in specific policy contexts rather than providing raw data for benefit transfer *per se*. Thus, it is not uncommon to find that original studies do not contain all the information that would be desirable for facilitating transfers. One objective of this special issue is to better communicate the information requirements of benefit transfer to valuation researchers so that the possibility of including their findings in future benefit transfer is considered *a priori* in the design and reporting of original research.

The 1992 AERE workshop and WRR special section also pointed out that benefit transfer often raises issues that are not encountered in original non-market value estimation. For instance, the utility-theoretic theory of non-market valuation was generally well understood by the 1980s, but this understanding did not extend to a broader economic theory of benefit transfer. Benefit transfer is theoretically different from valuing a specific resource or service at a given time and location. Benefit transfer takes values from one biophysical, economic, temporal, and spatial situation and transfers them to another. Since it lacked an explicit theoretical structure in its early years, benefit transfer appeared to some more as "economic alchemy" than science (Smith, 1992). The WRR special section addressed the gap in theory and method by providing new economic models for benefit transfer (Boyle and Bergstrom, 1992; McConnell, 1992) and by providing

[2] The term meta analysis as it is used in this special issue, is generally defined as a statistical technique for synthesizing the results of several existing non market valuation studies by estimating relationships between control variables (methodology used, sample demographic characteristics, characteristics of the good) and monetary values estimated across multiple studies.

systematic test of theoretical validity and statistical reliability (Desvousges et al., 1992; Loomis, 1992; Luken et al., 1992).

The benefit transfer literature grew rapidly during the 1990s and early 2000s once the initial theory and systematic empirical methods were developed. Contributions to this literature refined and extended the theoretical frameworks for benefit transfer (Bergstrom and De Civita, 1999; Smith and Pattanayak, 2002). New concepts and methods were proposed (Smith et al., 2002). Empirical experiments and tests were performed to probe the potential limits of benefit transfer (Brouwer and Spaninks, 1999; Groothuis, 2005; Kristofersson and Navrud, 2005; Morrison et al., 2002; Piper and Martin, 2001; Viscusi, 2004).

With the growth of the non-market valuation literature, meta analysis came into more common use as a means of conducting benefit transfer (Bateman and Jones, 2003; Bergstrom and De Civita, 1999; Rosenberger and Loomis, 2000; Shrestha and Loomis, 2003; vandenBergh and Button, 1997; Woodward and Wui, 2001) and new methods were proposed to deal with the spatial and biogeophysical distribution of ecosystem goods and services (Bateman et al., 1999; Brainard et al., 1999; Eade and Moran, 1996; Lovett et al., 1997; Wilson et al., 2004). Applications were also extended to nations around the globe and to transfers across national boundaries (Barton and Mourato, 2003; Brouwer and Bateman, 2005; Chang et al., 2001; Chotikapanich and Griffiths, 1998; French and Hitzhusen, 2001; Leon et al., 2002; Morrison and Bennett, 2004; Navrud, 2001; Pattanayak, 2004; Robinson, 2002).

By the start of the new millennium, the benefit transfer literature had grown into a substantial body of knowledge. To take stock of this literature, the U.S. Environmental Protection Agency and Environment Canada held an international workshop March 20–21, 2005 in Washington DC. The workshop, *Benefits Transfer and Valuation Databases*, provided a forum for the review of more than a dozen papers from experts in the field assessing the state of current non-market valuation data sets, contemporary practices and methods for benefits transfer, and the theoretical foundations for further progress in the field (Abt Associates, 2005). As such, it offered participants with the opportunity to explore unique insights into the core of the benefits transfer research program. Among other things, this second international workshop on benefit transfer underscored the rapid growth of the literature and the tentative acceptance of common terms, approaches, and findings that had occurred since the early 1990s.

3. Motivation and purpose

This special issue grew out of collaborative discussions following the workshop sponsored by U.S. EPA and Environment Canada in the spring of 2005. The workshop revealed the substantial progress that had been made in identifying the likely sources of error in benefit transfer and in developing new methods to control those errors. But, it also raised questions warranting further consideration:

1. What is the role of economic theory in guiding benefit transfer development given its strict utilitarian assumptions and pragmatic policy goals?
2. To what extent are non-economic factors important in benefit transfer and how might other natural and social sciences contribute to the development of benefit transfer models?
3. What are important sources of error in benefit transfer and how are these errors controlled or minimized?
4. What do we know about the effects of temporal differences, methodological differences, demographic differences, and spatial distribution on benefit transfer?
5. How does the quality and availability of primary benefit estimation studies limit the use, accuracy, and relevance of benefit transfer?

