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The Value of Time:
Combining Revealed and Stated Preference Data to Estimate Recreation Demand

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ABSTRACT

This paper explores the proper valuation of time when estimating recreational demand, where time costs represent a substantial portion of the "purchase price". To estimate demand, this paper uses travel cost analysis of revealed preference data and contingent behavior analysis of stated preference data. The contingent behavior analysis considers hypothetical increases in access fees, travel time, and travel distance. Based on responses to these contingencies, this analysis improves the valuation of time costs using the effect of increased access fees as the monetary benchmark. As evidence of improvement, adjusting time costs greatly increases the consistency between the revealed and stated data. Similarly, this paper improves the valuation of transportation-related costs.

Keywords: Recreation, Travel Cost, Revealed Preference Data, Stated Preference Data
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1. Introduction

The proper valuation of time is important for estimating the demand for several economic goods. Examples include automobile use (McFadden, 1974; Calfee and Winston, 1998), money (Mulligan, 1997), labor (Gronau, 1973; Grossbard et al., 1988), medical care (Cauley, 1987), energy (Deacon and Sonstelie, 1985), residential homes (Hochman and Ofek, 1977), air travel (De Vany, 1974), and household production goods (Becker, 1965). In the field of environmental economics, estimating the demand for recreational goods has a long history of research (Clawson, 1959; Bockstael, 1995). The main analytical framework is the travel cost model, in which travel costs ("purchase price") include access costs (e.g., entrance fee), transportation costs (e.g., vehicle depreciation), and time costs (i.e., opportunity costs). In empirical analysis, time costs generally represent a substantial portion of travel costs. Historically, economic analysis employed the travel cost model to examine actual recreational demand to measure revealed preferences over recreational goods. Recently, economic analysis has begun to employ an associated analytical method, contingent behavior analysis, to investigate intended demand under various circumstances (e.g., increase in entrance fee) to measure stated preferences over recreational goods. This paper employs both methods and types of preference data.

Although valuation of time costs is critical to the analysis of recreation demand (Chavas et al., 1989), most analyses address it in an ad hoc fashion, such as exploring multiple adjustment factors and selecting the factor that generates the best goodness of fit (e.g., Layman et al., 1996). Only a few previous analyses address the monetary valuation of time (Bockstael et al., 1987; Smith et al., 1983; McConnell and Strand, 1981; Casey et al., 1995; Larson, 1993). In general, it is difficult to address separately the individual components of travel costs — access fees, time costs, and transport costs — for two reasons. First, access fees do not vary across individuals and do not vary much across sites. Second, time and transport costs are highly collinear. Fortunately, contingent behavior analysis employed in this paper overcomes both of these impediments by generating variation in access fees and orthogonal data with respect to travel time costs by forcing current recreators to consider an increased entrance fee and travel time, respectively.[1] By estimating the responses to hypothetical changes in access fees and travel time, this paper explores the implicit trade-offs between money and time and provides better valuation of time costs. Results of this study show that better valuation greatly improves the consistency between revealed and stated preference data.[2] It also improves the consistency between stated demand measured in levels and changes in levels. In a similar fashion, this paper improves the valuation of transport costs and the associated consistency between revealed and stated preference data.

The rest of the paper is structured as follows. The following section theoretically frames the analysis of recreational demand. Section 3 describes the testing of consistency between revealed and stated preference data. Section 4 depicts the empirical application to Clinton Lake in Kansas. Section 5 provides regression estimates and consistency tests given the initial valuation of travel costs. Section 6 adjusts time and transport costs and re-tests consistency. Section 7 summarizes.

2. Theoretical Framework of Preferences and Behavior

The demand model describing the revealed preference (RP) data assumes that individual *i* allocates his/her

[1] Most previous contingent behavior studies consider only changes in the access fee (Cameron, 1992; Herriges et al., 1999; Loomis and Gonzalez-Caban, 1997; Englin and Cameron, 1996). Surprisingly, no previous study considers an increase in travel time or distance. [Adamowicz et al. (1994) consider variation in travel distance within a multiple-site random utility framework.]

[2] Previous studies also explore the consistency between revealed preference data and stated preference data used in travel cost analysis and contingent behavior analysis (Adamowicz et al., 1994; Cameron, 1992; Layman et al., 1996; Herriges et al., 1999).

income y_i between a composite commodity z_i^{RP} and a recreation good q_i^{RP}. This allocation depends on the price of the recreation good, denoted p_i^{RP} and titled "travel costs", and other factors, denoted x_i. (Note that y_i and x_i are not specific to the RP data.) The ordinary Marshallian demand function associated with the recreation good is the following:

$$q_i^{RP} = f^{RP} (p_i^{RP}, y_i, x_i; \hat{a}^{RP}) + g_i^{RP} , \qquad (1)$$

where $\hat{a}^{RP}$ is the vector of unknown parameters and g_i^{RP} is the additive stochastic term, which is assumed to follow a normal distribution: $g_i^{RP} \sim N(0,\acute{o}_{RP}^2)$.

In theory and practice, the price of the recreation good, p_i^{RP}, generally consists of three components: (1) transport costs, t_i^{RP}, (2) time (or opportunity) costs, o_i^{RP}, and (3) access fees, a_i^{RP}, so that $p_i^{RP} = t_i^{RP} + o_i^{RP} + a_i^{RP}$. In theory, this decomposition permits the proper monetary valuation of transport costs (associated with travel distance) and time costs. [See Bockstael et al. (1987) and Smith et al. (1983) for rigorous models on the monetary valuation of time costs.] One can regress recreational demand against the decomposed travel costs, i.e., estimate the following equation:

$$f(q_i^{RP}) = \acute{a}^{RP} + \hat{a}_t^{RP} t_i^{RP} + \hat{a}_o^{RP} o_i^{RP} + \hat{a}_a^{RP} a_i^{RP} + \hat{a}_y^{RP} y_i + \hat{a}_x^{RP} x_i , \qquad (2)$$

where the separate coefficients related to t_i^{RP}, o_i^{RP}, and a_i^{RP}, are denoted respectively $\hat{a}_t^{RP}$, $\hat{a}_o^{RP}$, and $\hat{a}_a^{RP}$. If transport costs and time costs are <u>properly</u> measured in monetary terms, then the ratios $\hat{a}_t^{RP}/\hat{a}_a^{RP}$ and $\hat{a}_o^{RP}/\hat{a}_a^{RP}$ should both equal 1 (i.e., $\hat{a}_t^{RP} = \hat{a}_o^{RP} = \hat{a}_a^{RP}$). If not true, these ratios represent the proper factor for adjusting the monetary valuation of transport and time costs, respectively, given the effect of access costs on demand as the proper benchmark.

In practice, decomposition of travel costs generally does not permit empirical analysis to calculate these adjustment factors with any confidence, if at all. First and foremost, access fees generally do not vary across individuals for a single site at a given time and generally vary little across multiple sites or time. Therefore, it is quite difficult to estimate $\hat{a}_a^{RP}$. Second, travel distance and time are highly correlated (Bockstael et al., 1987; Bockstael, 1995). Therefore, multicollinearity undermines accurate estimation of the individual coefficients associated with transport and time costs, $\hat{a}_t^{RP}$ and $\hat{a}_o^{RP}$, since it generates coefficients with wrong signs and/or implausible magnitudes (Greene, 1997). This concern notwithstanding McConnell and Strand (1981) exploit the monetary nature of transport costs and use the ratio of $\hat{a}_o^{RP}/\hat{a}_t^{RP}$ to estimate the ratio between the value of time and the wage rate. Their approach accepts the notion that individuals view transport costs at full value and disregards the concern of accurate estimation in the presence of multicollinearity.

Smith et al. (1983) also attempt to estimate separate effects for transport and time costs. They test whether time costs seem to be based on either full wage rates or one-third the wage rate as predicted by Cesario (1976). As expected, multicollinearity between these two types of costs generates contradictory signs for one of the effects in 12 of the 22 cases and implausibly large ratios between time value and wage rate for the majority of the remaining cases. These results and results shown in Section 5 undermine the validity of the McConnell and Strand (1981) approach.

