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Electricity Deregulation and the Valuation of Visibility Loss in Wilderness Areas: A Research Note

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1. Introduction

Visibility in most wilderness areas in the northeastern United States has declined substantially since the 1970s. As noted by Hill et al. (2000), despite the 1977 Clean Air Act and subsequent amendments, human induced smog conditions are becoming increasingly worse. Average visibility in class I airsheds, such as the Great Gulf Wilderness in New Hampshire's White Mountains, is now about one-third of natural conditions.

A particular concern is that deregulation of electricity production could result in further degradation because consumers may switch to lower cost fossil fuel generation (Harper 2000). To the extent that this system reduces electricity costs, it may also affect firm location decisions (Halstead and Deller 1997). Yet, little is known about the extent to which consumers are likely to make tradeoffs between electric bills and reduced visibility in nearby wilderness areas.

This applied research uses a contingent valuation approach in an empirical case study of consumers' tradeoffs between cheaper electric bills and reduced visibility in New Hampshire's White Mountains. We also examine some of the problems associated with uncertainty with this type of analysis; that is, how confident respondents are in their answers to the valuation questions. Finally, policy implications of decreased visibility due to electricity deregulation are discussed.

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2. Background

Deregulation of electricity markets, in spite of the events of recent years in California, has been moving forward on the policy agenda. As Burtraw, Krupnick, and Palmer (1996: 7) note, the "natural monopoly" status of this utility is being eroded by technological change:

> *"Because new, cleaner plants are not expected to dominate the industry for some time, there is concern about increased use of existing facilities….most often by states in the Northeast, who fear that more open access to electricity transmissions will increase coal-fired generation in the mideast."*

Moves toward deregulation are also fueled by the notion that the current system does not serve to keep prices low enough (Ando and Palmer 1998). Not surprisingly, the states which have some of the highest electricity costs in the country are those which are moving toward deregulation, including New Hampshire.

If deregulation does indeed lead to increased coal-fired electricity production in the Mideast, significant air quality deterioration in the Northeast could result. Simulations by Palmer and Burtraw (1996) confirm that increased power generation in the Midwest and MidAtlantic states would contribute to increased loading of atmospheric pollutants over the Northeast. These results are consistent with prevailing weather patterns which tend to sweep atmospheric pollutants toward and over New England (NERA 2001), leading to the region's unfortunate moniker of "the tailpipe of the United States."

A closely related impact of deregulation is that in competitive markets electricity producers have less incentive to promote energy efficiency programs. The Commission for Environmental Cooperation (created under the North American Free Trade Agreement) recently reported that North American power companies reduced energy efficiency programs by 42 percent during 1995-1999, in part because of deregulated markets. As a result, air pollution has increased in the Northeast (Vaughan et al. 2002; Reuters 2002). Moreover, while the full impacts of the current administration's air pollution policies are subject to debate, further increases in pollution may well be likely under the Bush administration's proposal that would relax air pollution rules when electric utilities are repaired or expanded. For example, the so-called "Clear Skies Initiative (CSI)" will likely increase pollution due to its elimination of New Source Review (SO_2 [a major culprit in visibility reduction], NO_x, Hg, CO_2, PM, and others) , though the decrease in pollutants from other CSI programs may offset this increase. CSI removes current Clean Air Act protections regarding transported pollution, so even if it reduces pollution overall, pollution may not be reduced where it most impacts

New Hampshire. There are provisions in place in the current Clean Air Act regarding visibility (e.g., Best Available Retrofit Technology) which CSI removes, so arguably the current Clean Air Act would improve visibility more than CSI (Environmental Integrity Project 2003; Colburn 2003).

Actual events will depend, in part, on how consumers respond to deregulation. Yet, there is very little information available about the tradeoffs individuals have already made between cheaper electricity from deregulation and environmental factors, such as atmospheric visibility. A major reason for this is that electricity deregulation is a relatively new phenomenon that has not been fully implemented in many regions of the nation. Ethier et al. (2000) note that actual sign-up rates for so called "green" electricity have generally been below 2 percent. However, at this time the only way to gain a more comprehensive understanding of tradeoffs is to employ stated preference methods that ask individuals about tradeoffs they are likely to make.

