Estimating Dynamic Recreational Demand by the Hedonic Travel Cost Method

by

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Abstract

This research explores how recreational values change over time. Hedonic functions linking travel costs to site amenities are estimated using data on nearly 70,000 visitors to Ohio State Parks from 1997 to 2002. The results suggest substantial changes in recreational values over time. Effects are estimated to show the importance of capturing changes in the hedonic prices.

Introduction

State parks are important recreational amenities in Ohio. For example, at Lake Erie, there are 9 state parks generating more than 15 million visits per year. The wide range of recreational resources and infrastructures in these parks generate their popularity. Over the years, park management has enhanced the quality of visits by developing unique visitation experiences for individuals interested in outdoor recreation. Continuing to provide opportunities for various recreational activities is a primary goal for the Ohio Department of Natural Resources (ODNR), the agency managing these resources.

Economic valuation provides important indicators of the quality of environmental resources. A number of studies have investigated the economic values of environmental resources, such as water quality, fishing, boating, wildlife viewing, and so on (see examples in Freeman; Braden and Kolstad; Hanley, Shogren, and White; etc.). These values have been applied in numerous development plans of environmental resources to assist the policymakers and managers to comprehend the public's needs. For the same purpose, this study proposes the methods to estimate the recreational values of amenities in Ohio state parks. The results reveal the social preferences visitors have for amenities at state parks, and can help managers determine the most valuable improvements for visitors.

One of the primary issues associated with valuing the natural environment is that monetary prices are not available for many environmental services and amenities. In state parks, the entrance fee is zero and most infrastructures are accessible to all visitors. The main trip costs are the expenses for traveling to the destination and the opportunity costs of their travel time. Various economic methods have been developed to evaluate these

resources and amenities. This research adopts the hedonic travel cost (HTC) method, first developed by Brown and Mendelsohn (1984), to estimate the recreational values.

The HTC method derives implicit prices of recreational attributes by regressing travel costs on the bundles of attributes associated with the destination sites. The equilibrium prices represent visitors' willingness to pay for the attributes and reveal the social benefits on managing the resources. This method has been applied to many recreational cases, such as steelhead fishing in Washington State (Brown and Mendelsohn), water-based recreation in the Pittsburgh area (Smith and Kaoru), swimming activities in the Boston region (Bockstael, Hanemann, and Kling), wilderness in Washington State (Englin and Mendelsohn), sport fishing in the estuary of North Carolina (Smith, Palmquist, and Jakus), and forest attributes in southeastern United States (Pendleton et al.).

For valuing recreational amenities in Ohio state parks, this study relates the information of park visitors to the amenities of their visited parks. The visitor information is provided by ODNR who conducts a survey of state park users each year. Six years of visitation data from 1997 to 2002 are generated with over 70,000 surveys in total. Because this method is to predict the recreational behavior of a targeted population, i.e., Ohioans in this case, the visitors from other states are excluded, resulting in nearly 60,000 eligible observations. The data regarding state park amenities are investigated every two years by the ODNR. Within the study period, amenity data are available for 1997, 1999, and 2001.

With these substantial datasets, this research provides the values of infrastructure developments, such as boat docks, launching ramps, campgrounds, and nature trails. The

information can help state park managers allocate amenities that provide the greatest values. Policy analysis focuses on the state parks at Lake Erie because this area is particularly important for recreational activities in Ohio.

The Data

Two sources of data are generated for this study: park visitation and amenity. The visitation data are provided by the ODNR which conducts the Write Right Survey every year on state park visitors. Six years of data from 1997 to 2002 are available. The visitor survey contains information on their home zip codes and the park they visited on a single choice occasion. The zip code distance between their home address and visited park are calculated by Zipfip software. The distance (d) is used to determine the travel costs of each visit (denoted by c), including the monetary costs of travel and the opportunity costs of time by the following equation:

(1) $$c = [2 \cdot d \cdot m] + [2 \cdot (d / v) \cdot r \cdot (w / h)]$$

The first term estimates the monetary costs for a round trip. The monetary cost for traveling per mile (denoted by m) is assumed to be \$0.30. The second term estimates the opportunity costs of travel time. Hours spent on traveling are derived from dividing the round trip distance by the assumed driving speed (v), 40 miles per hour. Then the travel hours are valued by r, the tradeoff rate between work and travel, assumed to be equal to 30% of their hourly wages. Because visitors' home zip codes are the only information to specify individuals, the information on income is derived from the 1990 U.S. Census Dataset to obtain the mean personal annual income in each zip code area. Since the income (w) data are in annual terms, the value is divided by the assumed annual working

hours (h), 2,040, to obtain the hourly wage rate. As a result, the estimated travel costs of each trip observed from the visitor data have the mean of about $39 with a standard deviation of $37.