In this special issue, we have brought together a group of internationally recognized experts and given them the freedom to address each of these key questions from their own unique vantage points. The articles for the special issue build on those presented in Washington DC in 2005, but also include insights from practitioners who were not able to attend. In selecting contributions, our goal has been to be inclusive in thought and international in scope. In so doing, we hope to expose readers to a unique selection of cutting-edge articles dealing with benefit transfer in the 21st century.

4. Contents of the special issue

In addition to this introductory essay, the special issue contains fourteen papers that cover a broad range of issues on environmental benefit transfer. Below, we suggest how each paper in the special issue fits into the broader context of an emerging international benefit transfer research agenda.

The first five papers explore different aspects of an emerging conceptual framework for benefit transfer that builds on, yet transcends the conventional utility theoretic model of non-market valuation. Taken together, the authors independently construct a theoretical basis for economic benefit transfer that is rooted in economic theory, yet remains open to explanatory variables that do not necessarily follow from a strict utility theoretic modeling structure. Differences in valuation method, study design, socio-demographic characteristics, environmental attitudes, and biophysical context between original studies and target sites are all considered as possible influences on transferred benefit estimates.

Loomis and Rosenberger (this volume) introduce the challenges of quantifying economic benefits through benefit transfer and identify criteria that influence reliability and validity. Building on economic theory, the analysis indicates that benefit transfers gain reliability and validity to the extent that study and policy sites are consistent with respect to the ecosystem commodity, the market context, and the formulated welfare measure. The original study and targeted policy sites need to be similar in these three regards or adjustments need to be made to account for differences in commodity, market, and welfare measures. The authors summarize these requirements as: commodity consistency, market consistency, and welfare measure consistency. The authors note that these consistency guidelines are often difficult to satisfy in today's literature due to the limited ability of authors to report raw data needed for consistency adjustments in their original peer-reviewed

studies. Opportunities for error reduction would be greatly improved by more complete reporting of commodity, market, and welfare measure data. Loomis and Rosenberger conclude that more complete reporting should be encouraged by improving institutional incentives – new data repositories, annual rewards for policy-relevant studies etc. – to encourage researchers and editors to report empirical research findings in a manner that explicitly considers future benefit transfers.

Bergstrom and Taylor (this volume) propose a general theoretical model of benefit transfer using meta analysis. The authors recognize three different purposes for meta analysis: to summarize and evaluate a portion of the valuation literature, to test hypotheses regarding variables that affect and influence values, and to use predictions of meta analytic models for benefit transfer. Each of these purposes has an impact on benefit transfer practice and on the degree of accuracy required of a given transfer. Bergstrom and Taylor show that economic theory, particularly utility-theoretic choice theory, provides an important tool for identifying acceptable mathematical forms for MA models, variables that influence and determine values, and hypotheses about the latter variables. Similar to Loomis and Rosenberger (this volume), the authors conclude that empirical MA models need to satisfy the criterion of core economic variable consistency if they are to be considered reliable, but they also recognize that researchers need to maintain flexibility to introduce explanatory variables in the model that do no necessarily follow from a strict structural utility theoretic model.

Smith, Pattanayak and Van Houtven (this volume) describe a strict utilitarian structural function benefit transfer and develop an example by transferring the economic values associated with mortality risk reduction. The structural transfer approach begins with an explicit description of the utility theoretic choice that leads to closed form functional description of a particular valuation. The authors show with the case of occupational mortality risk, that expected utility theory may be combined with specific functional forms to derive and describe willingness to pay for mortality risk reductions as a function of wage, non-wage income, the change in mortality risk, and a small number of empirical parameters. The analysis indicates that commodity consistency in the form of baseline and post-policy levels of mortality risk is central to the transfer of mortality risk valuation. However, the authors find that adjustments for other socio-demographic factors (e.g., age) are not supported by the theoretical model. The authors conclude that structural benefit transfer ultimately relies on the plausibility of the conventional constrained utility maximization model with a careful specification of the objects of choice. Thus the logic of structural transfer itself requires the analyst to carefully judge whether the evidence in the literature is sufficient to identify all of the parameters required by the preference function selected for benefit transfer.

