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Effects on consumer welfare of visitor satisfaction with recreation information availability: a case study of the Allegheny National Forest

Seong-Hoon Cho

Department of Agricultural and Resource Economics, University of Tennessee, 2621 Morgan Circle, 314-D Morgan Hall, Knoxville, TN 37996–4518, USA. E-mail: scho9@utk.edu. (Corresponding author.)

J.M. Bowker

Southern Research Station, USDA Forest Service, 320 Green Street, Athens, GA 30602–2044, USA. E-mail: mbowker@fs.fed.us.

Roland K. Roberts

Department of Agricultural and Resource Economics, University of Tennessee, Knoxville, TN, USA. E-mail: rrobert3@utk.edu.

Seunggyu Kim

Department of Agricultural Economics, Kyungpook National University, 1370 Sangyeok-dong, Buk-gu, Daegu, 702–010, Republic of Korea. E-mail: sgkimwin@knu.ac.kr.

Taeyoung Kim

Department of Agricultural and Resource Economics, University of Tennessee, Knoxville, TN, USA. E-mail:tkim24@utk.edu.

Dayton M. Lambert

Department of Agricultural and Resource Economics, University of Tennessee, Knoxville, TN, USA. Email:dmlambert@tennessee.edu.

This research quantifies changes in consumer welfare due to changes in visitor satisfaction with the availability of information about recreational sites. The authors tested the hypothesis that an improvement in visitor satisfaction with recreation information increases the number of visits to national forests, resulting in increased consumer welfare. They tested the hypothesis with a travel cost model for the Allegheny National Forest using data from the National Visitor Use

Monitoring (NVUM) programme. An *ex ante* simulation suggests that annual per capita consumer welfare increased when highly satisfactory recreation information was available. The findings, along with the expected costs of providing better recreation information, may be a useful reference for recreation site managers who wish to increase the number of visits in an economically effective way.

Keywords: recreation information availability; consumer welfare; travel cost model; Allegheny National Forest

National forests provide a range of ecosystem services including recreational visits. More than 160 million people annually visited US national forests for recreational purposes during the period 2008–2012; 4 million more than during the period 2005–2009 (USDA Forest Service, 2013a). Despite the important function of national forests as recreational attractions, the federal budget allocated for recreational use in national forests has decreased due to ongoing budget uncertainty. For example, the budget for national forest system recreation programmes declined by more than 8% (from US$283 million to US$261 million) during the period 2012–2013 (USDA Forest Service, 2013b). During the government shutdown in October 2013, visitor centres, public facilities and developed areas, such as campgrounds, were forced to shut in all 155 national forests (National Forest Foundation, 2013). Recognizing economically effective ways to increase the number of recreational visits is important given the trade-off between recreational use and ever-tightening budgets.

Improved availability and satisfaction with information about recreational sites may be one way to increase national forests visitation numbers. The recreation literature suggests that: (a) recreational sites are used more uniformly and efficiently when visitors have improved information about the sites (Lime and Stankey, 1971); (b) satisfaction from visits to recreational sites depends on site physical characteristics and on the availability of information about recreation opportunities and facilities (Mayes *et al*, 2004); and (c) visitor perception about the availability of recreation information is important for developing the demand for outdoor recreation in regional parks (Sobering and Harshaw, 2011). Although previous literature has emphasized the importance of visitor perceptions about the availability of recreational-site information on recreational demand, few studies have quantified changes in the number of visits arising from changes in perceptions. Given the ongoing fiscal budget crisis, such information about consumer perceptions may prove important to the objective of increasing the volume of recreational visits to US national forests.

Objectives and significance of the analysis

The objective of this research is to quantify changes in consumer welfare arising from changes in visitor perceptions about the availability of recreation information. We tested the hypothesis that an improvement in visitor satisfaction with recreation information availability increases the number of visits to national

forests, thereby increasing consumer welfare. We tested the hypothesis with a travel cost model for the Allegheny National Forest based on data from the National Visitor Use Monitoring (NVUM) programme (USDA Forest Service, 2013c). Using estimates from a travel cost model, we predicted and compared the number of visits under the current level of visitor satisfaction with recreation information availability and under a hypothetically improved level of satisfaction information availability, *ceteris paribus*. The objective of the comparison was to examine the effects of visitor perceptions of site information availability on visitation volume and correspondingly, consumer welfare.