Fortunately, contingent behavior analysis avoids these pitfalls. First, it can generate variation in access fees by asking the following question: "How many fewer recreational trips would you take if the access fee increases by $ A?" Second, contingent behavior analysis can generate data that contains orthogonal data on transport and time costs by asking the following questions: "How many fewer recreational trips would you take if your one-way travel time increased by B minutes?" and "How many fewer recreational trips would you take if the one-way distance from your home increased by C miles, yet your travel time remained the same?" The first question poses an increase only in time costs, while the second poses an increase only in transport costs.

Unfortunately, the second question proves too difficult to implement within a survey format. Instead, the chosen survey question combines the effects of transport and opportunity costs by asking the following question: "How many fewer recreational trips would you take if your one-way distance from home increased by D miles?" Although less analytically appealing then the previous question, it is much more realistic. Moreover, it is completely consistent with the common empirical approach of treating transport and time costs as a composite by measuring only travel distance and inferring travel time based on some fixed driving speed. With an additional step, the econometric analysis in Section 6.2 isolates the effect of transport costs on recreational demand by subtracting the "pure" effect of time costs. The contingent behavior analysis also asks respondents to state their intended demand under actual / normal circumstances.

Similar to the revealed preference data, the stated responses to the four contingent behavior questions stem from an underlying set of preferences or its associated demand equation. The demand model describing the stated preference (SP) data assumes that individual *i* allocates his/her income y_i between a composite commodity z_i^{SP} and a recreation good q_i^{SP}. This allocation depends on the price of the recreation good, $p_i^{SP} = t_i^{SP} + o_i^{SP} + a_i^{SP}$, and other factors, x_i. The ordinary Marshallian demand function associated with the recreation good is the following:

$$q_i^{SP} = f^{SP} (p_i^{SP}, y_i, x_i; \beta^{SP}) + \varepsilon_i^{SP} , \qquad (3)$$

where β^{SP} is the vector of unknown parameters and ε_i^{SP} is the additive stochastic term, which is assumed to follow a normal distribution: $\varepsilon_i^{SP} \sim N(0,\sigma_{SP}^2)$. For generality and testing purposes, each survey question is constructed as stemming from a separate demand equation. The four SP equations regarding actual / normal circumstances ("n" stands for normal), increased access fees, increased time costs, and increased transport and time costs ("d" stands for "distance") are shown below:

Actual / Normal Circumstances: $$q_i^{SPn} = f^{SPn}(p_i^{SPn}, y_i, x_i; \hat{a}^{SPn}) + g_i^{SPn}, \quad (4a)$$

Increased Access Fees: $$q_i^{SPa} = f^{SPa}(p_i^{SPa}, y_i, x_i; \hat{a}^{SPa}) + g_i^{SPa}, \quad (4b)$$

Increased Time Costs: $$q_i^{SPo} = f^{SPo}(p_i^{SPo}, y_i, x_i; \hat{a}^{SPo}) + g_i^{SPo}, \quad (4c)$$

Increased Transport and Time Costs: $$q_i^{SPd} = f^{SPd}(p_i^{SPd}, y_i, x_i; \hat{a}^{SPd}) + g_i^{SPd}, \quad (4d)$$

Intended demand under actual / normal circumstances represent levels of demand. In essence, stated preference data on demand levels under actual circumstances represent ex ante visitation, while revealed preference data on demand levels represent ex post visitation. Responses to the three contingent behavior questions noted above (i.e., "how many *fewer* trips ...?") represent changes in demand. Therefore, the empirical analysis estimates these changes: $Äq_i^{SPa}$, $Äq_i^{SPo}$, and $Äq_i^{SPd}$, where Ä denotes a change in demand. Most previous analyses phrase the contingent behavior questions to generate responses on demand levels under hypothetical circumstances or sum the changes in demand and intended levels to identify demand levels after the hypothetical change (Cameron et al., 1996; Herriges et al., 1999). The chosen question format seems more focused by linking changes in "price" to changes in demand and the chosen analytical approach seems more consistent with the question format.[3, 4]

For the empirical analysis, I specify the functional form of demand for the RP and SP data in both linear and semilog form to demonstrate robustness of the final results:

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[3] For completeness, I also calculate demand levels after the three hypothetical changes and estimate the relevant demand level equations; empirical results are available upon request.

[4] Although this analysis focuses on these changes in demand, it also examines demand levels for three reasons. First, the revealed data is measured only in levels. Second, to confirm the usefulness of testing the consistency between RP data and SP data on demand changes, the analysis must first test the consistency between RP data and SP data on demand levels. Third, inclusion of information on levels improves the overall estimation of demand within the chosen seemingly unrelated regression (SUR) econometric approach, which is described in Section 3.

Linear:

$$q_i^{RP} = á^{RP} + â_t^{RP} t_i^{RP} + â_o^{RP} o_i^{RP} + â_a^{RP} a_i^{RP} + â_y^{RP} y_i + â_x^{RP} x_i + g_i^{RP}\ , \tag{5a}$$

$$q_i^{SPk} = á^{SPk} + â_t^{SPk} t_i^{SPk} + â_o^{SPk} o_i^{SPk} + â_a^{SPk} a_i^{SPk} + â_y^{SPk} y_i + â_x^{SPk} x_i + g_i^{SPk}, \text{ where } k å \{n,a,o,d\}. \tag{5b}$$

Semilog:

$$\ln q_i^{RP} = á^{RP} + â_t^{RP} t_i^{RP} + â_o^{RP} o_i^{RP} + â_a^{RP} a_i^{RP} + â_y^{RP} y_i + â_x^{RP} x_i + g_i^{RP}\ , \tag{6a}$$

$$\ln q_i^{SPk} = á^{SPk} + â_t^{SPk} t_i^{SPk} + â_o^{SPk} o_i^{SPk} + â_a^{SPk} a_i^{SPk} + â_y^{SPk} y_i + â_x^{SPk} x_i + g_i^{SPk}, \text{ where } k å \{n,a,o,d\}. \tag{6b}$$

In the linear case, absolute changes in stated demand, $Äq_i^{SPk}$, relate to absolute changes in one or two of the price components — $Ät_i^{SPk}$, $Äo_i^{SPk}$, and $Äa_i^{SPk}$ — in the following way:

$$Äq_i^{SPk} = â_t^{SPk} Ät_i^{SPk} + â_o^{SPk} Äo_i^{SPk} + â_a^{SPk} Äa_i^{SPk} + ó_i^{SPk}\ , \text{ where } k\ å\ \{a,o,d\}. \tag{7}$$

In the semilog case, relative changes in stated demand, $Äq_i^{SPk} / q_i^{SPk}$, relate to absolute changes in price in the following way:

$$Äq_i^{SPk} / q_i^{SPk} = â_t^{SPk} Ät_i^{SPk} + â_o^{SPk} Äo_i^{SPk} + â_a^{SPk} Äa_i^{SPk} + ó_i^{SPk}\ , \text{ where } k\ å\ \{a,o,d\}, \tag{8}$$

which follows from taking a total derivative of equation (6b). Note that the analysis identifies $â_a^{SPk}$, effect of a_i, only in the SP dataset on increased access costs. The subsequent empirical analysis estimates separately and jointly the complete regression system for each specification:

Linear:

$$q_i^{RP} = á^{RP} + â_t^{RP} t_i^{RP} + â_o^{RP} o_i^{RP} + â_a^{RP} a_i^{RP} + â_y^{RP} y_i + â_x^{RP} x_i + g_i^{RP}\ , \tag{9a}$$

$$q_i^{SPn} = á^{SPn} + â_t^{SPn} t_i^{SPn} + â_o^{SPn} o_i^{SPn} + â_a^{SPn} a_i^{SPn} + â_y^{SPn} y_i + â_x^{SPn} x_i + g_i^{SPn}, \tag{9b}$$

$$Äq_i^{SPa} = â_t^{SPa} Ät_i^{SPa} + â_o^{SPa} Äo_i^{SPa} + â_a^{SPa} Äa_i^{SPa} + ó_i^{SPa}\ , \tag{9c}$$

$$Äq_i^{SPo} = â_t^{SPo} Ät_i^{SPo} + â_o^{SPo} Äo_i^{SPo} + â_a^{SPo} Äa_i^{SPo} + ó_i^{SPo}\ , \tag{9d}$$

$$Äq_i^{SPd} = â_t^{SPd} Ät_i^{SPd} + â_o^{SPd} Äo_i^{SPd} + â_a^{SPd} Äa_i^{SPd} + ó_i^{SPd}\ . \tag{9e}$$