Data on park amenities are from the ODNR's survey of Ohio state parks in 1997, 1999, and 2001. A total of 66 categories of amenities maintained by the ODNR are included in the dataset. Fourteen of them are selected according to their popularity and importance, including whether or not a park is located at Lake Erie, the number of parking spaces, campsites, electricity sites, resort lodge rooms, square feet of total cabins, the number of golf courses, boat ramps, total boat docks, swimming beaches, guard stations, visitor or nature centers, picnic tables, and the mileage of trails. The Lake Erie amenity is in a dummy variable format that is equal to one if a park is located at Lake Erie and zero otherwise. This specification can reveal the importance of water experiences at Lake Erie. For cabins and boat docks, the units operated by the State of Ohio and by private concessions are aggregated. Of the total cabins measured in square feet, nearly half are operated by the State of Ohio and the other half are concessions. About 20% of the total boat docks are operated by private concessions.

Because the hedonic pricing method is developed to reveal the marginal utility of attributes characterizing a set of similar goods, the estimated values would be more straightforward if all valued attributes are contained in every analyzed good and distributed continuously in units. However, only several of the selected attributes are provided in each state park and once an attribute is provided, it may be in a large amount, such as campsites or boat docks. Therefore, a set of dummy variable specifications is

used to distinguish the difference of attribute provision as well as to rationalize the estimates in a marginal setting.

Dummy variables are equal to one if an activity is available and zero otherwise. The variables are employed for the following: camping, cabins, golfing, boating, swimming, and visitor/nature centers. As shown in Table 1, several of these activities also contain information on the level, scope, or quality of the activity at each site. For example, the number of campsites is included to measure the effect of additional campsites on the price of a trip, and the number of electricity sites is included to measure the quality of the sites. Cabins are important for visitors who plan to have a longer stay in parks. Whether or not a park provides cabins can determine the site choice of visitors and square feet of cabins describe the matter of the scale. To attract boaters to visit, the accessibility and additional quantities of boat docks and boat ramps are essential. Swimming activity is also popular for the general public. Whether or not and how many swimming beaches and lifeguard stations are maintained make a difference on site decisions.

Moreover, golf courses and visitor/nature centers are mostly provided with one unit, so that these variables are presented by dummy variables, and denote the recreational preference for golfing and educating purposes, respectively. Most resorts at Ohio state parks are built with golf courses so they are collinear with each other. The number of resort lodge rooms determines the size of resorts. The other variables including parking spaces, picnic tables, and mileages of trails are not specified by dummy variables, because they are provided in most parks and distributed continuously in units. Table 1 concludes the specified variables used for the hedonic pricing estimation.

Methodologies

Unlike the conventional travel cost method that estimates site demands, the HTC method applies a dual approach to estimate the demand for site attributes. The HTC method stems from the fundamental economic assumption that visitors maximize their utility conditional on their budget constraint. The utility of a trip is assumed to depend on the quantities or qualities of attributes maintained in the visited site. If budget exhaustion occurs, the travel costs visitors spend on the trip can represent their trip budget. Therefore, the behavior that visitors maximize their utility of taking a trip subject to their budget constraint can be described as:

(2) $Max_Q \quad U(Q) + \lambda \cdot (C - P(Q))$

U(Q) is the utility level affected by a vector of attributes, *Q*. *C* denotes the trip budget and *P(Q)* is the travel costs spent on purchasing attributes in the visited site. Since *C* is the visitors' budget for a trip, λ represents the marginal utility of income.

Based on the utility maximization framework, the equilibrium condition on visitors' decision occurs as the marginal utility of attribute *i* ($U_{q(i)}$) in the unit of λ equal to the marginal cost of attribute *i* ($C_{q(i)}$), which can also be defined as the marginal willingness to pay for the attribute *i* ($P_{q(i)}$). That is,

(3) $U_{q(i)} = \lambda \cdot C_{q(i)} = P_{q(i)} \quad where\ i = 1,...,n$

where *n* is the number of attributes to distinguish the difference between sites. Without loss of generality, λ, the shadow price of income, can be set equal to 1, so that the marginal utility equals the marginal cost. Under the standardized equilibrium, the marginal willingness to pay, $P_{q(i)}$, can be substituted into the budget constraint (shown in

Equation (2)) and aggregated to visitors' willingness to pay for a trip to a site associated with a vector of attributes, Q. With the budget exhaustion assumption, the budget constraint (C) is equal to the travel costs, $P(Q)$, and can be decomposed to the implicit prices, $P_{q(i)}$, paid for enjoying the attributes in the visited site. The hedonic pricing function in a linear form becomes:

$$(4) \qquad C = P(Q) = P_0 + \sum_{i=1}^{n} P_{q(i)} \cdot q_{(i)}$$

where P_0 denotes the constant term. Since the travel costs are the aggregation of costs related to travel distance and time, this function also implies that site attributes are the factors determining how far and how long visitors are willing to travel.