The analysis contributes to the travel cost literature in an important way. Empirical estimates of the impact of improvement in visitor information satisfaction about national forests recreational sites have a direct and explicit implication for increasing the number of recreational visits to national forests. Interest in increasing the number of recreational visits to national forests has received recent attention from forest managers, policymakers and stakeholders involved in recreation and tourism of national forests. Increasing travel costs driven by higher gasoline prices elevated interest in this policy issue (Fantazzini *et al*, 2011). The recent budget crisis and higher travel costs emphasize the need for research to find ways to increase recreational visits to national forests. Our research fills this knowledge gap by quantifying the effects of visitor perceptions about recreation information availability on the number of visits and corresponding consumer welfare.

Methodological challenges

We estimated the travel cost model for the Allegheny National Forest using data collected during Round 1 of the NVUM survey from October 2000 to September 2001 (Kocis *et al*, 2002) and survey Round 2 from October 2004 to September 2005 (USDA Forest Service, 2006). Six methodological challenges arise in specifying and estimating the visitation-travel cost model applied in this research: (a) examining outlier effects on model performance; (b) defining substitution possibilities between recreation sites; (c) interpreting on-site sample data; (d) addressing spatial interdependence between site visits; (e) ensuring the exogeneity of a key explanatory variable (for example, satisfaction with recreation information availability in the travel cost model); and (f) attending to the panel data structure of the periods analysed.

Challenge (a) arises because the travel cost model assumes visitor travel to forest sites is for recreational purposes only. Screening out multi-purpose trips is challenging because the information facilitating identification of the observations is not available in the NVUM survey.

Challenge (b) pertains to accommodating recreation site substitutability. A general method, in which substitution possibilities are permitted, is to include a vector of self-assessed prices of substitute recreation sites as explanatory variables (Starbuck *et al*, 2006; Keske and Loomis 2007). However, including such information is problematic for this study because the NVUM survey does not collect alternate site cost data.

Challenge (c) is associated with proper handling of unique characteristics of on-site sample data. The on-site sample data may over-represent frequent

visitors. Visits are also non-zero, non-negative outcomes. Modelling this type of survey data requires careful attention to statistical methods.

Challenge (d) arises because of information exchange, the locality of substitutes and preference sharing between visitors from neighbouring areas (Diamond, 1980; Smirnov and Egan, 2009). Exchange of information between neighbours about a recreational site (for example, word of mouth) may be important in the travel decision-making process, resulting in spatially clustered trip origin patterns (Hushak, 1975). Little, if any, of the recreation literature has explored accommodating spatial patterns in typical travel cost models.

Challenge (e) occurs because higher satisfaction with recreation information availability may lead to more visits, while at the same time visitors that frequent sites more often might be more familiar with the recreation information leading them to be more satisfied with the information.[1] Thus, satisfaction with recreation information availability and the number of visits may be simultaneously determined, potentially making satisfaction with recreation information availability an endogenous explanatory variable in the travel cost model.

Challenge (f) occurs because of potential changes in travel conditions (for example, changes in gasoline price and other travel expenses) between the two periods when the NVUM survey was collected. For example, the national average price per gallon of regular unleaded gasoline was US$1.10 in 2001 and US$2.20 in 2005 (nominal values). Thus, changes in travel conditions may affect the structure of the travel cost model between the two periods.

Empirical model

The travel cost model is specified as an annual number of visits and is a function of visitor characteristics (type of sites where survey participants were interviewed, interview conducted during Rounds 1 or 2 of the survey, the number of accompanying persons in the vehicle and the number of accompanying persons under 16 years old), travel costs to the Allegheny National Forest and to substitute sites, and survey participant satisfaction with recreation information availability. The model was estimated as described below while addressing the aforementioned methodological challenges.