There are several types of stated preference techniques that might be used to examine consumer tradeoffs between electricity bills and environmental factors. The traditional contingent valuation method, CVM, has been widely used to value many types of money / environmental quality tradeoffs (Mitchell and Carson 1989). In this approach, individuals are generally asked if they would be willing to pay (WTP) a certain dollar amount to avoid a stated level of reduction in some aspect of environmental quality. A willingness to accept (WTA) format can also be used wherein respondents are asked, for example, whether they would accept a given environmental quality reduction in exchange for a specified reduction in their monthly electricity bill. While many economists and policymakers prefer the WTP approach, there are several reasons why information about WTA may be useful in the situation examined in this study. First, from a theoretical perspective, property rights to a clean environment are often assumed to belong to the public, and consequently environmental losses should be evaluated using a WTA measure (Harper 2000). And if, as suggested by Kahneman et al. (1990), individuals value losses more highly than gains, willingness to pay estimates could severely understate value. Second, given deregulation of electricity generation, acceptance of an increase in air pollution in exchange for cheaper electricity is a very realistic scenario given that electricity generated by coal-fired plants in the Ohio River Valley tends to generate plumes which eventually impact the White Mountains. However, for this study the WTP measure of consumer surplus was used, as previous attempts to use the WTA measure to study the issue revealed problems with model stability and insufficient variation in response (e.g., see Stevens et al. 2000).

Most previous studies of the value of visibility in wilderness (or remote) areas have used the traditional contingent valuation method (CVM) to focus on mean or median WTP, in dollar terms, to maintain visibility. One of the first studies was conducted by Rowe et al. (1980) who found that nonresidents were willing to pay about $4 per day to preserve visual range in southwestern Colorado. Schulze et al. (1983) reported that residents of Los Angeles, Denver, Albuquerque and Chicago were willing to pay $3.75 to $5.14 per month to preserve visibility in the Grand Canyon. Crocker and Shogren (1991) estimated that residents were willing to pay about $3.00 per day to preserve visibility in the Cascades of Washington State. And, Chestnut and Rowe (1990) found that respondents were willing to pay $4.35 per month to avoid a change in average levels of visibility in the Grand Canyon, Yosemite and Shenandoah National Parks.[2]

We suggest, however, that from a public policy perspective, WTP or WTA "values" may often be of relatively little use. What actually counts is more likely to be the *proportion* of the relevant population that favors a proposed policy. In the case of electricity deregulation, we believe that the most relevant issue is not the mean or median amount people are willing to pay. Rather, the percentage of people who would likely trade pollution for expenditures on power determines the actual outcome of deregulated markets. And, in the political arena, decisions are often made on the basis of the number of voters favoring a given proposition, not the aggregate WTP or WTA value. Consequently, the following case study focuses primarily on the proportion of individuals who would likely pay higher electric bills to avoid degraded visibility. We do, however, present median WTP estimates for comparative purposes.

3. Case Study Methods

A case study of visibility / electricity cost tradeoffs in the Great Gulf Wilderness in New Hampshire was undertaken during summer of 2000. Visibility in the study area, which is about one quarter mile northeast of the Mt. Washington summit, is commonly impaired by regional haze that is largely a product of fossil fuel energy production (Hill et al. 2000).

A stated preference survey was used to measure electric bill / visibility tradeoffs in the Great Gulf Wilderness region. Computer modeled images derived from the WinHaze Visual Air Quality Program allowed us to hold weather conditions constant (primarily cloud cover) while changing visibility and electric bills only. The survey was conducted by mail of a random sample of 1,000 residents of northern New England (New Hampshire, Vermont, and Maine). The survey sought to estimate respondents' willingness to pay (using the CVM method) to *avoid* degradation of visibility.

The first section of all surveys asked respondents to rate according to "acceptability" four pictures with different amounts of haze in each. Each picture was a view taken from Camp Dodge, directly across from the Great

[2] Many of these studies were modeled after research and ideas developed or presented at a 1982 conference on visual values (Rowe and Chestnut 1983).

Gulf Wilderness that had been altered by WinHaze to simulate different levels of atmospheric pollution, all else held constant (cloud cover, etc.).

