

Evaluating Recreational Benefits of Water Resources on Small Geographical Areas: An Application to Rivers in Puerto Rico

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Abstract. In Benefit Cost Analysis of water resources Travel Cost Models (TCM) and Contingent Valuation Methods (CVM) are commonly used by National and International agencies. The purpose of this work is to point at a previously unrecognized limitation of one of these recommended tools, the TCM. In valuation assessments that take place at small geographical areas (such as islands) the assumption of a continuous spatial market might not hold. In other words, visitors might not be able to reveal their full willingness to pay through their travel costs because these are limited by the space available. This could cause the valuation estimates coming from TCM to be biased downwards. To deal with this problem, researchers can use CVM studies to obtain results that better reflect how valuable a water resource is. This paper reports on a case study of the effect of the underestimate from using the TCM to estimate recreation use benefits for two rivers in Puerto Rico.

1. Introduction

In 1983 the U.S. Water Resources Council recommended the TCM and CVM approaches for estimating recreation benefits in Benefit-Cost Analyses performed by the Bureau of Reclamation and the US Corps of Engineers. These methods are not only used in America, but are also worldwide by agencies like USAID and the World Bank. These models are very important tools to assess the value of stream features or for the public they serve. This information can be pertinent for managers because it allows them to consider the impact that proposed developments could have on visitor demand and benefits. Economists like to use Revealed Preference Methods such as the TCM because they provide information on the individual's actual trips taken in response to travel costs which vary with distance from the site. Ever since Clawson and Knetsch (1966) TCM was shown to rely upon the notion of a spatial market where visitors' willingness to trade travel costs for site visits reveals their willingness to pay (WTP) for the site and its characteristics. This market is represented as a continuum of concentric circles emanating from the site to through the residential areas where visitors live around the recreation area of interest each. Each ring is of a given distance increment, and hence visitors residing in each ring have a determined travel cost to visit the site. In the model, these travel costs represent the price paid by a visitor for the site. When the spatial market surrounding the site has limited physical size the maximum travel cost that a visitor can incur is limited or truncated, possibly at an amount less than their maximum willingness to pay. Any study that takes place on small islands such as Hawaii, Puerto Rico, Jamaica etc., i.e., islands with significant resident populations that visit local sites might find that, if the site is of high value to the locals, such that their maximum WTP exceeds the maximum travel cost associated to the distance necessary to drive to the site, the valuation

obtained by a typical trip frequency recreation demand model will not be accurate.

2. Methods

To measure the degree of under-estimation in visitors WTP from the TCM in a constrained island environment, we compare our TCM estimates to those estimated from a dichotomous choice Contingent Valuation Method (CVM). CVM does not suffer from these physical limits as it increases the travel cost by a random amount. For example in our data from Puerto Rican residents visiting streams on the Caribbean National Forest, the maximum observed travel cost was approximately \$60 (strongly influenced by the 100 mile width of the island). To allow respondents WTP to not be constrained by this physical limit on the choke price, we asked them if they would still take their most recent trip at a random increase in the bid amount that was upwards of \$200. We also correct the dichotomous choice CVM for on-site sampling bias. While CVM relies on statements of intended behavior, rather than actual behavior, in unconstrained spatial markets around recreation sites nearly a hundred comparisons of WTP from the two methods have been shown to yield equivalent estimates of WTP (Carson, et al. 1996).

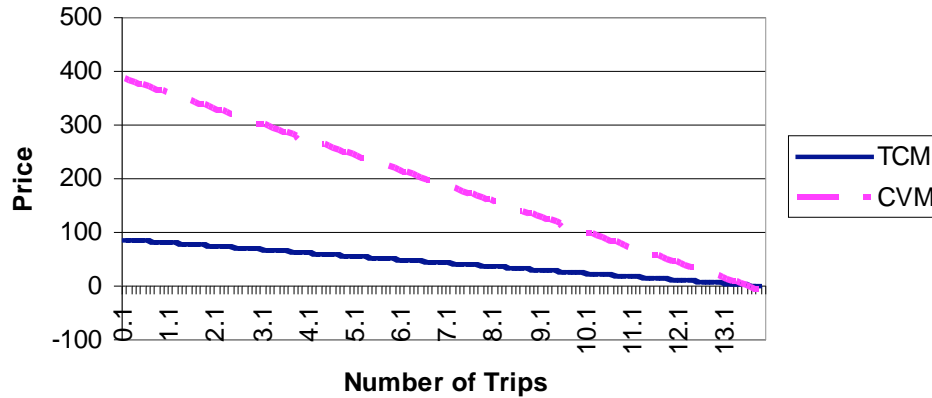
3. Empirical Application

As mentioned above, the study uses data set from a survey administered in the Caribbean National Forest in Puerto Rico. The on site surveys contained information on trip demand for the 2005 season and a CVM question that was meant to complement the trip assessment. Data were collected at 11 different river recreation areas within the forest and contained demographic information of the users, distance and time traveled, and characteristics of the visited rivers.

4. Results

The count data TCM demand model corrected for on-site sampling bias had a negative and statistically significant travel cost coefficient, in conformance with economic principles. The TCM yielded an average net WTP \$22 per trip. The dichotomous choice CVM had a negative statistically significant bid coefficient, also in conformance with economic principles. However, the CVM yielded an average net WTP of \$96.85 per trip. As can be seen this is a sizeable difference given that both are modeling the exactly the same people at the same rivers. Our interpretation is that the higher WTP estimate from the dichotomous choice CVM is more reflective of the high quality visitor experience and the visitors' net WTP than would be the TCM. This can be illustrated in Figure 1 which shows that the effect of the island's physical size limit determining the choke price in the "continuous" count data model also biases the slope coefficient. So the reduced WTP with the TCM is combination of the censored choke price and its affect on the price coefficient. Figure 1 also illustrates what the implied demand curve from the CVM looks like.

Figure 1. Implied Demand Curves for Recreational Trips Under CVM and TCM



Our very large difference in net WTP per trip due to the physical size limit of the island of Puerto Rico. We base this on the reference to the Carson et al. study typically showing equivalence of WTP for the two methods in estimating recreation benefits in large spatial markets. Thus, the difference in our study appears attributable to the limited size of the spatial market as dictated by the physical size of the island. It would be interesting to repeat this type of TCM and CVM analysis at similar quality recreation sites on islands of different sizes to see what the relationship is. As an island grows in size relative to the quality of the recreation site, the difference in the WTP estimates should be less pronounced. Alternatively, on islands smaller than Puerto Rico the bias could even be much larger. Researchers need to be aware of this concern when doing local recreation site valuation on islands where most of the visitor use is by island residents.

5. References

- Carson, R., N. Flores, K. Martin and J. Wright. 1996. Contingent Valuation and Revealed Preference Methodologies: Comparing Estimates for Quasi-Public Goods. *Land Economics* 72(1):80-99.
- Clawson M. and J. Knetsch. 1966. *Economics of Outdoor Recreation*. John Hopkins University Press, Baltimore.