In a sensitivity analysis addressing the multi-purpose trip issue of Challenge (a), outliers were examined in four ways: (i) observations with a value of Cook's D (that is, measures the effect of deleting a given observation (Cook (1977)) greater than $4/n$, where n is the number of observations that were not used; (ii) observations with a *dfbeta* value greater than 1 were excluded (that is, the change in the coefficient that emerges after deleting a given observation (Chen *et al*, 2003)); (iii) influential observations with a diagonal value of the $X(X'X)^{-1}X'$ matrix (the 'hat matrix') exceed $2k/n$, where k is the number of parameters in the model and X an n by k matrix of explanatory variables (Bollen and Jackman, 1990; Belsley *et al*, 2004) were omitted and (iv) all observations were included.

In relation to Challenge (b), only 18% and 33% (128 of 693 and 256 of 794) of the participants from Rounds 1 and 2, respectively, answered the survey question regarding substitute recreation sites, 'Have you been elsewhere for

different activities during the past 12 months?' This type of missing information may lead to omitted variable bias regarding the prices of substitute recreation sites, which, in turn, may bias welfare estimates of price changes (Gum and Martin, 1975; Henderson, 1991; Levine, 1999; Brasington and Hite, 2005). Thus, we used travel costs based on travel distances from a visitor's origin to the nearest national park or forest, state park or forest and local park or forest to proxy the cost of substitute recreation sites.

To address Challenge (c), the probability distribution of the number of visits (Y_i) during the previous 12 months, which always exceeds zero, was specified using the zero truncated negative binomial distribution (Greene, 1994):

$$\Pr(Y = Y_i \mid Y > 0) = \frac{\Gamma(Y_i + 1/\alpha)}{\Gamma(Y_i + 1)\Gamma(1/\alpha)} (\alpha\mu_i)^{Y_i} (1 + \alpha\mu_i)^{-Y_i+1/\alpha} \left(\frac{1}{1-(1 + \alpha\mu_i)^{-1/\alpha}} \right), \quad (1)$$

where $Y = Yi$ is the annual number of visits to the Allegheny National Forest, α is an overdispersion parameter and μ_i is the expected value of the distribution.

A spatial heteroscedastic autocorrelation consistent (HAC) estimator was applied to Equation (1) to attend to Challenge (d). Lambert and McNamara (2009) modified Kelejian and Prucha's (2007) spatial HAC estimator for the negative binomial regression. Stewart and Lambert (2011) used a similar approach to modify the bivariate probit covariance estimator to attend to spatial covariance and heteroscedasticity. Covariance among the observations was modelled using a kernel density function, to define the extent to which spatial autocorrelation decays between visitor origins. We examined the performance of Parzen (1962), Epanechnikov (1969), Bartlett (Newey and West, 1987) and bi-square kernels (Stock, 1991) to check the sensitivity of the standard errors estimated with each kernel. We also used bandwidths with $n^{1/4}$, $n^{1/3}$ and $n^{1/2}$ cut-off values as a further sensitivity analysis of statistical inference. Details about the spatial HAC estimator associated with kernel functions and bandwidth selection are available in Kelejian and Prucha (2007) and Lambert and McNamara (2009).

Regarding Challenge (e), the endogeneity of visitor satisfaction with recreation information availability was tested following Wooldridge (2002, pp 663–665) to determine if participant satisfaction with recreation information availability was correlated with an unobserved latent variable. This unobserved heterogeneity is potentially affected by the annual number of visits. Participant ratings of importance of recreation information availability was used as an instrumental variable in the endogeneity test since it is potentially correlated with information satisfaction, but uncorrelated with the annual number of visits. The Anderson Lagrange multiplier (LM) statistic of 115.50 rejected the null hypotheses that the importance of recreation information availability is correlated with satisfaction with recreation information availability, and the Cragg–Donald Wald F statistic of 167.37 rejected the null hypothesis of weak identification (Baum *et al*, 2003), suggesting appropriateness of recreation information availability as an instrumental variable for the endogeneity test.