The hedonic method is used to estimate the marginal value or price of amenities for different user groups or markets (Rosen, 1974). A system of demand functions for amenities can be derived from these hedonic estimates, and reveals the social preference as one representative individual. Integrating the demand system based on the provided amenities measures the social welfare from the enjoyment of these amenities. The change of welfare affected by a discrete-, or multiple change(s) of amenities can be obtained from the differences of welfare measures associated with different amounts of amenities.

Alternatively, the hedonic prices reveal the marginal social values of amenities in different state parks or markets without estimating the second stage of the demand functions (Englin and Mendelsohn; Pendleton et al.). Measuring the welfare by a discrete change derived from the demand functions rather than from the marginal values can avoid possible estimation errors when the demand is price-sensitive (Brown and Mendelsohn).

Hedonic Price Functions

In this study, the total observations of Ohio visitors are divided into 41 subsets, according to their geographical origins, to represent the market areas for park recreation demand. These market areas are defined mostly by counties, although some adjacent counties are combined into one market area when sample sizes are small. Six years of data from 1997 to 2002 are used. Visitors observed in 1997 and 1998 are assumed to consume the amenities available in 1997; visitors in 1999 and 2000 are assumed to consume the amenities available in 1999; and visitors in 2001 and 2002 are assumed to consumed the amenities available in 2001. Separately estimating the data each two years results in three sets of hedonic prices. Each hedonic equation represents the recreation behavior of visitors from each market area in different time periods, and is estimated by using the ordinary least squares regression technique. The hedonic pricing function for market area *j* in period *t* is assumed in a linear form with subscript numbers denoting the variables shown in Table 1. Subscripts (Superscripts) for market area *j* (time period *t*) are ignored for simplicity.

$$
\begin{aligned}
c = {} & p_0 + p_1 \cdot q_1 + p_2 \cdot q_2 + [p_3 \cdot q_3 + p_4 \cdot (q_3 \cdot q_4) + p_5 \cdot (q_3 \cdot q_5)] \\
& + [p_6 \cdot q_6 + p_7 \cdot (q_6 \cdot q_7)] + p_8 \cdot q_8 + p_9 \cdot q_9 \\
& + [p_{10} \cdot q_{10} + p_{11} \cdot (q_{10} \cdot q_{11}) + p_{12} \cdot (q_{10} \cdot q_{12})] \\
& + [p_{13} \cdot q_{13} + p_{14} \cdot (q_{13} \cdot q_{14}) + p_{15} \cdot (q_{13} \cdot q_{15})] \\
& + p_{16} \cdot q_{16} + p_{17} \cdot q_{17} + p_{18} \cdot q_{18} + \varepsilon
\end{aligned} \tag{5}
$$

Each equation demonstrates how the travel costs, *c*, are distributed on purchasing $q_{(i)}$, the amount of amenity *i*. The parameter p_0 is the intercept; $p_{(i)}$ is interpreted as the marginal value or price of an extra unit of amenity *i*; ε denotes the error term. Different estimates

are developed in different user groups, defined here as visitors from particular counties who travel in particular periods.

Positive hedonic values indicate that visitors value more access to the amenities. The negative estimates may not be defined as the willingness to accept to use these amenities, because every park amenity is environmental “goods”, not “bads.” However, the negative estimates are not unreasonable. The amenity can be over-satiated at the margin, so that visitors are not willing to drive further to a park with a higher level of the amenity (Englin and Mendelsohn). More specifically, if an amenity is over-satiated, visitors cannot distinguish the difference on the quantity of the amenity. They are likely to drive further to a park with more amounts of other amenities they need but with less amenity that is over-satiated in a closer park.

If there is no additional dummy variable for specifying the discontinuity of amenities, the hedonic method reveals the marginal utility of amenities directly from the hedonic estimates, such as the second variable representing the amenity for parking spaces in Equation (5):

$$(6) \qquad \frac{\partial u}{\partial q_2} = \frac{\partial c}{\partial q_2} = p_2$$

If a dummy variable is used to reveal the access to a specific activity like camping, the marginal price for camping is conditional on the current supply of campsites (q_4) and electricity sites (q_5) that are varied by individuals who come from the same market area but visit different parks:

$$(7) \qquad \frac{\partial c}{\partial q_3} = p_3 + p_4 \cdot q_4 + p_5 \cdot q_5$$

Consequently, the marginal price obtained by Equation (7) is varied by individuals. To obtain the hedonic price for camping ($\hat{c}_{q(3)}$) representing the recreation behavior in a market area during a period, the value can be derived from the averaged quantities of campsites ($\overline{q}_4$) and electricity sites ($\overline{q}_5$) over the parks (K_j^t) that the sampled visitors of size m_j^t visit.