The CVM question was then presented. Following an introductory statement about electricity deregulation and air quality in the White Mountains (see appendix), each respondent viewed two pictures in this section. Picture A represented the status quo visibility and the individual's current electric bill while picture B represented reduced visibility with the option to pay to avoid this visibility loss and incur a higher electric bill. The question was asked as follows:

> *Would you be willing to pay $x per month more for electricity to avoid this new level of visibility (indicated by Picture B) in the White Mountain National Forest?*

In all cases, picture A, which represented the base scenario, or status quo, described the actual average visibility level at the site during the summer months (about 90 miles). Picture B represented one of four visual range reductions (visual range of 30, 20, 7.3 or 4.4 miles). Respondents to the survey were confronted with cost increases ranging from $10 to $50 per month (these values were chosen based on the results of a similar survey conducted in the region the previous year).

A series of follow-up questions were asked to obtain information about each respondent's socio-economic characteristics, motives involved in answering the tradeoff question, and plans, if any, to visit the wilderness area in the future. Double wave mailings with postcard follow-ups resulted in response rates of approximately 39 percent, slightly below average for academic surveys of the general population (Mitchell and Carson 1989).

4. Results

Characteristics of individuals responding to each survey are summarized in Table 1. Given the relatively low response rate of the survey, questions of non-response bias and sample representativeness must be addressed if any generalizations are to be made from the study. The sample mean annual income of $49,500 is close to the weighted census data for the region of $52,265, while the average respondent age of 51 compares with a weighted average of 47.8 years for the region. Thus, at least for these characteristics, the sample appears comparable to the general population of the area.

All respondents were asked to indicate, on a scale of 1 to 10, how certain they were of their answer to the WTP question (a 10 indicated very certain while a 1 indicated very uncertain). Two WTP logit models were estimated (Table 2). The dependent variable in the first model equaled 1 if the respondent answered yes to the WTP question while the dependent variable in the second model equaled 1 if the respondent answered yes to the WTP question and gave a certainty rating of 8, 9, or 10.

Table 1. Logit Model WTP Specification

Variable	Definition	Mean	Standard Deviation	Expected Sign
Model 1 Dependent	Yes to CVM	.33	.47	
Model 2 Dependent	Yes to CVM (certainty = 8, 9, or 10)	.17	.38	
	Ln $ payment per month	3.25	.57	-
Ln WTP	Ln Miles	2.47	.76	-
Ln Visibility	Years	51	15.5	+/-
Age	Thousands	49.5	32.8	+
Income	Dummy; New Hampshire Resident = 1	.50	.50	+/-
NH				
	Dummy; Plans for Future Visit = 1	.64	.48	+
FVisit				

As indicated in Table 1, about 33 percent of respondents answered yes to the CVM question, but only 17 percent were relatively certain about their “yes” response. Empirical studies which compare actual payments to hypothetical payments have established a firm relationship between actual payment and stated certainty. It would certainly be appropriate for policymakers to consider that imposing a “certainty” constraint on the results reduces support for the policy by nearly half. We expected the likelihood that an individual would be willing to pay to avoid reduced visibility would decrease with the payment asked for, would be less if the visibility is relatively good, and would increase with income and planned future visits to the site.

Model results are presented in Table 2. As expected, the probability of payment decreased with the dollar amount elicited, and with high levels of visibility. Median dollar values of WTP were computed by first calculating the probability of payment by:

$$Pr = \frac{1}{1+e^{-(\alpha+Bx)}} \tag{1}$$

where Pr is probability, α is the estimated intercept, B is a vector of the estimated coefficients, and x is a vector of the independent variables given in Table 2. The mean value of each independent variable was used in equation (1), except for the value of WTP. Given this formulation, the value of WTP which results in Pr = .5 is the median value of WTP for the "average" respondent in dollars. As shown in Table 2, the estimated median WTP values are generally consistent with previous WTP estimates for atmospheric visibility in remote areas. Zhao and Kling (2001) argue that these WTP estimates may be understated if individuals are uncertain of the value of a good. In essence, they argue that respondents forced to make a decision on the spot demand compensation for this loss of quasi-option value (Arrow and Lind, 1972), and produce WTP bids less than their expected value of the good so as to insure not "overpaying." Champ et al. (1997) note that for goods with substantial public good characteristics, actual donations may be *underestimates* of the full value of a good to the respondent due to free riding/strategic behavior. Due to the well-known warm glow phenomenon and other problems (Andreoni 1989), others have argued that CVM may *overestimate* "true" values. Goldar and Misra (2001) attribute much of the disparity to the familiar hypothetical bias problem.