To address Challenge (f), we performed a Chow test to determine if the regression coefficients were not different when using the NVUM Round 1 and 2 surveys. The null hypothesis could not be rejected (F-statistic = 2.719, p-value = 0.100), suggesting the two periods could be pooled. To reaffirm the

stability of the coefficients between the two rounds, we included a dummy variable for the survey round and its interaction with participant satisfaction with recreation information availability. The coefficient for the interaction term was not significant at the 5% level (t = 0.967, p-value = 0.330), suggesting no inter-period differences between the two survey rounds. Consequently, we kept the structure of the travel cost model constant between the two rounds, but included the dummy variable to allow different intercepts.

Consumer welfare

We predicted the annual number of visits under the *status quo* level of visitor satisfaction with recreation information availability represented by the satisfaction dummy variable being 1 or 0 depending on each visitor's answer. We also predicted the annual numbers of visits under a hypothetically improved level of information satisfaction under the assumption that 100% of visitors have a 1 for this dummy variable, *ceteris paribus*. We used the predicted annual number of visits under the two assumptions to calculate the change in average annual per capita consumer welfare based on Heberling and Templeton (2009):

$$\Delta CS/\text{person/year} = \Sigma_{i=1}^{N} (\hat{Y}_{i,hypothetical} - \hat{Y}_i) \times \frac{(-1/\beta_{travel\ cost})}{NP_i} \times \frac{1}{N}, \quad (2)$$

where $\beta_{travel\ cost}$ is the travel-cost coefficient for observation i; $\hat{Y}_{i,hypothetical}$ is the predicted annual number of visits under the hypothetical improvement in satisfaction arising from recreation information availability; $\hat{Y}_i$ is the predicted annual number of visits under the *status quo* level of information satisfaction; NP_i is number of people in the vehicle; and N is the number of observations.

Study area and data

Study area

The Allegheny National Forest was chosen for the analysis. It covers 512,998 acres of land located in northwestern Pennsylvania and represents sites with common recreational opportunities and demands (USDA Forest Service, 2013d). The National Forest was established in 1923 as part of the Weeks Acts that were enacted in 1911 (Whitney, 1990). During the period after initial establishment, visitors enjoyed recreational activities such as hunting and fishing. After the Allegheny Reservoir was developed in 1965, recreational opportunities expanded into activities using campgrounds, boat launches, beaches, picnic areas, hiking trails and views around the Reservoir.

NVUM survey

The NVUM programme of the USDA Forest Service has surveyed more than 100,000 visitors to 120 national forests in the United States on a 5-year cycle since 2000. The NVUM programme was established to develop reliable estimates of recreation use of the National Forest System through a nationally

consistent, statistically valid sampling approach (White and Wilson, 2008). Survey respondents were asked face-to-face questions about demographics and visit descriptions at 7,532 different sites across the National Forest System (Bowker *et al*, 2005; USDA Forest Service, 2005).

Data

The annual number of visits was collected through the NVUM question, 'Including this visit, about how many times have you come to this National Forest for recreation in the last 12 months?' (USDA Forest Service, 2007). Information was collected about the types of recreational sites at which the participants were interviewed. Three dummy variables, indicating the type of sites where participants were interviewed, were created from this information. Participants were interviewed at four types of sites (day-use developed sites, overnight-use developed sites, and general forest area and wilderness sites) and 'general forest area' was used as the reference dummy variable (O'Neill and Davis, 1991). A dummy variable indicating the survey round (1 if the survey was taken in Round 2 and 0 otherwise) was created. The number of accompanying people in the vehicle and the number of accompanying people under 16 years old were collected from the NVUM questions, 'How many people (including you) travelled here in the same vehicle as you?' and 'How many of those people are less than 16 years old?'.

Information about visitor satisfaction with recreation information availability was collected from the answer to the survey request, 'Rate your satisfaction or dissatisfaction with recreation information availability.' Ratings were based on a five-point scale (very dissatisfied, somewhat dissatisfied, neither dissatisfied nor satisfied, somewhat satisfied and very satisfied) using a flash card. The survey request did not explicitly specify the kind of recreation information. However, we can reasonably assume that survey participants rated the information available at the recreation site where they were interviewed (referred to as 'on-site information') because the survey participants were interviewed while exiting the survey site.