(8) $$\hat{c}_{q(3)} = p_3 + p_4 \cdot \overline{q}_4 + p_5 \cdot \overline{q}_5 \quad where \quad \overline{q}_{ij}^t = \sum_{k \in K_j^t} q_{ijk}^t / m_j^t \quad \forall\, i = 4,5;\ j \in J;\ t \in T$$

For campsites and electricity sites, the marginal values are conditional on whether or not camping is available, so that the value for each market in each period is also estimated by the average over the parks visited by the sample visitors as shown above.

(9) $$\hat{c}_{q(4)} = p_4 \cdot \overline{q}_3$$

(10) $$\hat{c}_{q(5)} = p_5 \cdot \overline{q}_3$$

The hedonic prices for other amenities are estimated in a similar treatment depending on how the variable is specified.

Marginal Social Values and Changes over Time

Marginal social value is the value that the observed visitors are willing to pay for an extra unit of amenity in a specific park. Each of the estimated hedonic prices (p_{ij}^t) denotes the visitors' willingness to pay for one unit of amenity *i* by a visitor from an assigned origin *j* in the period of *t*. Weighting p_{ij}^t by r_{jk}^t, the ratio of the number of visits from area *j* to park *k* in period *t* (n_{jk}^t) to its total observed visits, determines the marginal social value of an amenity in a park (v_{ik}^t).

(11) $$v_{ik}^{t} = \sum_{j=1}^{J=41} r_{jk}^{t} \cdot p_{ij}^{t} \quad for\ i \in N; k \in K; t \in T, \quad where\ r_{jk}^{t} = n_{jk}^{t} / \sum_{l=1}^{L=41} n_{lk}^{t} \quad for\ j \in J$$

Social values can detect the efficiency of amenity management, as well as provide suggestions for amenity developments in the future. For example, Table 2 shows the quantity changes of amenities from 1997 to 1999 in 69 state parks. Summing up the changes over the parks, the decreased amenities include parking spaces, campsites, cabins, boat ramps, beaches, picnic tables, and miles of trail. There is no change in resort lodge rooms, golf courses, and lifeguard stations. Only three amenities show increases: electricity campsites, boat docks, and visitor/nature centers. If an amenity is valued, an addition can produce the social benefits, but a deduction leads to degradation of recreation experience, and causes welfare loss.

The change of social values over time can be detected by estimating the difference of marginal social values between the former period *t'* and the latter period *t''*:

(12) $$\Delta v_{ik}^{\Delta t} = \sum_{j=1}^{J=41} p_{ij}^{t''} \cdot r_{jk}^{t''} - \sum_{j=1}^{J=41} p_{ij}^{t'} \cdot r_{jk}^{t'} \quad for\ i \in N; k \in K.$$

$$where \quad r_{jk}^{t''} = n_{jk}^{t''} / \sum_{l=1}^{J=41} n_{lk}^{t''} \quad and \quad r_{jk}^{t'} = n_{jk}^{t'} / \sum_{l=1}^{J=41} n_{lk}^{t'}$$

When the estimated $\Delta v_{ik}^{\Delta t}$ is positive, it suggests that the marginal social value for amenity *i* in park *k* has increased over time. If its marginal social value is also significantly positive during the observed period, meaning that the amenity is highly and increasingly valued by visitors, it should be valuable to create more access to fulfill the recreational needs. More specifically, Figure 1 illustrates the welfare gains by increasing the supply of an increasingly valued amenity. If the demand is shifted from $D^{t'}$ right to $D^{t''}$, increasing the amenity supply from unit $Q^{t'}$ to $Q^{t''}$ can increase the welfare from the

amount of area $C^{t'}E^{t'}P^{t'}$ to $C^{t''}E^{t''}P^{t''}$. The increased supply, therefore, produces significant benefits.

On the contrary, if a negatively valued amenity has a decreasing demand over time, the suggested plan for park managers is to remove it, since the excess supply will not be valued in the future. When an amenity is not valued in the current period because it is in excess supply but visitors tend to value the amenity more in the future, however, the excess supply may fulfill the future demand. As illustrated in Figure 2, $P^{t'}$ denotes visitors' implicit price for the Q* units of an over-satiated amenity. Although a negative price can imply the willingness to compensate for consuming an additional unit of the good, the compensation does not occur in the park recreation case. Rather, the information suggests that there is no incentive for visitors to pay for an extra unit under the current amount of supply. This also implies that the supply does not maximize the consumer surplus because Q* could offer the maximum amount of welfare in area C*Q*O if the good is not over-satiated. If the compensation is possible, the consumer surplus can be represented by area $C^{t'}E^{t'}P^{t'}$, which equals area C*Q*O, so that the consumer surplus is maximized. Since the compensation is not possible, the Q* amount of the supply actually produces the amount of welfare in area $C^{t'}Q^{t'}O$, which only takes $Q^{t'}$ amount of supply. In other words, there is an excess supply, $(Q^* - Q^{t'})$, which does not produce benefits. However, if the good has an increasing demand over time, the excess supply will be consumed and the welfare is increasing so that a Pareto Improvement is possible. When the demand shifts right to D* or further, the consumer surplus is maximized and the park manager's goal is reached.