Rosenberger and Stanley (this volume) identify three categories of benefit transfer error and examine the extent to which these three errors arise in empirical research. The first error category is generalization error that arises from differences between the study sites for which values are estimated and the policy sites to which values are transferred. Cited empirical work shows that generalization error tends to be smaller the more similar study and policy sites are in their physical and market characteristics. Measurement error is the second category and stems from the judgments and methods used in the original study. Sampling error contributes to measurement error, but other methodological factors and research decisions of the original research contribute as well. The authors indicate that such factors and decisions are not sufficiently reported in published research so that assessing the full degree of measurement error in existing benefit transfers and transfer experiments. The final source of error is publication bias and arises from the review process leading to publication. In particular, the authors note that economic journals tend to show greater interest in methodological innovations than in the thorough reporting of conventional benefit estimation studies. The authors suggest that a new e-journal dedicated to benefit estimation and transfer may provide stronger incentives and broader access to the type of studies needed for benefit assessment and transfer.

In the final paper of this section, Spash and Vatn (this volume) challenge practitioners to consider a more inclusive approach to benefit transfer by placing it within a broader paradigm of scientific information transfer for policy evaluation. The authors present a general theoretical framework for information transfer that includes economics, the natural sciences and non-economic social sciences within its purview. In a sense, this framework extends Loomis and Rosenberger's (this volume) criteria of commodity, market, and welfare consistency to include factors such as institutional setting, geographic location and environmental attitudes. According to Spash and Vatn, benefit transfer practice needs to be deepened and widened to include explanatory variables from multiple sources of scientific information. Adjustments for market conditions for example, need to better address social and attitudinal variables that may not automatically follow from the strict utilitarian theoretical model. Environmental values as estimated by monetary valuation are one specific class of values and need to be seen as such. Viewed in this light, the authors remain hopeful that richer framework of preference formation and choice may be developed to guide further benefit information transfers.

The next five papers in the special issue examine different empirical and methodological developments in benefit transfer literature and how these developments may affect transferred benefits in the future. Here, the focus is on methodological improvements that may improve the validity and reliability of benefit transfer estimates on-the-ground.

Hoehn (this volume) investigates the effects of non-random sampling that affects benefit transfer studies. The analysis suggests that the completion and reporting of an original valuation study is not a random event. Valuation studies are typically funded by public agencies because there is a significant policy problem associated with a given resource. Hoehn thus hypothesizes that 'significance' creates a selection bias: studies associated with ecosystem services that have higher profiles or more social benefits are more likely to receive funding and therefore more likely to be evaluated by analysts. Selection, in turn, creates a potential for upward bias in benefit transfer. The author proposes a two-stage Heckman panel data estimator to test for and adjust for selection effects.

Empirical results confirm selection bias effects on the absolute level of transferred total benefits, though the incremental values associated with ecosystem attributes seem less susceptible to selection effects.

Using a case study approach, Brouwer (this volume) evaluates the extent that recreational values are temporally stable. The underlying logic is that non-market values may vary over time for the same reasons that market values and prices exhibit both temporal variation and temporal trends. The problem is that value transfers often involve the summary of value estimates from studies that are widely separated in time. Brouwer's case involves the contingent value raising water quality standards for coastal and inland waters. Test results indicate that contingent values are temporally stable and transferable if one assumes that the two, temporally distinct samples are drawn randomly. However, if one introduces demographic and attitudinal variables to account for differences between the two sample groups, temporal stability is statistically rejected and the values are not transferable between the two samples. In the latter case, it appears that adjusting for contextual market differences in terms of socio-demographics does not result in values that meet a conventional statistical criterion for transferability across time.

Johnston, Besedin and Ranson (this volume) examine the extent to which research methods and analyst judgments influence measurement error in transferred values. The authors use the stochastic bootstrap method to estimate empirical sampling distribution of values transferred from a meta analytic model of contingent values. The methodological variables used in the analysis include whether the original study used (1) a discrete choice statistical model, (2) in-person or mail surveys, (3) a voluntary payment vehicle, (4) lump-sum payments, and (5) nonparametric estimation methods. Results indicate that measurement error is sensitive to the number of studies contributing to the transferred values. Measurement error for benefit transfers based on one or two primary values is six to nine times larger than for transfers based on large sample of primary studies, as would be the case in meta analysis. Hence, transfer studies that are limited to one or a few studies introduce substantial uncertainty and broader error bounds around transferred values. These implicit bounds on measurement error may be reduced only by making available more primary studies or by identifying the methodological assumptions that are truly correct. The authors conclude that the former approach appears more feasible than the latter.