The on-site information that survey participants rated may have included: operation hours, weather alerts, safety notices, signs of available amenities (such as interpretive site, picnic area, camping amenities, toilets, drinking water and parking), signs of available recreational activities (such as water-, viewing-, picnicking-, education-, recreational motor vehicle-, winter sports-, gathering- and hunting-related recreational activities), and daily use fee, site reservation, and lodging information. Conversely, information that may have been obtained from websites, emails and mail-order brochures prior to visiting the site was supposedly not considered when survey participants responded to the request to rate their satisfaction with on-site information.

A dummy variable equal to 1 if the participant was 'somewhat satisfied' or 'very satisfied' and 0 otherwise, was included as an explanatory variable. Participants were asked to rate the importance of recreation information availability by responding to the request, 'Rate the importance of the recreation information availability.' The rating was based on a 10-point scale (1 being the least important and 10 being the most important). The importance rating was used

Table 1. Variable names, definitions and descriptive statistics.

Variable	Description	Mean	SD	Min	Max
Number of visits	Number of visits during the previous 12 months	23.147	55.479	1	365
TC to ANF	TC for round trip ($) to the Allegheny National Forest (ANF)	29.494	70.031	0.130	730.830
TC to national park or forest	TC for round trip ($) to nearest other national park or forest	170.591	70.112	9.380	329.560
TC to state park or forest	TC for round trip ($) to nearest state park or forest	29.609	15.899	0.000	76.720
TC to local park or forest	TC for round trip ($) to nearest local park or forest	57.659	39.902	0.700	170.380
Day-use developed site	1 if the participant was interviewed at a day-use developed site, 0 otherwise	0.490	0.501	0	1
Overnight-use developed site	1 if the participant was interviewed at an overnight-use developed site, 0 otherwise	0.202	0.402	0	1
Wilderness site	1 if the participant was interviewed at a wilderness site, 0 otherwise	0.046	0.210	0	1
Survey round	1 if the participant was surveyed in Round 1, 0 otherwise	0.617	0.487	0	1
Number of accompany people under 16	Number of accompanying people under 16 years old	0.683	1.101	0	5
Number of accompanying people	Number of accompanying people in the same vehicle	2.666	1.370	1	8
Satisfaction with recreation information availability	Satisfaction dummy variable (1 if somewhat satisfied or very satisfied, 0 otherwise)	0.784	0.412	0	1
Importance of recreation information availability[a]	Importance rating ranging from 1 (least important) to 10 (most important)	7.708	2.611	1	10

Notes: [a]Indicates instrumental variable. TC = travel cost.

as an instrumental variable to test for the endogeneity of visitor satisfaction with recreation information availability.

Visitor travel costs to the Allegheny National Forest and to substitute sites (that is, the nearest national park or forest, the nearest state park or forest and the nearest local park or forest) were calculated by multiplying the estimated distances in miles by standard mileage reimbursement rates in 2001 and 2005 (IRS, 2013) for Rounds 1 and 2 of the NVUM survey, respectively. Descriptions and detailed statistics for variables used in the travel cost model are reported in Table 1.

Empirical results

Model and sample selection

While some deviations from the negative binomial distribution were observed, the deviation between the observed distribution and negative binomial distribution simulated with the expected value (μ_i) and overdispersion (α) parameters of 23.15 and 1.85 was not significant (p = 0.294, Kolmogorov–Smirnov test). This result provides no evidence of oversampling of frequent visitors in our dataset (Meisner *et al*, 2006).

The Cook's distance, dfbeta and influence statistics, respectively identified 10, 1 and 23 observations as potential outliers. The magnitude and statistical significance of all coefficients, including the coefficient for travel cost to the Allegheny National Forest, were sensitive to the different outlier detection methods. The three methods did not offer clear evidence about which outliers to remove. Selection of kernel functions and bandwidths for the spatial HAC estimator did not change the significance levels at the 5% when all observations were used (see Appendix Tables A1, A2 and A3). Given these results, the regression results using all observation, a bi-square kernel and the K-nearest neighbour (KNN = $n^{1/2}$, where n = 347) are presented in Table 2 and were used to calculate the change in average annual per capita consumer welfare.

The null hypothesis of no endogeneity of visitor satisfaction with recreation information availability could not be rejected at the 5% level (see Appendix Table A4, ρ = –0.086, standard error = 0.413). This result suggests that the residuals of the visitation model are uncorrelated with recreation information availability, providing support for treating satisfaction with recreation information availability as an exogenous variable.