The Results

This study first estimates the hedonic prices from two datasets separated by time. Each set of estimates reveals visitors' willingness to pay for an additional unit of amenities by visitors in 41 assigned market areas between 1997 and 2000. Results are addressed on the amenity demand in the state parks at Lake Erie.

The state parks located at Lake Erie include: Cleveland Lakefront, Geneva, Headlands Beach, Crane Creek, East Harbor, Lake Erie Islands, and Maumee Bay. Lake Erie Islands represent three parks, including Catawba Island, Kelleys Island, and South Bass Island. The first three parks are located in the Eastern Basin to Cleveland City and the others are in the Western Basin. Table 3 shows the units of amenities maintained at these parks in 1997. The amenities seem unequally distributed in this area. Overall, only Maumee Bay has resort lodge rooms and a golf course. Only Maumee Bay and East Harbor maintain a visitor/nature center.

How do state park visitors to Lake Erie value amenities? The recreation preferences can be revealed by marginal social values of amenities derived by Equation (11). The resulting values are measured in dollars per visit, and shown in Table 4. These parks have very similar demands for recreation amenities. Parking spaces are usually overabundant in most state parks in Ohio but visitors to the Lake Erie area apparently demand for them because these parks may be congested during the summer. However, an additional campsite or electricity site is not valued, suggesting that they are oversupplied, so that visitors have no motivation to look for an extra unit of these amenities, once a park has offered them. A more spacious cabin by square feet is also not important. The accessibility of boating is all available but satiated in these parks; however, more boat

docks are still needed. That is, visitors are not sensitive to whether a park offers a boating opportunity, but they are very sensitive to which park contains more boat docks and are willing to travel further for the additional boat docks. Swimming activity is very popular to the general pubic. Not only is the accessibility of swimming activities valued, but also an additional swimming beach. The one exception is Crane Creek state park. Although this park only provides one swimming beach, it is quite spacious, about 3,500 feet, which tends to be sufficient to share with numerous visitors together, so that its visitors do not tend to value more of it. Additional guard stations are not necessary, because they seem too abundant to affect the park visit. All visitors to the Lake Erie area also value more picnic tables and nature trails.

Interestingly, visitors to the state parks located in the Eastern and Western basins have very distinguishable variations in valuing some amenities because the two areas are characterized with different recreational resources that attract visitors for different recreational activities. In the Eastern Basin, camping and resorts are valued positively. On the other hand, they are negatively valued in the Western Basin, probably because both amenities are comparatively more available in that region. Note that more (less) access of an amenity does not necessarily discourage (encourage) its attraction if the amenity is popular (unpopular). Although the state parks in the Western Basin (Eastern Basin) provide more (less) cabins and visitor/nature centers, they are still valued (disvalued).

Some amenities are especially preferred in particular parks. Although neither a golf course nor a resort is provided in East Harbor and Lake Erie Islands, their visitors are potentially interested in the golfing/resort activities. Therefore, a golf course or resort might be a good addition in both parks. Besides, visitors in Crane Creek and East Harbor

demand more boat ramps. Overall there are many potential needs for these amenities in the Lake Erie area. Increasing the recreation supplies can significantly improve the recreation experiences around the neighborhood.

Table 5 shows the amenity changes from 1997 to 1999 in the parks at Lake Erie. There are several amenities added to or deducted from the parks. More notably, 332 units of boat docks are added, but one boat ramp and one swimming beach are deducted from Cleveland Lakefront. There are 150 picnic tables removed from East Harbor. In Lake Erie Islands, 64 units of campsites are deducted but 34 units of electricity, one visitor/nature center, and 45 picnic tables are added. There is no amenity change in Headlands Beach or Maumee Bay.

Since the marginal social values estimated above reflect the social welfare for increasing one unit of amenity, welfare gain or loss from changing the supply of amenity can be detected. For example, boat docks are valued positively to Cleveland Lakefront. The increases of boat docks thus will provide a gain of social welfare and benefit the Ohio recreators. However, damage on social welfare occurs if the demanded amenities are removed from the service. For example, the only boat ramp is deducted from Crane Creek. Since the amenity is valued by its visitors, the deduction reduces its attraction and results in loss of social welfare.

Not only is providing the valued amenities a beneficial strategy for social welfare, but the welfare can also increase over time if the amenities are demanded by an increasing amount of visitors. Therefore, this study also predicts the change of marginal social values for each amenity over time, estimate by Equation (12) and shown in Table 6. The positive sign of estimates reveals the increasing willingness to pay for the amenities.