Morrison and Bergland (this volume) review thirteen recent studies that use multi-attribute choice models to estimate potentially transferable marginal values for environmental and ecological services. The thirteen studies are drawn from a range of countries and evaluate the effects of differences in demographics, sites, and geographic scale. Results of the review indicate that transfers across similar sites, populations and geographic scale meet the standards of conventional benefits assessment. However, transfers between widely differing demographic and physical situations, such as transfers between rural and urban areas, and transfers across regional and national context are not sufficiently accurate for benefit assessments. The authors wrap up with a discussion of a Bayesian approach to benefit transfer using choice modeling that is less restrictive than either pooled models or meta analytic models. They conclude that this is a promising future direction for benefit transfer research using choice modeling.

Ready and Navrud (this volume) explore approaches for conducting international benefit transfers. The authors argue that international transfers invoke issues that are analogous to transfers within national boundaries. In both national and international cases, adjustments need to be considered for the consistency of commodities, markets, and welfare measures. Adjusting for differences in national currencies is also analogous to the adjustments made for changes in national price level over time. The authors review the literature on international benefit transfers to identify both the necessary procedures and empirical outcomes. They conclude that transfer errors in the international setting are comparable to the errors arising with transfers within national boundaries, thereby challenging the conventional assumption that studies conducted further away from the target policy site are inherently less reliable than studies conducted nearby. Rather, when international transfer is 'done well' and 'within reasonable limits', the authors conclude that it can generate transfers with acceptably low potential transfer errors.

The next two papers of the special issue review innovative methods using geographic information systems (GIS) technology that have been developed to control socio-demographic and bio-geophysical context factors that influence the variability of benefit transfer results. Such methods explicitly take into account the fact that ecological context, market attributes, demographic characteristics and welfare measures vary across space in identifiable patterns. Yet, the effect of these spatial patterns on estimated benefits are not yet well represented by conventional transfers across geographical boundaries. Future benefit transfers need to account for the different spatial distributions of services, attributes, and welfare measures that occur with distinct geographical boundaries.

Troy and Wilson (this volume) present the results from three recent empirical studies to show how benefit transfer may incorporate the spatial distribution of ecosystem services using geographical information systems (GIS). They note that ecological services, the commodities in benefit transfer, are not distributed uniformly. Failure to account for the spatial heterogeneity in ecosystems admits a significant potential for error. The authors propose a seven-stage decision heuristic for identifying and documenting biogeophysical characteristics of original study areas and targeted policy sites; and then linking identified ecosystem services to their respective economic values. The case studies show that the framework allows analysts to identify and map the spatial distribution of values across study subareas, habitats and ecosystem services.

Bateman, Day, Georgiou and Lake (this volume) develop and test hypotheses about the spatial distribution of willingness to pay with respect to distance from a site and demographic factors. The conceptual analysis indicates that aggregate willingness to pay by users is likely to decline with distance from a site while non-use values are likely to be more stable over distance. However, both use and non-use values are subject to survey non-response. The analysis indicates that survey non-response increases with distance, causing aggregate use and non-use values to decline with distance. The empirical analysis consists of two case studies. The results in these cases are

consistent with the hypotheses. Aggregate willingness to pay is sensitive to distance and the spatial distribution of the demographic variables. Due to the decay in values with distance, use of the spatial sensitive value functions results in aggregate benefit estimates that are markedly smaller than those computed using mean value transfers.

The final two papers in the special issue shift from theoretical and methodological issues associated with environmental benefit transfer to explore practical policy implications. As noted at the outset of this essay, environmental agencies and financial institutions rarely conduct original valuation studies to support their decisions. Instead, as a practical matter, they often turn to previously conducted studies of a desired environmental resource to review how ecological benefits might accrue from a specified strategic decision. This engenders a strong bias towards the benefits transfer approach in the strategic policy arena.

McComb, Van Lantz, Nash and Rittmaster (this volume) review several online databases that have recently evolved to support the empirical practice of benefit transfer. The authors identify four major and ten smaller online databases. The major databases are the Environmental Valuation Reference Inventory summarizing 1500 valuation studies, the Envalue database covering about 400 studies, the Ecosystem Services Database covering 300 studies, and the Review of Externality Database that contains data from about 200 studies. The authors examine three examples to show the major databases may be used to search for and transfer unit values from the database to policy sites and policy issues. They concludes with concerns about the future direction and prospects for such databases. A foremost concern is finding sufficient new valuation studies-that are relevant to environmental policy. These authors echo Rosenberger and Stanley (this volume) by noting that high quality benefit studies appear evermore scarce relative to the expanding needs for the analysis of increasingly diverse ecological concerns. Nevertheless, they remain optimistic that the maintenance and growth of such databases will be supported by cooperative efforts between government agencies, universities, and non-governmental institutions.