Table 2. Logit Model WTP Results

	Model 1 (Yes)		Model 2 (Yes; 8, 9, and 10)	
Variable	Parameter Estimates	Std Error	Parameter Estimates	Std Error
Intercept	3.326	1.58**	-1.015	2.013
Ln WTP	-1.192	0.334***	-1.113	0.396***
Ln Visibility	-0.682	0.256***	-0.495	0.308*
Age	0.004	0.014	0.018	0.02
Income	0.018	0.006***	0.014	0.008*
NH	-0.203	0.390	0.184	0 .481
FVisit	0.532	0.450	2.89	1.08***
N	166		166	
Chi-squared	32.1856***		32.0016***	
Percent Correct Predictions	75.1		81.2	

Median WTP ($ Per Month)

Model	**Median ($/Month)**
WTP Model 1	$12
WTP Model 2	$3

*** significant at .01 level
** significant at .05 level
* significant at .10 level

5. Summary and Conclusions

The findings that emerge from this study can be summarized as follows. First, most respondents were *not* willing to pay higher electricity rates in exchange for increased visibility over the range examined in this study. If respondents are well informed, we might therefore infer that deregulation could possibly result in decreased visibility as a result of greater household demand for the cheapest source of electricity. Thus, based strictly on the referendum side of the study, avoided visibility losses are not sufficient to cause most respondents to pay more for electricity. This effect is especially pronounced when one considers only those fairly certain of their responses. It is important to note that some of the respondents may have been effectively engaging in protest behavior—that is, they valued the loss in visibility, but were unwilling to pay higher electric fees (possibly because they felt they had the "right" to the status quo and should not have to pay to preserve it). A section of the survey which asked respondents to rate photographs with varying degrees of visibility found that they consistently rated those with visibility ranges below 30 kilometers "unacceptable."

However, if policymakers respond simply to estimates of willingness to pay, programs to preserve visibility in the mountains might more likely be supported due to the median estimates of $3 – 12 / month which respondents would pay in increased electric bills. This points out a conundrum in interpreting contingent valuation studies within a policy framework.

The results (referendum vs. median values) are not necessarily contradictory. In provision of public goods, it is well known that individuals may place radically different values on the same level of a public good. If true benefits (Lindahl) pricing were used, each would pay according to utility gained. In reality, benefits received are often at odds with payments made (via general funds, etc.). A policy could pass the net benefits test with a majority of individuals opposing it.

From the perspective of regional policy initiatives, provision of information about the likely consequences of purchasing cheaper power in deregulated markets is therefore of particular importance. That is, if people are aware of the visibility tradeoffs associated with purchase of deregulated power, this research suggests that the policy chosen will depend on how the results are interpreted.

From the perspective of regional economies, it is possible that there could be measurable effects of lost visibility to local business activity. Those respondents planning future visits were less likely to accept reduced visibility and were more likely to be willing to pay to avoid reduced visibility. Surveys conducted on site indicate that the "average" visitor will make .91 fewer trips per year due to decreased visibility. This could result in spending losses ranging from about $21,700 to $116,214 for the sample of about 200 individuals considered (Halstead, Harper, and Hill 2000).

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APPENDIX
Introduction to Valuation Questions

For the next question, consider the following: Currently, many states are debating the issue of deregulation in the electric utility industry. If deregulation occurs in your state, you may be able to choose your own power provider. Assume for the purposes of this question that cheaper power (that is, less than what you currently pay) is available through a Mid-western power company. Further, this power company produces electricity by burning coal. Increased demand for this company's cheaper power will contribute to air pollution and poor visibility in the White Mountains.

Now suppose picture A represents the level of visibility most often experienced in this region during the summer months. Further suppose that you were faced with a situation where the visibility level would change to that in picture B. The purposes of this question assume that visibility would change ONLY in the White Mountain National Forest.