Semilog:

$$\ln q_i^{RP} = á^{RP} + â_t^{RP} t_i^{RP} + â_o^{RP} o_i^{RP} + â_a^{RP} a_i^{RP} + â_y^{RP} y_i + â_x^{RP} x_i + g_i^{RP} , \qquad (10a)$$

$$\ln q_i^{SPn} = á^{SPn} + â_t^{SPn} t_i^{SPn} + â_o^{SPn} o_i^{SPn} + â_a^{SPn} a_i^{SPn} + â_y^{SPn} y_i + â_x^{SPn} x_i + g_i^{SPn}, \qquad (10b)$$

$$Äq_i^{SPa} / q_i^{SPa} = â_t^{SPa} Ät_i^{SPa} + â_o^{SPa} Äo_i^{SPa} + â_a^{SPa} Äa_i^{SPa} + ó_i^{SPa} , \qquad (10c)$$

$$Äq_i^{SPo} / q_i^{SPo} = â_t^{SPo} Ät_i^{SPo} + â_o^{SPo} Äo_i^{SPo} + â_a^{SPo} Äa_i^{SPo} + ó_i^{SPo} , \qquad (10d)$$

$$Äq_i^{SPd} / q_i^{SPd} = â_t^{SPd} Ät_i^{SPd} + â_o^{SPd} Äo_i^{SPd} + â_a^{SPd} Äa_i^{SPd} + ó_i^{SPd} . \qquad (10e)$$

Estimation of these regression systems represents only the first step towards improving the valuation of time and transport costs. In turn, the analysis performs the following additional steps:

- confirm that the RP data analysis cannot provide useful adjustment factors for properly valuing time costs;
- test the consistency between the RP and SP data using standard valuations of travel costs**;**
- use the SP data on demand changes to generate useful adjustment factors for time costs;
- confirm the factors' usefulness by re-testing the consistency between RP and SP data;
- replicate the adjustment process for the valuation of transport costs.

3. Testing for Consistency between RP and SP data

As an integral part of this progression, the empirical analysis seeks to test whether the RP and SP data yield consistent information on the underlying preferences of consumers. Towards this end, the analysis tests whether the set of parameters from the RP equation differ statistically from the common parameters in the three SP equations on demand changes. The only common parameters are the coefficients associated with price or travel costs. Before comparing the RP data on levels of demand and the SP data on changes in demand, I test the consistency between RP data on levels (ex post visitation) and SP data on levels under actual circumstances (ex ante visitation). Inconsistency between these two data sets may indicate that the underlying structure of preferences changed over time, in particular, from the past 12 months to the future 12 months.[5] If true, there is no reason to test consistency between the RP data and the SP data on changes in demand under hypothetical circumstances. Fortunately, testing yields consistency between the two data sets on levels.

To perform the estimation and testing, I employ two econometric approaches. One approach estimates the demand equations separately, which accommodates groupwise heteroskedasticity across the four equations. The other approach is a seemingly unrelated regression (SUR) framework that permits correlation across the error terms, while retaining groupwise heteroskedasticity. In other words, the diagonal elements of the covariance matrix of disturbances are not forced to be identical and the off-diagonal elements are allowed to be non-zero. Put differently, the underlying error distributions are related but allowed to differ. (A complete formulation of this specific estimator is available upon request.) The error distributions may differ for several reasons (Herriges et al., 1999). First, respondents decide to visit the recreation site before responding to the stated preference survey. Thus, the errors inherent in the data are formed at different times, prompting differences in error variance. Second, errors in the RP data most likely stem from random preferences, errors in the consumer's optimization strategy, and numerous possibly omitted variables, while errors in the SP data most likely stem from the survey construction and respondents' understanding of the hypothetical details (e.g, increase in travel time).

Even if the variance of the error terms are allowed to differ, the parameters of the two data sets may still differ due to biases specific to one model or biases common to both models yet having different effects. In

[5] Alternatively, the two data sets may be drawn from different underlying preference structures.

particular, both models rely on proper valuation of time and transport costs. If both models poorly measure these costs, the parameters will be inconsistent. However, better measurement of these costs may eliminate this source of difference. The subsequent empirical analysis finds such a set of results.

4. Application to Clinton Lake in Kansas

4.1. Data Collection

To examine the consistency between RP and SP data and proper measurement of time and transport costs, this study surveyed actual and hypothetical recreation at Clinton Lake, a reservoir located near Lawrence, KS. The survey instrument was developed according to the responses of two focus groups — one representing water recreators and one representing fishermen — and a pretest of 10 respondents.[6] The survey was implemented on site at the Bloomington Park section of the Clinton Lake project managed by the U.S. Army Corp of Engineers. Recreation users were sampled at two locations: beach and boat dock. The survey was performed on weekdays and weekends during the months of July, August, and September in 1998. The interviewer contacted all adults who had not been previously interviewed at the research site. Unlike some previous studies, this study did not limit contact to only one person from each recreation group (Loomis and Gonzalez-Caban, 1997) since each recreator has his or her own time costs. In total, 310 surveys were completed.

The economic section of the survey instrument elicited information on the respondents' revealed preference behavior and use of Clinton Lake. It elicited information on ex post visitation (previous 12 months),

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[6] A copy of the survey instrument is available from the author upon request.

duration of visit (day versus overnight), fishing activity (yes or no), catch rate of anglers, entrance into the lake water (yes or no), and the perception of water quality (scale of 1 to 5 from very low to very high), and travel costs (one-way travel distance and time). The economic section also elicited information on respondents' contingent behavior by posing these questions:

(1) How many times do you intend to visit the lake in the next 12 months?

(2) Suppose that, for each visit to Clinton Lake, you and other visitors were charged an additional fee of $ 3.00, and the collected fees were pooled with general federal revenues. How many fewer times in the next 12 months would you visit?

(3) If you moved 20 miles farther away from Clinton Lake, yet remained the same distance from other recreational sites, how many fewer times in the next 12 months would you visit Clinton Lake?

(4) If there was no change in your current residence but your travel time to the lake increased by 30 minutes (due to construction, for example), how many fewer times would you visit the lake in the next 12 months?

These questions force the respondent to re-examine its intended visitation rather than reconsider in hindsight its previously chosen visitation. Consequently, the responses are linked to the reported ex ante visitation. This approach seems more appropriate for a contingent framework.

The demographic section of the survey instrument gathers information on the following components: gender, age, marital status, existence of children, zip code, employment status, capacity to work at a paid job on the day of visit, and hourly wage or annual salary.

From these reported data, I generate additional variables. I calculate respondents' travel costs associated with recreating at Clinton Lake using wage/salary data and one-way travel distance and time. Transport costs equal the product of two-way travel distance and 31.5 ¢ per mile, the IRS official rate of auto travel reimbursement for 1998.[7] Time costs equal the product of two-way travel time and the mid-point of the respondent's identified wage bracket or salary bracket (except the top bracket, where the bottom point is used) after dividing salary by 2,000 hours per year. Thus, unemployed workers face no time costs and employed workers without capacity to work on the day of visit face time costs based on their full wage/salary. Later in this paper, I use SP data to adjust both of these restrictions so that time costs more accurately reflect individuals' valuation of time. Access fees equal $ 1 per person.[8]

In addition, I calculate annual income for each respondent. For salaried workers, annual income equals their annual salary. For teenage wage earners (18-19 years), I assume that each works half-time during the nine academic months and full-time during the three summer months. All other wage earners, I assume, work full-time

[7] To calculate transport costs more accurately, the study may have gathered information on the number of people in each respondent's group. However, there is no reason to believe that the same sized group always visits the site together. In this regard, the study overestimates transport costs for those recreators traveling in groups.