Parameter estimates and consumer welfare

Travel cost, site type (day-use developed sites, overnight-use developed sites and wilderness sites), survey round and satisfaction with recreation information were significant at the 5% level (hereafter, significant at the 5% level is referred to as 'significant'), while the number of accompanying people under 16 years old, number of accompanying people in the vehicle and travel cost to three types of substitute sites were not significant (see Table 2). The negative marginal effect of travel cost on the annual number of visit suggests that an increase of US$1 in the travel cost of a round trip decreases the number of annual visits by 0.044 visits, which is typical of price–demand relationships.

Table 2. Zero-truncated negative binomial regression estimates.

Variables	Coefficient	Marginal effect
TC to ANF	–0.004*	–0.044*
	(0.002)	(0.016)
TC to national park or forest	0.004	0.043
	(0.003)	(0.027)
TC to state park or forest	0.003	0.029
	(0.006)	(0.058)
TC to local park or forest	0.010*	0.100*
	(0.005)	(0.048)
Day-use developed sites	–0.820*	–8.420*
	(0.220)	(2.550)
Overnight-use developed sites	–1.614*	–11.168*
	(0.272)	(1.878)
Wilderness site	–1.519*	–8.434*
	(0.450)	(1.584)
Survey round	0.136	1.351
	(0.186)	(1.824)
Number of accompanying people under 16	–0.196	–1.972
	(0.161)	(1.634)
Number of accompanying people	–0.014	–0.143
	(0.111)	(1.118)
Satisfaction with recreation information availability	0.547*	4.777*
	(0.224)	(1.777)
Intercept	1.506*	–
	(0.543)	–
N = 347		

Notes: *Indicates statistical significance at the 5% level. Standard errors are in parentheses, estimated using a spatial HAC covariance estimator (bi-square kernel, 19 nearest neighbours) modified for the zero-truncated negative binomial regression. TC = travel cost.

The negative marginal effects of the three site-type dummy variables suggest that the number of annual visits decreased by 8.420, 11.168 and 8.434 visits if the survey was conducted at day-use developed sites, overnight-use sites and wilderness sites, respectively, compared to the number of visits to the general forest area. This finding reflects the popularity of the general forest area (USDA Forest Service, 2013a). The insignificant of the coefficient for the survey round dummy variable suggests that annual visits in Round 2 were not significantly different from those in Round 1.

The travel costs to the nearest national park or forest and travel cost to the nearest state park or forest did not have significant effects while travel cost to the nearest local or forest was positive and significant. The positive marginal effect of travel cost to the nearest local park or forest suggests that an increase of US$1 in the travel cost of a round trip to the nearest local park or forest increases the number of annual visits by 0.100 visits. These findings suggest that, among three types of substitute sites, the nearest local park or forest is a substitute recreational site for Allegheny National Forest.

The positive marginal effect of the perception on availability of recreational information indicates that visitors would increase the annual number of visits

by close to five times if the said perception was improved from the 'non-satisfactory' to the 'satisfactory' level, *ceteris paribus*. The predicted annual number of visits per capita for the *status quo* (78.4% of the 347 participants indicated 1 for the satisfaction dummy variable and 21.6% indicated 0) was 17.18 visits and the predicted annual number of visits per capita for the hypothetically improved level of satisfaction with recreation information availability (that is, the satisfaction dummy variable was assumed to be 1 for all 347 participants) was 18.70 visits. The increased annual consumer welfare due to improved satisfaction with recreation information availability was estimated to be US$95.07 per capita annually obtained through Equation (2) (or US$347 million for all 683,000 visitors in 2005).

This finding and the positive marginal effect for satisfaction with recreation information availability imply that we reject the hypothesis that an improvement in the visitors' satisfaction with recreation information availability has no effect on the number of visits to national forests or consumer welfare.

Conclusion

We estimated a travel cost model for the Allegheny National Forest using NVUM data to test the hypothesis that an improvement in satisfaction with the availability of information about recreational sites increases consumer welfare. Using the parameter estimates from the travel cost model, we predicted the number of visits and corresponding consumer welfares at the *status quo* and hypothetically improved levels of satisfaction with recreation information availability.