On the other hand, the negativity of estimates demonstrates that visitors have decreasing valuations for the amenities over the years.

This study points out the positively and increasingly valued amenities in each park for a potential park improvement project. Parking spaces are very important to Lake Erie visitors, especially because those parks attract more and more recreators over the years, including Headlands Beach, Crane Creek, East Harbor, and Lake Erie Islands. The camping accessibility continues to be very important to Geneva- and Headlands Beach visitors. The access to cabins strongly determines visitors' interest on Crane Creek, East Harbor and Lake Erie Islands. Cleveland Lakefront and Headlands Beach are highly expected to provide more resort lodge rooms. For boating activity, there is a significant demand for boat ramps by Crane Creek- and East Harbor visitors, but boat docks are undersupplied in most of these parks. Swimming activity is highly popular in this area, especially in Cleveland Lakefront, Headlands Beach, Crane Creek, East Harbor, and Lake Erie Islands. Although parks in this area have more than one swimming beach available, there still have increasing demands in Headlands Beach and Maumee Bay. The visitor/nature center currently in East Harbor seems quite popular. An additional unit of it can also attract more visits. Picnic tables and nature trails are both highly favorable amenities to visitors of Cleveland Lakefront, Headlands Beach, Crane Creek, and Lake Erie Islands.

Conclusions

Although the hedonic pricing method is initially developed for valuing market goods, it is not necessary to avoid non-market goods from the market equilibrium

framework, as long as the consumers are free to choose and willing to pay for the products while the suppliers intend to fulfill consumers' needs and improve the qualities of the products they offer. In this case of state park recreation, individuals take a trip to a state park over the choices of nearly 70 alternative sites. Each site contains different quantity and quality of recreation resources and services. Visitors make a decision on a recreation site depending on its attributes, and the observed visit is assumed to maximize visitors' trip utility. Simultaneously, park managers adjust and improve the quantity and quality of site attributes in order to attract more visits and fulfill the recreation needs. Although the process is not as efficient and straightforward as in real markets, the interaction between the buyer and supplier of non-market goods appears to follow a similar scheme to reach equilibrium. In fact, it is the task of an environmental economist to push the margin, i.e., to impel non-market goods towards efficiency as market goods.

For the hedonic travel costs technique, each resident faces a different set of travel costs to visit alternative sites, so that different market residents have their best opportunity sets varied by their residential locations. Therefore, as long as site attributes have sufficient price variation, the hedonic structural equations can be formed (Mendelsohn). In this hedonic method practice, there are 41 geographically defined markets to elicit visitors' recreation behavior on taking trips to 69 Ohio state parks from 1997 to 2002. Through the sufficient variations of the cross-sectional multi-markets, the valuation is representative for the social point of view on these recreational resources. The estimated results have shown reasonable consistency in subsequent years. Nonetheless, the independence of multiple markets remains questionable, because no evidence shows the existence of separate markets so that the hedonic prices may or may

not vary spatially. The future development of this method shall depend on a convincing rationale on treating multiple markets.

Despite the fact that the hedonic pricing method is widely applied to value various goods, such as houses, there still are difficulties in expanding this method to public goods. The most restrictive rule of this method is that the measuring attributes are required to be continuous in appropriate units, so that each additional unit can be recognized and judged by the purpose for individual usage, and the estimated marginal value can be comparable to the unitary costs. For recreational resources, attributes are very often provided in a discrete unit. For example, not every park provides campsites; but once they are provided, there may be a considerable number of campsites. Therefore, this study uses dummy variables to specify the importance of provisions so that the marginal estimates can be rationalized. Despite that, how visitors view the amenities is highly dependent on the recreational activities taken at the park. Boaters may care less about the golf courses. Campers may not value the boat ramps and docks even though they are provided in their visited parks. But the hedonic regression assumes that every visitor values every attribute included to define a park trip. Therefore, the effort of designing a scheme to adjust the attributes in a rational manner of personalized usage would be an important step to expend the applicability of the hedonic pricing method in the area of environmental and natural resource valuations.

Tables and Figures

Table 1. Specified Variables in Hedonic Pricing Estimation.

	Variable Specification
1	Lake Erie (1,0)
2	# of parking spaces
3	Camping (1,0)
4	# of campsites
5	# of electricity sites
6	Cabins (1,0)
7	Sqft of total cabins
8	Golf courses/resorts (1,0)
9	# of resort lodge rooms
10	Boating (1,0)
11	# of boat ramps
12	# of total boat docks
13	Swimming (1,0)
14	# of swimming beaches
15	# of lifeguard stations
16	Visitor/nature centers (1,0)
17	# of picnic tables
18	Miles of trails

Table 2. Amenity Changes from Year 1997 to 1999 in 69 State Parks.