[8] The prices of other recreation sites may influence recreational demand for Clinton Lake. As an alternative specification, the study also calculates the price or travel costs associated with recreation at other comparable sites in the vicinity: Perry Lake, Douglas County Lake, Lone Star Lake, and Pomona Lake. Transport costs depend on the mileage from each lake and the respondent's zip code. Time costs depend on the associated travel time, which is derived from the identified mileage and each respondent's implicit travel speed (reported one-way travel distance to Clinton Lake relative to reported one-way travel time). However, Wald tests cannot reject the joint null hypothesis that the effects of these additional variables equal zero in the linear specification ($\div^2$ statistic equals 8.19). In the semilog specification, Wald tests cannot reject the null hypothesis for ex ante visitation but can for ex post visitation ($\div^2$ statistics equal 4.25 and 8.40, respectively). Regardless of this one exception, inclusion of substitute site prices when prices are correlated is unsatisfactory since coefficients cannot be estimated with any precision (Bockstael, 1995), which is reflected in previous research (Casey et al., 1995). Rather than confounding estimation of the travel cost coefficients for Clinton Lake, I exclude the four alternative lakes from the regression system. Fortunately, this exclusion does not relate to the estimation of the SP data on changes in demand and the adjustment of time costs.

year-round.[9] Full documentation on the database is available upon request from the author.[10]

4.2. Data Description

Analysis of the collected and derived data proves quite informative. Since the survey was implemented on site, each person has taken at least one trip. Thus, analysis of ex post visitation involves a truncated sample. Ex ante visitation is not truncated at one since some respondents did not intend to visit in the subsequent 12-month period. Nevertheless, it involves limited censoring at zero (only five observations). Similarly, intended changes in visitation are top censored at the level of intended demand under actual circumstances.[11] Estimation of the demand equations separately addresses the truncated sample by applying the appropriate maximum likelihood estimation techniques (Greene, 1997) and addresses the censoring issues by applying a Tobit model. (A complete formulation of these specific estimators is available upon request.) The seemingly unrelated regressions (SUR) approach omits steps to address truncation and/or censoring since the framework accommodates these steps only with enormous manipulation. Therefore, each econometric approach has its own drawback. Estimation of demand equations separately ignores correlation across error terms, while the SUR approach ignores truncation and censoring issues. Fortunately, the two approaches generate highly similar results based on which I draw nearly identical conclusions.[12] Therefore, discussion on the results speaks to both approaches in general, while

[9] An alternative calculation for wage earners in their 20's, similar to the calculation for teenagers, does not alter the regression results in any substantive way.

[10] For four observations, I estimate responses to questions regarding wage/salary based on age and gender. For two observations, I estimate one-way travel based on the zip code.

[11] One could argue that intended changes in visitation are also bottom censored at zero since the survey did not permit increased visitation in response to increased travel costs. Since such responses would be economically irrational, the analysis ignores this possible censoring.

[12] By employing two approaches, I can assess the robustness of the estimation results. However, I cannot rule out the possibility that the two approaches are biased in similar ways.

noting differences when relevant.[13]

As an additional complication, the on-site survey design most likely oversamples individuals who visit more often, which leads to endogenous stratification (Loomis and Gonzalez-Caban, 1997). To accommodate this stratification, I weight each response by the reciprocal of ex post visitation frequency.

After adjusting for the stratification, Table 1 displays the mean responses to the survey instrument. Of the 310 surveys completed, 256 of them provided complete information for all four SP questions. Since the SUR model depicted in Section 3 requires a consistent sample of observations across all five equations in the regression system, this paper restricts its analysis to only these 256 observations with complete response data. The average recreator visited Clinton Lake 2.5 times in the previous 12-month period, intends to visit 3.8 times in the subsequent 12-month period, and faces \$ 17 time costs and \$ 20 transport costs per trip. In response to a \$ 3 increase in the access fee, the average recreator takes 1.3 fewer trips, reducing its visitation by 33 %. In response to a 20-mile increase in the one-way travel distance, the average recreator faces increased costs of \$ 12 and takes 1.8 fewer trips, reducing its visitation by 45 %. In response to a 30-minute increase in the one-way travel time, the average recreator faces increased time costs of \$ 11 and transport costs of \$ 13 and takes 1.7 fewer trips, reducing its visitation by 44 %.

5. Regression Estimates and Consistency Tests given Initial Valuation of Travel Costs

This section analyzes the data given the initial valuation of time and transport costs. The next section re-analyzes the data after adjusting first time costs and then transport costs.

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[13] I choose not to employ a count data model, such as Poisson, because nearly 10 % of the respondents visit Clinton Lake at least 20 times in a 12-month period and count data models poorly explain large integers (Englin and Shonkwiler, 1995).

5.1. Regression Analysis of RP and SP Data

The survey instrument distinguishes people with and without employment and of those employed, which had the capacity to work on the day of their visit. Based on this information, I identify three categories of respondents:

(1) non-employed (including retired),

(2) employed without the capacity to work on day of visit — fixed work schedule,

(3) employed with the capacity to work on day of visit — flexible work schedule.

Based on previous research, economists anticipate that the value of time varies across these three categories of respondents because of differences in their time constraints and discretion to work during recreational time (Smith et al., 1983; Bockstael et al., 1987). Group (1) is not able to work during recreational time because it has chosen a corner solution regarding work allocation. Group (2) is unable to work because it has chosen to work at a job that requires a fixed-work-week. Group (3) has the discretion to work during recreational time. While Smith et al. (1983) show that the opportunity cost of time is best treated as a nonlinear function of wage rates for all workers, Bockstael et al. (1987) show that no relationship exists between the wage rate and the opportunity cost of time for workers without the flexibility to trade time for work. Moreover, Bockstael et al. (1987) show that the wage rate serves as neither an upper nor lower bound on the opportunity cost of time for workers with a fixed work schedule. Consistent with these previous studies, this analysis examines the effects of travel costs, especially time costs, for each category separately, while recognizing that the wage rate may not be an appropriate reference for workers lacking the capacity to trade recreational time for work.[14]

[14] Bockstael et al. (1987) examine the latter two worker groups in a manner different from the manner chosen for this paper. For group (2), transport costs and time costs enter the regression separately. For group (3), transport costs and time costs enter the regression jointly. To implement this strategy properly, Bockstael et al. (1987) include the total work time expended by workers and the discretionary wage available

The analysis also distinguishes the three components of travel costs. For the RP and SP data on demand levels, I decompose travel costs into transport costs and time costs (the access fee of $ 1 is subsumed into the regression's constant term). For proper comparison, I decompose the increased travel costs for the SP dataset involving increased travel distance. This type of decomposition does not apply to the other SP datasets since they involve only access or time costs.

Applying the two noted econometric approaches, I estimate the regression system described in Section 2. For estimation of the demand equations separately, Table 2 displays the regression results relating to travel costs for the five-equation regression system in the linear and semilog specifications. (Complete regression results are available upon request.) The two specifications generate highly similar results. Consider the linear specification first. For the ex post RP data on demand levels, two of the six coefficients on travel cost components are incorrectly signed and all are statistically insignificant. In the semilog specification, only the coefficient on transport costs for workers with a flexible schedule is significant (and correctly signed).[15] The SUR framework generates very similar estimates, as shown in Table 3.

Both sets of results for demand levels are consistent with the effect of multicollinearity and similar to those of Smith et al. (1983), as noted in Section 2. Therefore, the analysis should not use these estimates for adjusting time costs. In other words, analysis of the RP data noted in Section 2 is theoretically capable yet practically incapable of examining the proper monetary valuation of time costs. More importantly, like previous research exploring time costs, the RP data analysis cannot identify the coefficient for access costs, which represents the most appropriate benchmark for monetary valuation. Use of this benchmark for adjusting time costs represents

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for workers on a flexible work schedule. The current study gathers neither of these details.

[15] Although not noted explicitly in the tables, the effect of time costs significantly varies across the type of worker, which confirms the need to estimate this effect for each type separately.

an important contribution of this paper.