An *ex ante* simulation demonstrated annual per capita consumer welfare increased with a hypothetical improvement in visitor satisfaction with recreation information availability. Our results provide a useful reference point for recreation-site managers who wish to increase site visits in an economically effective way. We provide an estimate of the benefits from improving visitor satisfaction with the availability of recreation-site information in the Allegany National Forest, but do not address the cost of that improvement. A complete cost–benefit analysis would help recreation-site managers make decisions about improving the availability of recreation information as they attempt to increase the number of visits in economically effective ways. Thus, further analysis is needed to measure the costs of providing more and better recreation information.

The analysis warrants some caveats. First, the opportunity cost of travel time to the Allegany National Forest was not considered in our travel cost model because income information was not available from the NVUM survey. Second, the lowest rate among the applicable IRS standard mileage reimbursement rates (IRS, 2013) was used to estimate travel costs to the Allegheny National Forest and to substitute sites. These two caveats would lead to an underestimation of travel costs, leading to an underestimation of the gain in consumer welfare due to the improvement in visitor satisfaction with recreation information availability. Third, we used all observations to estimate the travel cost model because we were unable to identify and exclude outliers that may have been multi-purpose trips. This inability to identify and exclude observations with multi-

purpose trips may have exaggerated our consumer welfare estimates because all benefits from multi-purpose trips would have been allocated to visiting the Allegany National Forest.

Endnote

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Appendix

Table A1. Regression results after removing observations detected as outliers by Cook's distance, dfbeta and influence statistics.

Variable	Entire obs	Cook's D	dfbeta	Influence statistics
TC to ANF	–0.004*	–0.004	–0.005*	–0.008
	(0.001)	(0.001)	(0.001)	(0.010)
TC to national park or forest	0.004	0.002	0.004	0.005
	(0.004)	(0.003)	(0.003)	(0.078)
TC to state park or forest	0.003	–0.001	0.005	0.003
	(0.003)	(0.003)	(0.003)	(0.008)
TC to local park or forest	0.010	0.005	0.007	0.007
	(0.006)	(0.005)	(0.006)	(0.015)
Day-use developed sites	–0.820*	–0.576*	–0.521*	–0.825*
	(0.152)	(0.167)	(0.131)	(0.179)
Overnight-use developed sites	–1.614*	–0.944*	–1.305*	–1.648*
	(0.154)	(0.172)	(0.186)	(0.738)
Wilderness site	–1.519*	–1.026*	–1.286*	–1.170
	(0.288)	(0.297)	(0.302)	(1.467)
Survey round	0.136*	–0.217	0.070	0.160
	(0.013)	(0.117)	(0.060)	(0.328)
Number of accompany people under 16	–0.196	–0.062	–0.066	–0.146
	(0.157)	(0.086)	(0.128)	(0.947)
Number of accompanying people	–0.014	–0.210*	–0.226*	–0.062
	(0.010)	(0.076)	(0.106)	(1.804)
Satisfaction with recreation information availability	0.547*	0.445*	0.831*	0.522
	(0.135)	(0.123)	(0.160)	(0.325)
Intercept	1.506*	2.517*	1.639*	1.673
	(0.439)	(0.335)	(0.398)	(1.102)
N	347	337	346	324

Notes: *Indicates statistical significance at the 5% level. Standard errors are in parentheses, estimated using a spatial HAC covariance estimator (bi-square kernel, 19 nearest neighbours) modified for the zero-truncated negative binomial regression. TC = travel cost.

Table A2. Regression results using different kernel functions of the spatial HAC covariance estimator.