Amenities	Total Changes	Mean (Std. Dev.)
# of parking spaces	-938	-13.59 (82.29)
# of campsites	-67	-0.97 (13.14)
# of electricity sites	241	3.49 (20.36)
Sqft of total cabins	-15300	-221.74 (1841.90)
# of golf courses	0	0.00 (0.00)
# of resort lodge rooms	0	0.00 (0.00)
# of boat ramps	-5	-0.07 (1.14)
# of total boat docks	1214	17.59 (74.68)
# of swimming beaches	-1	-0.01 (0.27)
# of lifeguard stations	0	0.00 (0.00)
# of visitor/nature centers	3	0.04 (0.27)
# of picnic tables	-125	-1.81 (19.06)
Miles of trails	-33	-0.48 (7.60)

Table 3. Amenities Maintained by the State Parks at Lake Erie in Year 1997.

Lake Erie Basin	**Eastern Basin**			**Western Basin**			
Park / Facility	Cleveland Lakefront	Geneva	Headlands Beach	Crane Creek	East Harbor	Lake Erie Islands	Maumee Bay
# of parking spaces	6862	1200	3500	1200	1097	340	1400
# of campsites	0	91	0	0	559	264	256
# of electricity sites	0	91	0	0	366	0	256
Sqft of total cabins	0	9696	0	0	0	3164	18000
# of golf courses/resorts	0	0	0	0	0	0	1
# of resort lodge rooms	0	0	0	0	0	0	120
# of boat ramps	4	6	0	1	3	7	0
# of total boat docks	363	383	0	0	125	11	32
# of swimming beaches	4	1	1	1	1	2	2
# of lifeguard stations	13	2	3	5	3	0	3
# of visitor/nature centers	0	0	0	0	1	0	1
# of picnic tables	662	290	12	250	1400	438	150
Miles of trails	3	1	5	0	9	6	17

Table 4. Marginal Social Values of Amenity per Visit from 1997 to 2000 to State Parks at Lake Erie.

Lake Erie Basin	**Eastern Basin**			**Western Basin**			
Park / Amenity	Cleveland Lakefront	Geneva	Headlands Beach	Crane Creek	East Harbor	Lake Erie Islands	Maumee Bay
# of parking spaces (x10)	$0.07	$0.07	$0.06	$0.18	$0.03	$0.04	$0.08
Camping (1,0)	$14.16	$42.48	$37.92	($41.09)	($7.31)	($3.93)	($12.70)
# of campsites (x10)	($0.89)	($0.14)	($0.30)	($1.33)	($0.70)	($0.65)	($0.90)
# of electricity sites (x10)	($1.70)	($1.84)	($2.46)	($0.05)	$0.03	($0.05)	($0.21)
Cabins (1,0)	($2.76)	($23.08)	($20.57)	$49.02	$20.94	$21.29	$26.63
Sqft of total cabins (x1000)	($0.68)	($0.52)	($0.88)	($0.03)	($0.08)	($0.13)	($0.14)
Golf courses/resorts (1,0)	($11.14)	($0.41)	($3.75)	($18.49)	$4.70	$1.57	($6.33)
# of resort lodge rooms	$0.23	$0.25	$0.31	($0.16)	($0.07)	($0.05)	($0.03)
Boating (1,0)	($41.15)	($36.19)	($49.03)	($16.67)	($15.74)	($16.99)	($20.23)
# of boat ramps	($1.78)	($3.00)	($2.73)	$0.74	$0.12	($0.13)	($0.16)
# of total boat docks (x10)	$0.29	$0.18	$0.39	$0.02	$0.12	$0.13	$0.12
Swimming (1,0)	$13.75	$2.18	$14.77	$25.24	$15.49	$14.06	$16.50
# of swimming beaches	$14.35	$16.51	$16.70	($1.28)	$3.71	$4.57	$3.94
# of lifeguard stations	($12.67)	($11.38)	($11.65)	($9.59)	($6.93)	($6.84)	($7.88)
Visitor/nature centers (1,0)	($13.12)	($0.74)	($12.61)	$0.33	$1.36	$1.59	$1.17
# of picnic tables	$0.17	$0.12	$0.18	$0.10	$0.06	$0.07	$0.09
Miles of trails	$1.24	$0.83	$1.24	$0.67	$0.50	$0.54	$0.64
Observations	410	387	418	448	1635	988	921

* Values in ( ) are negative.; (x10) and (x1000) denote the values are measured in 10 and 1,000 units increased respectively; otherwise, values are measured per unit.

Table 5. Amenity Changes from 1997 to 1999 in State Parks at Lake Erie.