The SP data on demand levels also fails to identify the coefficient for access costs and fares no better in estimating meaningful coefficients for transport costs and time costs. First consider estimation of the demand equations separately. In the linear specification, one coefficient is incorrectly signed and all six are insignificant, as shown in Table 2; in the semilog specification, two coefficients are incorrectly signed and only one of the six coefficients is significant. The SUR approach generates more wrong signs and no improvement in significance, as shown in Table 3. Rather than relying on analysis of demand levels, this study relies on SP data analysis of changes in demand under hypothetical circumstances to provide more accurate estimates and benchmark values.

In sharp contrast to the analysis of demand levels, estimation of stated changes in demand generates useful regression results in both approaches and specifications. First, estimation of demand changes prompted by increased access costs clearly identifies the coefficient on access costs: each coefficient is highly significant at the 1 % level and correctly signed. Second, estimation of demand changes prompted by increased travel time clearly identifies the coefficient on time costs: each coefficient is correctly signed and highly significant at the 1 % level. It proves useful to distinguish between types of workers since the effect of time costs significantly varies across types. Third, estimation of demand changes prompted by increased travel distance clearly identifies the coefficient on transport costs: each coefficient is statistically significant and correctly signed.

5.2. Consistency Tests

Next, I test the consistency between the RP and SP data by determining whether or not various pairings of coefficients associated with travel costs are equal. First, I examine whether or not the underlying structure of preferences structurally shifted from the ex post time frame to the ex ante time frame even under the same actual circumstances. I compare each travel cost component separately, as shown in Tables 4 and 5. For both transport costs and time costs regarding all three worker types in both approaches and specifications, Wald tests cannot reject the hypothesis of equal parameters at generally accepted significance levels, except time costs for flexible workers in the semilog specification. (This exception does not affect the adjustment of time costs since the associated consistency tests compare the effect of time costs on ex post RP demand levels and the effect of access costs on SP changes in demand, as described in Section 6.) Therefore, the analysis can appropriately test the consistency between RP data under ex post, actual circumstances and SP data under ex ante, hypothetical circumstances, with the noted exception.

Tables 4 and 5 display the Wald test statistics for testing consistency between the RP data and SP data on demand changes. Consider first estimation of the demand equations separately as shown in Table 4. According to Wald tests, the effect of transport costs in the RP data is highly inconsistent with the effect of access costs in the SP data for three of the six cases; these effects differ very significantly at the 1 % level and below. Results of the SUR approach reveal a stronger pattern. This pairing of effects is highly inconsistent for all six cases, as shown in Table 5. Therefore, transport costs should not be regarded as a good benchmark for evaluating monetary costs. Instead, it is preferable to use access costs as the proper benchmark.

The effects of time costs are generally consistent between the RP and SP data for both approaches and specifications. Consider first separate estimation of demand equations. In ten of the 12 cases, Wald tests cannot reject the hypothesis of equal parameters. (The effect of time costs is inconsistent for workers on a flexible schedule in the semilog specification; this result is not surprising since evidence reported above indicates that the underlying structure of preferences for this worker type and specification shifted from the ex post to the ex ante time frame.) However, the effect of time costs in the RP data is completely inconsistent with the effect of access costs in the SP data for both specifications. The Wald tests reject the hypothesis of equal parameters at high significance levels, most substantially below the 1 % level. The SUR approach generates even stronger results. Therefore, the initial valuation of time costs leaves much room for improvement.

Comparison of the SP data on demand levels and SP data on demand changes reveals a pattern similar to the RP data on demand levels for both approaches and specifications, as shown in Tables 4 and 5. The effects of transport costs and time costs are generally consistent between the SP levels data and SP changes data, while the effect of transport costs or time costs in the SP levels data significantly differ from the effect of access costs in the SP changes data.

The rejection of consistency between the RP dataset and SP data on demand changes may stem from some underlying difference between the preference structure associated with RP and SP data, biases in one or both of the preference methods, or from mismeasurement of time costs and/or transport costs. The next section examines the last potential cause. It also explores this measurement as the cause behind the rejection of consistency between the SP demand levels data and SP demand changes data.

6. Improved Valuation of Time and Transport Costs

6.1. Time Costs

6.1.1. Adjusting the Valuation of Time Costs

To improve the monetary valuation of time costs, this study uses the SP data on demand changes to estimate the ratio of time costs to access fees ($\hat{a}_o^{SPo}/\hat{a}_a^{SPa}$). This ratio differs significantly from 1 for both employed worker types in both specifications.[16] Therefore, time is inconsistently valued relative to access fees in the SP data

[16] For the linear specification, Wald test statistics are 17.33 and 6.86, respectively for fixed- and flexible-schedule workers; for the semilog specification, the Wald test statistics are 30.93 and 37.86.

on demand changes; these differences are used to improve valuation. The ratio of $\hat{a}_o^{SPo}/\hat{a}_a^{SPa}$ indicates the factor needed to adjust time costs so that time cost and access fees generate the same effect on demand. Consider first groups (2) and (3) — employed workers with fixed and flexible schedules. As shown in Table 6, employed workers on a fixed schedule value their time between 19 % and 23 % of their wage/salary rate, depending on the econometric approach and specification, while employed workers on a flexible schedule value their time between 10 % and 15 % of their wage/salary rate, depending on the approach and specification. These results are consistent with the theory described by Bockstael et al. (1987) and their empirical results in which workers on a fixed schedule valued the trade-off between money and time at more than three-fold the rate of workers on a flexible schedule.

Next, consider the valuation of time costs for the non-employed respondents. Since their opportunity costs are initially set at zero, I cannot generate an adjustment ratio for them. Nevertheless, I can calculate an implicit value of time. Responses by the non-employed to the SP question regarding increased travel time strongly reject the notion that their time is worthless. The mean responses of absolute and relative change in visitation (-0.019 trips and - 47.0 %) are highly significant at the 1 % level (t-test statistics equal 3.74 and 7.48, respectively). Each mean response decomposes into increased time costs times the parameter translating opportunity costs into demand reduction, denoted ã. The first component decomposes further into the change in travel time (60 minutes) and the parameter translating time into costs, denoted è. As estimated, $\hat{a}_o^{SPo}$ captures the ratio between the mean response and the increased travel time. Therefore, è = $\hat{a}_o^{SPo}$/ã. $\hat{a}_a^{SPa}$ represents the parameter translating increased access costs ($ 3) into demand reduction. Letting $\hat{a}_a^{SPa}$ substitute for ã, since both translate increased travel costs into demand reduction, è equals $\hat{a}_o^{SPo}/\hat{a}_a^{SPa}$. The two approaches and two specifications generate very similar results, as shown in Table 6. Estimates vary between 0.0645 and 0.0728 — roughly 7 ¢ per minute

— or between $ 3.86 per hour and $ 4.37 per hour. This range of estimates seems very reasonable.

6.1.2. Re-Testing Consistency between RP and SP Data

Given these calculated valuation factors for time costs, I employ them to adjust time costs. Then I re-test the consistency between the RP data and SP data on demand changes and between the SP data on levels and SP data on changes. In particular, these tests compare the effect of time costs on demand levels and the effect of access costs on changes in demand. Adjustment alters neither the effects of transport costs nor the relationship between the effect of time costs in the levels data and the same effect in the demand changes data.

Adjustment lowers the consistency test statistics dramatically. Consider first the comparison of RP data and SP data on changes. As shown in Tables 4 and 5, before adjustment, the effects for neither of the two relevant worker categories are consistent. After adjustment, the effects for workers on a fixed schedule are consistent and the chi-square test statistics for workers on a flexible schedule are dramatically lower, even to the point of consistency in the linear specification, as shown in Table 7. (This last point holds for estimation of demand equations separately but not the SUR approach.) Moreover, the effects for non-employed workers are consistent after generating a value of time for these workers; before adjustment, the analysis could not test the consistency between the effects of time and access fees.

Similar results hold for the comparison between SP data on levels and SP data on demand changes. For the category of fixed-schedule workers, the effects of time costs and access costs become consistent after adjustment in both specifications. For flexible-schedule workers, the effects become consistent after adjustment in the linear specification. However, effects in the semilog specification are less consistent after adjustment, though the effects are consistent before adjustment under the SUR approach so adjustment is presumably unnecessary. For non-employed workers, the effects are consistent in the semilog specification.

