D. BROOKSHIRE, J. CHERMAK AND R. DESIMONE

UNCERTAINTY, BENEFIT TRANSFERS AND PHYSICAL MODELS: A MIDDLE RIO GRANDE VALLEY FOCUS

1. INTRODUCTION

Climate issues, institutional changes, population growth, and environmental concerns are requiring policy analyses into new arenas of complex decision-making for water allocations in the desert Southwest. In addition, increased focus on water quality standards, as well as Native American water rights claims and traditional cultural uses further exacerbate resolution. This has lead to a process of continuing re-evaluation of water policies.

The increasing complexity of the water issues has necessitated the development of models at a micro-policy level in order to capture difficult institutional nuances and representations of preference differences across stakeholder groups. More often than not, adequate local micro-data are not available in all settings for modeling and policy decisions. This constrains both the robustness of the model as well as the viability of the policy analysis. In order to circumvent the problem, data and benefit transfers are used in the modeling and policy analysis.

Policy models incorporate physical science and economic data such as preference data. Policy analysis thus can require many types of data transfers when local (primary) data are not available. As such, this "transferred" data can have a great deal of underlying uncertainty. For the physical sciences, the data (as in the case of climate) are usually interpolated from large-scale models. For preference data, the adequacy of benefit transfers depends on the uncertainty of the transferred component, relative to the actual.

Benefit transfer studies have been conducted over the years. Generally, transfers in environmental economics have consisted of transferring a preference-based value from one study to another. These conceptual foundations received renewed interest in the early 1990s in the US. For example, a special issue of *Water Resources Research* (1992), the Association of Environmental and Resource Economists proceedings volume from a benefit transfers workshop and more recently Desvousges *et al.* (1998) are devoted to benefit transfer issues.

The use of benefit transfer data in environmental studies has been growning. A sampling of these efforts would include Harrison *et al.* (1993), Rowe *et al.* (1994), Lee *et al.* (1995), Douglas and Johnson (1993), Kirchhoff *et al.* (1997), Smith and Kaoru (1990), Feather and Hellerstein (1997) and Kirchhoff (1998).

Benefit transfers or data transfers have been used to varying degrees of success in other areas. For example, data transfers have been used to construct time-of-use (TOU) prices for electricity in areas where no time-of-use data existed. The data from different geographic locations are pooled and used to construct TOU

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tariffs for other areas. Examples of this research and the applicability of the results include Kohler and Mitchell (1984), Caves *et al.* (1984), Aigner and Leamer (1984), and Patrick (1990). The transferability in TOU tariffs is heavily dependent on comparable weather patterns, as well as generation capacity. The transfers we consider in this research are closely related to these types of data transfers as well as the traditional value transfers.

Benefit transfers can only provide a precise replicate of the underlying structure when the original study area and the new area are identical, which is highly improbable. When there are characteristic differences between the original study area and the new area, the precision of the data are diminished, which results in increased uncertainty.[1] The degree of uncertainty should be inversely related to the similarity of the sites as well as the similarity of preference structures.[2]

In addition to benefit transfers, physical science data transfers are also incorporated into policy models. This results in an interesting problem for much policy analysis currently taking place. For example, consider the problem of climate change. While there appears to be a growing consensus that, in fact, climate change is occurring, forecasts across competing scientific models are inconsistent. A basic criticism of the climate model is that the scale currently used is too large to adequately forecast local phenomena. As such, environmental economic policy is potentially based on uncertain physical science model predictions, coupled with the uncertainty of the benefit transfer data. Thus, we have a substantive push in both the physical and social sciences to refine the precision of the functions and parameters used in the analyses.

This paper assesses the effects of the relative uncertainty of benefit transfer methods, uncertainty of climate data and alternative population projections on policy decisions. Our motivation stems from the need to address the relative importance of more accurate data for policy analysis, from the physical sciences as well as from demography and economics. For instance, while there has been substantial effort directed at climate assessments in the US and in the arena of benefit transfers, seldom do the uncertainty concerns get addressed in a single framework.

The objective of this research is to evaluate, via a case study, what transfers deserve the most attention from the perspective of reducing uncertainty. That is, is the uncertainty of the benefit transfer larger or smaller than that of the physical science models? We do this by seeking to answer two questions:

- How much does the surrounding uncertainty of the benefit transfer, climate information, and other forecast information impact policy decisions in reallocation issues? and,
- Where should research efforts be focused in order to improve analyses on which policy decisions are based?

While the first question addresses the precision of benefit and data transfers, the second focuses on the "value of information." Models are inherently plagued by uncertainties. Risk and uncertainty can be attributed, for example, to imprecision in data, overly restrictive assumptions, or imprecise model specification (this is certainly not a complete listing). Modeling problems are augmented by similar risks