Variable	Kernel function			
	Parzen	**Epanechnikov**	**Bartlett**	**Bi-square**
TC to ANF	–0.004*	–0.004*	–0.004*	–0.004*
	(0.001)	(0.001)	(0.001)	(0.001)
TC to national park or forest	0.004	0.004	0.004	0.004
	(0.005)	(0.004)	(0.004)	(0.004)
TC to state park or forest	0.003	0.003	0.003	0.003
	(0.004)	(0.003)	(0.003)	(0.003)
TC to local park or forest	0.010	0.010	0.010	0.010
	(0.010)	(0.006)	(0.007)	(0.007)
Day-use developed sites	–0.820*	–0.820*	–0.820*	–0.820*
	(0.169)	(0.152)	(0.173)	(0.173)
Overnight-use developed sites	–1.614*	–1.614*	–1.614*	–1.614*
	(0.165)	(0.154)	(0.169)	(0.172)
Wilderness site	–1.519*	–1.519*	–1.519*	–1.519*
	(0.358)	(0.288)	(0.336)	(0.334)
Survey year	0.136*	0.136*	0.136*	0.136*
	(0.035)	(0.013)	(0.001)	(0.006)
Number of accompanying people under 16	–0.196	–0.196	–0.196	–0.196
	(0.206)	(0.157)	(0.181)	(0.180)
Number of accompanying people	–0.014	–0.014	–0.014	–0.014
	(0.144)	(0.100)	(0.125)	(0.125)
Satisfaction with recreation information availability	0.547*	0.547*	0.547*	0.547*
	(0.195)	(0.135)	(0.159)	(0.153)
Intercept	1.506*	1.506*	1.506*	1.506*
	(0.559)	(0.439)	(0.519)	(0.521)
N	347	347	347	347

Notes: *Indicates statistical significance at the 5% level. Standard errors are in parentheses, estimated using a spatial HAC covariance estimator (19 nearest neighbours) modified for the zero-truncated negative binomial regression. TC = travel cost.

Table A3. Regression results using different bandwidths.

Variable	Bandwidth cut-off value		
	KNN 4 ($=n^{1/4}$)	KNN 7 ($=n^{1/3}$)	KNN 19 ($=n^{1/2}$)
TC to ANF	–0.004*	–0.004*	–0.004*
	(0.001)	(0.001)	(0.001)
TC to national park or forest	0.004	0.004	0.004
	(0.003)	(0.003)	(0.004)
TC to state park or forest	0.003	0.003	0.003
	(0.003)	(0.004)	(0.003)
TC to local park or forest	0.010*	0.010	0.010
	(0.004)	(0.005)	(0.006)
Day-use developed sites	–0.820*	–0.820*	–0.820*
	(0.123)	(0.132)	(0.152)
Overnight-use developed sites	–1.614*	–1.614*	–1.614*
	(0.133)	(0.152)	(0.154)
Wilderness site	–1.519*	–1.519*	–1.519*
	(0.304)	(0.297)	(0.288)
Survey round	0.136	0.136	0.136*
	(0.098)	(0.110)	(0.013)
Number of accompanying people under 16	–0.196*	–0.196	–0.196
	(0.088)	(0.107)	(0.157)
Number of accompanying people	–0.014	–0.014	–0.014
	(0.064)	(0.068)	(0.110)
Satisfaction with recreation information availability	0.547*	0.547*	0.547*
	(0.118)	(0.126)	(0.135)
Intercept	1.506*	1.506*	1.506
	(0.421)	(0.429)	(0.439)
N	347	347	347

Notes: *Indicates statistical significance at the 5% level. Standard errors are in parentheses, estimated using a spatial HAC covariance estimator (bi-square kernel) modified for the zero-truncated negative binomial regression. TC = travel cost.

Table A4. Regression results for the endogeneity test.

Variable	Coefficient
TC to ANF	–0.005*
	(0.001)
TC to national park or forest	0.004
	(0.004)
TC to state park or forest	0.003
	(0.005)
TC to local park or forest	0.009
	(0.007)
Day-use developed site	–0.824*
	(0.331)
Overnight-use developed site	–1.623*
	(0.173)
Wilderness site	–1.526*
	(0.375)
Survey round	0.149*
	(0.053)
Number of accompanying people under 16	–0.192
	(0.221)
Number of accompanying people	–0.016
	(0.196)
Satisfaction with recreation information availability	0.612*
	(0.299)
Intercept	1.492*
	(0.650)
ρ	–0.086
	(0.413)
N	347

Notes: *Indicates statistical significance at the 5% level.