These results strongly indicate that the adjusted valuation of time costs is proper since it greatly improves the consistency between RP and SP data and between SP demand levels data and SP demand changes data to a lesser extent.[17]

6.2. Better Valuation of Transport Costs, Adjustment, and Re-Testing Consistency

Given this improved valuation of time costs, the analysis attempts to isolate better the effect of transport costs and improve the monetary valuation of transport costs. Unfortunately, the contingent behavior analysis does not generate orthogonal data on transport costs. The contingent behavior question on increased travel distance increases both transport costs and time costs. However, the analysis isolates the effect of transport costs by subtracting the effect of increased time costs from the demand response prompted by increased travel distance. In particular, the analysis captures the pure effect of time costs based on the orthogonal data generated by increasing only travel time. (Equivalently, the econometric analysis constrains the effect of time costs in the SP distance equation to equal the effect of time costs in the SP time equation.) The isolated effect, $\hat{a}_{ti}^{SPd}$, for each worker category and econometric approach and specification is shown in Table 8.

As with time costs, to adjust the monetary valuation of transport costs, this study uses the ratio of transport costs to access fees ($\hat{a}_{ti}^{SPd}/\hat{a}_{a}^{SPa}$). The ratio of $\hat{a}_{ti}^{SPd}/\hat{a}_{a}^{SPa}$ indicates the factor needed to adjust transport costs so that transport cost and access fees generate the same effect on demand. As shown in Table 8, non-employed respondents value their transport costs at between 3 % and 14 % of the IRS rate of 31.5 ¢ per mile

[17] Casey et al. (1995) address the valuation of time costs in recreational demand analysis by asking survey respondents to state their willingness to accept overtime work (expressed as a hourly wage rate) in lieu of a specific hiking experience. This stated rate presumably improves the valuation of each respondent's time costs. However, their analysis cannot assess this presumption, unlike the current paper, which provides evidence of improvement.

or between 1 ¢ and 4 ¢ per mile, depending on the econometric approach and specification. Workers on a fixed schedule value their transport costs at between 13 % and 16 % of the IRS rate or 4 ¢ and 5 ¢ per mile. Workers on a flexible schedule value their transport costs at between 23 % and 41 % of the IRS rate or between 7 ¢ and 13 ¢ per mile. Based on these results, the IRS rate greatly exaggerates the valuation of transport costs.

Given these calculated valuation factors for transport costs, I employ them to adjust transport costs. Then I re-test the consistency between the RP data and SP data on demand change and between the SP data on levels and SP data on changes. In particular, these tests compare the effect of transport costs on demand levels and the effect of access costs on changes in demand. Adjustment does not alter the relationship between the effect of transport costs in the demand levels data and the same effect in the demand changes data.

Adjustment greatly improves consistency. Consider first the comparison of RP data and SP data on changes. As shown in Tables 4 and 5, before adjustment, only the linear specification in the separate equation approach generates consistent effects. As shown in Table 9, after adjustment, all of the pairings have consistent effects and the χ^2 test statistics are lower for the three previously consistent pairings. Similar results hold for the comparison between SP data on levels and SP data on demand changes. Before adjustment, none of the effects are consistent. After adjustment, all but one pairing of effects is consistent.

As with time costs, these results strongly indicate that the adjusted valuation of transport costs is proper since it greatly improves the consistency between RP and SP data and between SP data on demand levels and SP data on changes in demand.

6. Summary

In sum, this paper improves the valuation of time costs and transport costs related to recreational demand. To demonstrate the improvement, it tests the consistency between RP and SP data on recreational demand before and after adjustment of time and transport costs. Based on standard valuation of time costs, regression results strongly reject the hypothesis of equal parameters between time costs and access costs for employed respondents and cannot test this hypothesis for non-employed respondents since no information exists for their value of time. Fortunately, the SP data on changes in demand permit improved valuation of time costs based on responses to hypothetically increased access fees and travel time. Most notably, this analysis generates a highly reasonable non-zero value of time for non-employed respondents and reasonable fractions of wage/salary rates for valuing the time of employed respondents. After adjusting time costs separately for each category of worker depending on their capacity to trade time for money, analysis finds substantial improvement in the consistency between RP and SP data on demand levels and between SP data on levels and SP data on changes. In particular, RP and SP data generate comparable parameter estimates in 5/6 of the cases where before none of the cases indicated similar estimates. These results strongly indicate that adjusted valuation of time costs is proper since it greatly improves the consistency between RP and SP data. In a similar fashion, this paper demonstrates an equally substantial improvement in the valuation of transport costs.

Table 1

Statistical Summary

Variable	Description of Values	Mean	Standard Deviation
Ex post Visitation		2.508	2.121
Ex ante Visitation		3.776	2.768
Time Costs ($)		17.095	22.126
Transport Costs ($)		19.734	10.945
Reduced Visitation - Access Fee (Trips)		1.310	1.683
Reduced Visitation - Access Fee (%)		33.353	26.013
Reduced Visitation - Travel Time (Trips)		1.657	1.627
Reduced Visitation - Travel Time (%)		43.513	26.793
Reduced Visitation - Travel Distance (Trips)		1.818	1.901
Reduced Visitation - Travel Distance (%)		45.345	27.096
Increased Time Costs - Travel Time		12.499	8.795
Increased Time Costs - Travel Distance		11.034	13.352
Increased Transport Costs - Travel Distance		12.600	N/A
Perceived Water Quality	1=very low 5=very high	3.104	0.437
Entrance into Lake Water	1=yes, 0=no	0.919	0.182
Fish Activity	1=yes, 0=no	0.285	0.285
Catch Rate (for fisherpeople, N=93)		5.933	4.786
Duration of Use	1=Overnight 0=Day	0.223	0.263
Age	1=18-19 2=20-29, etc. 9=90+	2.576	0.791
Marital Status	1=yes, 0=no	0.426	0.313
Existence of Children	1=yes,0=no	0.384	0.308
Gender	0=M,1=F	0.548	0.315
Annual Income ($)		24,306	17,756

Table 2

Truncated Regression of Revealed Preference Data on Ex Post Visitation
Tobit Regression of Stated Preference Data on Ex Ante Visitation

Travel Cost Coefficient [a]	Linear Specification			Semilog Specification		
	Category of Respondent's Work Schedule			Category of Respondent's Work Schedule		
	Flexible	Fixed	Nonemployed	Flexible	Fixed	Nonemployed
Ex Post Revealed Preference Data on Visitation Levels [b]						
Transport	- 0.2699 (0.4038)	- 0.3841 (0.3995)	0.2536 (0.6713)	- 0.0150 * (0.0093)	- 0.0097 (0.0096)	0.0120 (0.0156)
Time [c]	0.0602 (0.2827)	- 0.4164 (0.3857)	- 0.2746 (0.4226)	0.0060 (0.0067)	- 0.0149 (0.0108)	- 0.0112 (0.0093)
Ex Ante Stated Preference Data on Visitation Levels [b]						
Transport	- 0.0448 (0.0611)	- 0.0702 (0.0620)	- 0.0397 (0.1009)	0.0045 (0.0240)	- 0.0287 (0.0246)	0.0080 (0.0400)
Time [c]	- 0.0637 (0.0466)	- 0.1111 (0.0701)	0.0080 (0.0602)	- 0.0937 *** (0.0175)	- 0.0218 (0.0278)	- 0.0667 (0.0239)
Ex Ante Stated Preference Data on Changes in Visitation						
Increase in Access Fee						
Access	- 0.6952 *** (0.1244)	- 0.6701 *** (0.1126)	- 0.6206 *** (0.1302)	- 0.1520 *** (0.0200)	- 0.1240 *** (0.0180)	- 0.1448 *** (0.0207)
Increase in Travel Distance						
Transport	- 0.3770 *** (0.0556)	- 0.2069 *** (0.0576)	- 0.2523 ** (0.1105)	- 0.0701 *** (0.0084)	- 0.0457 *** (0.0087)	- 0.0712 *** (0.0168)
Time [c]	0.0544 (0.0253)	- 0.0056 (0.0503)	0.0098 (0.0246)	0.0094 (0.0039)	0.0070 (0.0077)	0.0049 (0.0038)
Increase in Travel Time						
Time [c]	- 0.0692 *** (0.0142)	- 0.1428 *** (0.0240	- 0.0421 *** (0.0073)	- 0.0154 *** (0.0027)	- 0.0279 *** (0.0045)	- 0.0105 *** (0.0014)

No. of Obs. = 256

Log-likelihood values for linear specification equations in order shown: -550.2, -701.1, -538.9, -514.6, -522.0.