Iovanna and Griffiths (this volume) examine how benefit transfer techniques are used by the U.S. Environmental Protection Agency to evaluate ecosystem services affect by regulations proposed to implement the Clean Water Act (CWA). The authors note that benefit assessment and transfer are subject to the constraints of the regulatory process. Regulatory evaluations must meet time constraints set by legislation and judicial rulings. These time constraints typically rule out *de novo* benefit studies and encourage benefit transfer. However, benefit transfer is limited by the need for transferred studies to pass rigorous peer and internal review standards and the subsequent dearth of studies evaluate most ecological services. The authors show how these constraints affect benefit transfer by examining a number of actual evaluations carried out by the U.S. EPA. Results indicate that monetized ecological benefits often center on recreation benefits since non-recreation benefits related to the CWA are either difficult to transfer to the U.S. EPA policy metrics, do not meet the regulatory review requirements, or do not exist. Hence, the lack of suitable original studies appears to be a significant constraint on benefit transfer and the ability to assess economic benefits of major policies.

5. Conclusion

As the contributions to this special issue show, in the last two decades environmental benefit transfer has matured into a viable approach for estimating the value of environmental goods and services. The international, peer-reviewed literature in the field has grown substantially and transfer methods are increasingly being recognized as distinct from those used in original non-market valuation studies. In the maturation process, benefit transfer appears to have developed a distinct theoretical framework, innovative methods for statistically controlling error and bias, and a novel research agenda.

Nevertheless, as several authors in this special issue remind us, benefit transfer ultimately remains dependent on the quality of original benefit estimation. The first dependency is that the accuracy of benefit transfers is partially conditioned on the errors contained in original benefit studies. Control of these errors in benefit transfer requires accurate and full reporting of original research designs and procedures, including factors such as response rates, survey procedures, and spatial-biophysical contexts that may be constant within a study but may vary across different studies.

The second dependency is that original benefit studies are the essential inputs to benefit transfer. Benefit transfer is simply not feasible when there are no original benefit studies or the original studies are poorly designed and reported. While the latter constraint may be theoretically obvious, it all too often obviates the possibility of benefit transfer in practice. McComb et al. (this volume) indicate that the lack of benefit studies across multiple contexts remains one of the significant challenges to the growth and sustainability of online databases. From a practical policy perspective, Iovanna and Griffiths (this volume) have further shown that important ecological services may be neglected in policy analysis because there are simply no suitable empirical studies from which benefits may be transferred.

Echoing the comments of previous authors, several contributors to this special issue have argued that professional (dis) incentives are to blame at least in part, for the lack of breadth and depth being reported by new environmental valuation studies (Loomis and Rosenberger this volume; McComb et. al. this volume; Rosenberger and Stanley this volume). On the one hand, environmental valuation and benefit transfer is increasingly an interdisciplinary endeavor, requiring insights from fields as diverse as ecology, economics, geography and sociology. As a result, research and publication in this field does not tend to follow conventional disciplinary boundaries and is therefore too often seen as a 'second tier' research endeavor, providing a clear disincentive for scholars seeking to follow conventional academic advancement. On the other hand, mainstream journals tend to focus on the latest methodological innovations and 'hot' policy topics. Editors and reviewers tend to show minimal interest in value replication for common ecosystem goods and services using standard valuation methods (Brookshire and Neill, 1992; Smith and Pattanayak, 2002). Creative thinking is needed to put in place the incentives that

will stimulate empirical data collection to supply the raw information needed for the next generation of environmental benefit transfers.

In summary, the field of environmental benefit transfer appears poised to grow in exciting new directions during the 21st century. To maintain this momentum, however, innovative, interdisciplinary thinking must continue be encouraged to foster the development of a truly unique benefit transfer theory; one that is coupled with methodological tools that facilitate our ability to extend ecological and economic knowledge from one context to another with minimal loss of information. Concluding in the spirit of collaboration that initiated this special issue, we believe that our collective challenge is to maintain an inclusive rather than an exclusive perspective as analysts from different disciplines and professional backgrounds work together expand our collective knowledge and understanding.

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