Log-likelihood values for semilog specification equations in order shown: -241.5, -481.8, -212.6, -222.3, and -255.7.

[a] *, **, and *** indicate statistical differences from zero at significance levels 0.10, 0.05, and 0.01, respectively.

[b] Regression includes additional regressors: perceived water quality, entrance into lake water, fish activity, catch rate, duration of use, age, marital status, existence of children, gender, and income.

[c] Travel time included for non-employed respondents since value of time is unavailable.

Table 3

SUR Regression of Revealed and Stated Preference Data on Ex Post and Ex Ante Visitation Levels and Changes in Ex Ante Visitation Levels

Travel Cost Coefficient [a]	Linear Specification			Semilog Specification		
	Category of Respondent's Work Schedule			Category of Respondent's Work Schedule		
	Flexible	Fixed	Nonemployed	Flexible	Fixed	Nonemployed
Ex Post Revealed Preference Data on Visitation Levels [b]						
Transport	- 0.0067 (0.0332)	- 0.0024 (0.0344)	0.0503 (0.0566)	- 0.0152 * (0.0092)	- 0.0076 (0.0095)	0.0127 (0.0154)
Time [c]	0.0237 (0.0224)	- 0.0308 (0.0387)	- 0.0071 (0.0337)	0.0076 (0.0067)	- 0.0147 (0.0107)	- 0.0092 (0.0092)
Ex Ante Stated Preference Data on Visitation Levels [b]						
Transport	- 0.0181 (0.0357)	- 0.0192 (0.0372)	0.0082 (0.0619)	0.0026 (0.0223)	- 0.0194 (0.0230)	0.0112 (0.0377)
Time [c]	0.0020 (0.0258)	- 0.0313 (0.0419)	0.0358 (0.0369)	- 0.0822 *** (0.0161)	- 0.0205 (0.0259)	0.0020 (0.0225)
Ex Ante Stated Preference Data on Changes in Visitation						
Increase in Access Fee						
Access	- 0.2826 *** (0.0944)	- 0.4265 *** (0.0879)	- 0.3891 *** (0.1040)	- 0.1008 *** (0.0149)	- 0.0946 *** (0.0138)	- 0.1190 *** (0.0159)
Increase in Travel Distance						
Transport	- 0.0627 *** (0.0255)	- 0.0686 *** (0.0273)	- 0.1090 ** (0.0557)	- 0.0309 *** (0.0049)	- 0.0210 *** (0.0052)	- 0.0438 *** (0.0102)
Time [c]	- 0.0250 * (0.0140)	- 0.0457 * (0.0258)	- 0.0019 (0.0115)	- 0.0006 (0.0025)	- 0.0056 (0.0048)	0.0009 (0.0022)
Increase in Travel Time						
Time [c]	- 0.0428 *** (0.0098)	- 0.0790 *** (0.0163)	- 0.0251 *** (0.0053)	- 0.0110 *** (0.0018)	- 0.0199 *** (0.0030)	- 0.0081 *** (0.0009)

No. of Obs. = 256
Adjusted R^2 values for linear specification equations in order shown: 0.52, 0.34, 0.30, 0.17, and -0.75.
Adjusted R^2 values for semilog specification equations in order shown: -1.45, -5.23, -7.53, -9.01, and -11.61.
[a] *, **, and *** indicate statistical differences from zero at significance levels 0.10, 0.05, and 0.01, respectively.
[b] Regression includes additional regressors: perceived water quality, entrance into lake water, fish activity, catch rate, duration of use, age, marital status, existence of children, gender, and income.
[c] Travel time included for non-employed respondents since value of time is unavailable.

Table 4

Test of Consistency between Revealed and Stated Preference Datasets: Truncated Regression of RP Data and Tobit Regression of SP Data

Table 4.a. Linear Specification

Travel Cost Component	Pairing of Dataset	Respondent Category according to Work Schedule					
		Flexible		Fixed		Non-employed	
		÷^{2}-statistic	P-value	÷^{2}-statistic	P-value	÷^{2}-statistic	P-value
Data on Demand Levels: Ex Post RP vs Ex Ante SP							
Transport		0.304	0.582	0.601	0.438	0.187	0.665
Time		0.187	0.666	1.805	0.179	0.439	0.508
Ex Post RP Data on Demand Levels vs Ex Ante SP Data on Changes in Demand							
Transport Costs	Fee Increase	1.011	0.315	0.477	0.490	1.639	0.200
	Distance Increase Transport-related	0.069	0.793	0.192	0.661	0.554	0.457
Time Costs	Fee Increase	5.974	0.015	7.304	0.007	N/A	N/A
	Distance Increase Time-related	0.000	0.984	1.173	0.279	0.452	0.502
	Time Increase	0.167	0.683	2.089	0.148	0.303	0.582
Ex Ante SP Data on Demand Levels vs Ex Ante SP Data on Changes in Demand							
Transport Costs	Fee Increase	22.127	0.000	21.720	0.000	12.477	0.000
	Distance Increase Transport-related	16.179	0.000	2.611	0.106	2.002	0.157
Time Costs	Fee Increase	22.711	0.000	17.734	0.000	N/A	N/A
	Distance Increase Time-related	4.965	0.026	1.497	0.221	0.001	0.978
	Time Increase	0.001	0.971	0.186	0.667	0.684	0.408

Table 4

Test of Consistency between Revealed and Stated Preference Datasets: Truncated Regression of RP Data and Tobit Regression of SP Data

Table 4.b. Semilog Specification

Travel Cost Component	Pairing of Dataset	Respondent Category according to Work Schedule					
		Flexible		Fixed		Non-employed	
		χ^2-statistic	P-value	χ^2-statistic	P-value	χ^2-statistic	P-value
Data on Demand Levels: Ex Post RP vs Ex Ante SP							
Transport		0.573	0.449	0.517	0.472	0.009	0.925
Time		28.113	0.000	0.053	0.818	0.031	0.859
Ex Post RP Data on Demand Levels vs Ex Ante SP Data on Changes in Demand							
Transport Costs	Fee Increase	38.551	0.000	31.425	0.000	36.688	0.000
	Distance Increase Transport-related	19.224	0.000	7.699	0.006	13.170	0.000
Time Costs	Fee Increase	56.045	0.000	27.013	0.000	N/A	N/A
	Distance Increase Time-related	0.188	0.665	2.734	0.098	2.587	0.108
	Time Increase	8.687	0.003	1.234	0.267	0.006	0.941
Ex Ante SP Data on Demand Levels vs Ex Ante SP Data on Changes in Demand							
Transport Costs	Fee Increase	25.099	0.000	9.787	0.002	25.099	0.000
	Distance Increase Transport-related	8.601	0.003	0.425	0.514	3.328	0.068
Time Costs	Fee Increase	4.804	0.028	9.549	0.002	N/A	N/A
	Distance Increase Time-related	32.871	0.000	0.999	0.318	0.230	0.631
	Time Increase	19.435	0.000	0.048	0.827	0.026	0.873

Table 5
Test of Consistency between Revealed and Stated Preference Data: SUR Regression

Travel Cost Component	Pairing of Dataset	Respondent Category according to Work Schedule					
		Flexible		Fixed		Non-employed	
		$\div^2$-statistic	P-value	$\div^2$-statistic	P-value	$\div^2$-statistic	P-value
LINEAR SPECIFICATION							
Data on Demand Levels: Ex Post RP vs Ex Ante SP							
Transport		0.108	0.742	0.223	0.637	0.529	0.467
Time		0.756	0.385	0.000	0.990	1.544	0.214
Ex Post RP Data on Demand Levels vs Ex Ante SP Data on Changes in Demand							
Transport Costs	Fee Increase	7.645	0.006	20.459	0.000	13.770	0.000
	Distance Increase	1.738	0.187	2.096	0.148	3.440	0.060
Time Costs	Fee Increase	9.860	0.002	16.775	0.000	N/A	N/A
	Distance Increase	2.979	0.084	0.093	0.761	0.019	0.889
	Time Increase	6.499	0.011	1.280	0.258	0.278	0.598
Ex Ante SP Data on Demand Levels vs Ex Ante SP Data on Changes in Demand							
Transport Costs	Fee Increase	6.929	0.009	18.582	0.000	10.768	0.001
	Distance Increase	0.995	0.319	1.028	0.311	1.603	0.206
Time Costs	Fee Increase	8.423	0.004	16.150	0.000	N/A	N/A
	Distance Increase	0.812	0.368	0.075	0.784	0.827	0.363
	Time Increase	2.593	0.107	1.077	0.299	2.676	0.102
SEMILOG SPECIFICATION							
Data on Demand Levels: Ex Post RP vs Ex Ante SP							
Transport		0.684	0.408	0.285	0.593	0.002	0.967
Time		33.484	0.000	0.055	0.815	0.270	0.603
Ex Post RP Data on Demand Levels vs Ex Ante SP Data on Changes in Demand							
Transport Costs	Fee Increase	24.041	0.000	27.211	0.000	35.337	0.000
	Distance Increase	2.250	0.134	1.500	0.221	8.658	0.003
Time Costs	Fee Increase	44.276	0.000	20.996	0.000	N/A	N/A
	Distance Increase	1.316	0.251	0.575	0.448	1.089	0.297
	Time Increase	7.227	0.007	0.225	0.635	0.015	0.903
Ex Ante SP Data on Demand Levels vs Ex Ante SP Data on Changes in Demand							
Transport Costs	Fee Increase	14.934	0.000	7.921	0.005	10.113	0.002
	Distance Increase	2.126	0.145	0.005	0.945	1.839	0.175
Time Costs	Fee Increase	0.723	0.395	6.353	0.012	N/A	N/A
	Distance Increase	24.866	0.000	0.308	0.579	0.002	0.961
	Time Increase	19.233	0.000	0.000	0.983	0.200	0.655

Table 6
Adjustment of Time Costs

6.a. Based on Truncated Regression of RP Data and Tobit Regression of SP Data

Respondent Category According to Work Schedule	No. of Observations	Coefficient on Travel Costs		Coefficient Ratio
		SP Travel Time	SP Access Fee	
Linear Specification				
Non-employed [a]	63	- 0.0421	- 0.6206	0.0679
Fixed Schedule	109	- 0.1428	- 0.6708	0.2129
Flexible Schedule	84	- 0.0692	- 0.6952	0.0995
Semilog Specification				
Non-employed [a]	63	- 0.0105	- 0.1448	0.0728
Fixed Schedule	109	- 0.0279	- 0.1240	0.2250
Flexible Schedule	84	- 0.0154	- 0.1520	0.1015

6.b. Based on SUR Regression of RP and SP Data

Respondent Category According to Work Schedule	No. of Observations	Coefficient on Travel Costs		Coefficient Ratio
		SP Travel Time	SP Access Fee	
Linear Specification				
Non-employed [a]	63	- 0.0251	- 0.3891	0.0645
Fixed Schedule	109	- 0.0790	- 0.4265	0.1852
Flexible Schedule	84	- 0.0428	- 0.2826	0.1515
Semilog Specification				
Non-employed [a]	63	- 0.0081	- 0.1190	0.0681
Fixed Schedule	109	- 0.0199	- 0.0946	0.2104
Flexible Schedule	84	- 0.0110	- 0.1008	0.1091

[a] To generate coefficient on increased travel costs for the SP data involving travel time, regress the change in visitation on the change in travel time (60 minutes) rather than the change in travel costs.

Table 7

Test of Consistency between Effect of Time Costs on Demand Levels and Effect of Access Costs on Changes in Demand: After Adjustment of Time Costs

Dataset of Demand Levels	Respondent Category according to Work Schedule					
	Flexible		Fixed		Non-employed	
	÷^{2}-statistic	P-value	÷^{2}-statistic	P-value	÷^{2}-statistic	P-value
Truncated Regression of RP Data and Tobit Regression of SP Data						
Linear Specification						
Ex Post RP	0.209	0.648	0.501	0.479	0.202	0.653
Ex Ante SP	0.013	0.910	0.184	0.668	6.893	0.009
Semilog Specification						
Ex Post RP	9.269	0.002	1.270	0.260	1.025	0.311
Ex Ante SP	19.617	0.000	0.048	0.827	0.361	0.548
SUR Regression of RP and SP Data						
Linear Specification						
Ex Post RP	4.256	0.039	1.566	0.211	1.409	0.235
Ex Ante SP	1.336	0.248	1.337	0.248	4.804	0.028
Semilog Specification						
Ex Post RP	6.444	0.011	0.192	0.662	0.541	0.462
Ex Ante SP	20.063	0.000	0.001	0.970	0.647	0.421

Table 8
Adjustment of Transport Costs

9.a. Based on Truncated Regression of RP Data and Tobit Regression of SP Data

Respondent Category According to Work Schedule	No. of Obs.	Coefficient on Travel Costs		Coefficient Ratio	Adjusted Cost (¢/mi)
		SP Transport [a]	SP Access Fee		
Linear Specification					
Non-employed	63	- 0.0735	- 0.6206	0.1184	3.73
Fixed Schedule	109	- 0.0867	- 0.6708	0.1292	4.07
Flexible Schedule	84	- 0.2140	- 0.6952	0.3079	9.70
Semilog Specification					
Non-employed	63	- 0.0205	- 0.1448	0.1415	4.46
Fixed Schedule	109	- 0.0191	- 0.1240	0.1537	4.84
Flexible Schedule	84	- 0.0382	- 0.1520	0.2512	7.91

9.b. Based on SUR Regression of RP Data and SP Data

Respondent Category According to Work Schedule	No. of Obs.	Coefficient on Travel Costs		Coefficient Ratio	Adjusted Cost (¢/mi)
		SP Transport [a]	SP Access Fee		
Linear Specification					
Non-employed	63	- 0.0123	- 0.3891	0.0316	1.00
Fixed Schedule	109	- 0.0688	- 0.4265	0.1613	5.08
Flexible Schedule	84	- 0.1156	- 0.2826	0.4090	12.88
Semilog Specification					
Non-employed	63	- 0.0064	- 0.1190	0.0540	1.70
Fixed Schedule	109	- 0.0133	- 0.0946	0.1407	4.43
Flexible Schedule	84	- 0.0231	- 0.1008	0.2291	7.22

[a] To isolate the effect of transport costs on changes in visitation, reduce the change in visitation due to increased travel distance by the product of increased time costs (or increased time for non-employed respondents) and the coefficient relating time costs (or time for non-employed respondents) to the change in visitation prompted by increased travel time.

Table 9

Test of Consistency between Effect of Transport Costs on Demand Levels and Effect of Access Costs on Changes in Demand: After Adjustment of Time Costs

Dataset of Demand Levels	Respondent Category according to Work Schedule					
	Flexible		Fixed		Non-employed	
	÷^{2}-statistic	P-value	÷^{2}-statistic	P-value	÷^{2}-statistic	P-value
Truncated Regression of RP Data and Tobit Regression of SP Data						
Linear Specification						
Ex Post RP	0.241	0.624	0.493	0.482	0.157	0.692
Ex Ante SP	0.186	0.666	0.261	0.610	0.074	0.786
Semilog Specification						
Ex Post RP	0.018	0.894	0.222	0.638	1.390	0.238
Ex Ante SP	0.740	0.390	0.913	0.339	0.130	0.719
SUR Regression of RP and SP Data						
Linear Specification						
Ex Post RP	4.612	0.032	3.222	0.073	1.221	0.269
Ex Ante SP	3.482	0.062	1.572	0.210	0.109	0.741
Semilog Specification						
Ex Post RP	0.656	0.418	0.352	0.553	1.522	0.217
Ex Ante SP	1.299	0.254	0.069	0.793	0.217	0.641

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