Lake Erie Basin	Eastern Basin			Western Basin			
Park / Amenity	Cleveland Lakefront	Geneva	Headlands Beach	Crane Creek	East Harbor	Lake Erie Islands	Maumee Bay
# of parking spaces	0	0	0	0	0	-340	0
# of campsites	0	-6	0	0	11	-64	0
# of electricity sites	0	-6	0	0	-1	34	0
Sqft of total cabins	0	0	0	0	0	0	0
# of golf courses/resorts	0	0	0	0	0	0	0
# of resort lodge rooms	0	0	0	0	0	0	0
# of boat ramps	-1	0	0	-1	0	0	0
# of total boat docks	332	0	0	0	2	11	0
# of swimming beaches	-1	0	0	0	0	0	0
# of lifeguard stations	0	0	0	0	0	0	0
# of visitor/nature centers	0	0	0	0	0	1	0
# of picnic tables	0	0	0	0	-150	45	0
Miles of trails	0	0	0	0.5	0	-1	0

Table 6. Changes of Marginal Social Values of Amenity in Dollars per Visit from 1997 and 1998 to 1999 and 2000 to State Parks at Lake Erie.

Lake Erie Basin	**Eastern Basin**			**Western Basin**			
Park / Amenity	Cleveland Lakefront	Geneva	Headlands Beach	Crane Creek	East Harbor	Lake Erie Islands	Maumee Bay
# of parking spaces (x10)	($0.00)	($0.01)	$0.01	$0.04	$0.00	$0.04	($0.02)
Camping (1,0)	($1.69)	$4.76	$2.93	($7.62)	($3.54)	($7.73)	$4.71
# of campsites (x10)	($0.04)	$0.15	$0.02	($0.12)	($0.07)	($0.22)	$0.11
# of electricity sites (x10)	$0.03	$0.02	($0.34)	($0.16)	$0.09	($0.15)	($0.00)
Cabins (1,0)	$0.61	$1.02	($5.80)	$7.01	$2.81	$11.48	($4.11)
Sqft of total cabins (x1000)	($0.01)	($0.00)	($0.12)	($0.04)	$0.01	($0.06)	$0.01
Golf courses/resorts (1,0)	($0.45)	$3.84	($1.47)	($4.67)	($0.67)	($3.19)	$4.84
# of resort lodge rooms	$0.00	($0.04)	$0.05	($0.02)	($0.02)	($0.06)	($0.02)
Boating (1,0)	($0.59)	$2.41	($5.58)	$0.22	($0.08)	($1.60)	$1.06
# of boat ramps	$0.04	$0.12	($0.42)	$0.07	$0.09	$0.16	$0.04
# of total boat docks (x10)	$0.00	$0.02	$0.02	($0.01)	($0.02)	$0.03	$0.03
Swimming (1,0)	$1.18	($2.17)	$2.01	$0.71	$1.83	$2.79	($1.43)
# of swimming beac[1]hes	($0.07)	($0.30)	$1.69	($1.10)	($0.41)	($1.75)	$0.19
# of lifeguard stations	$0.10	$0.03	($0.28)	($0.80)	$0.10	($0.84)	$0.28
Visitor/nature centers (1,0)	($0.39)	($1.07)	($2.20)	($0.96)	$0.12	($1.92)	($1.22)
# of picnic tables	$0.00	($0.01)	$0.02	$0.02	($0.00)	$0.02	($0.01)
Miles of trails	$0.03	($0.01)	$0.11	$0.07	($0.00)	$0.12	($0.02)
Observations	410	387	418	448	1635	988	921

* Values in ( ) are negative.; (x10) and (x1000) denote the values are measured in 10 and 1,000 units increased respectively; otherwise, values are measured per unit.

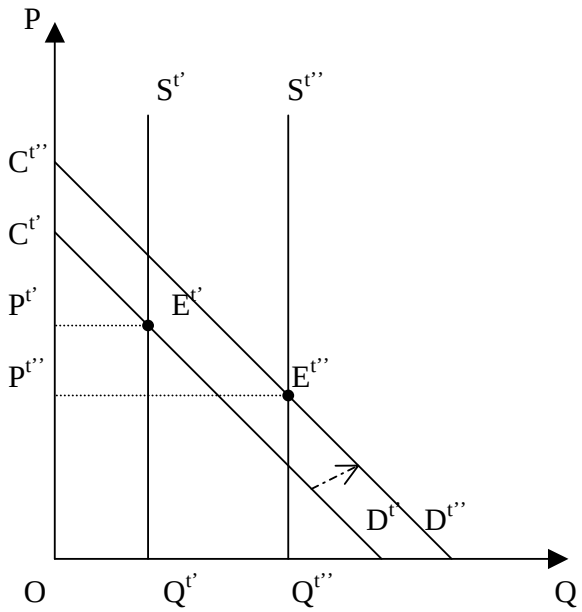

Figure 1. Welfare Gains by Increasing Supply of a Favorable Amenity with an Increasing Demand over Time.

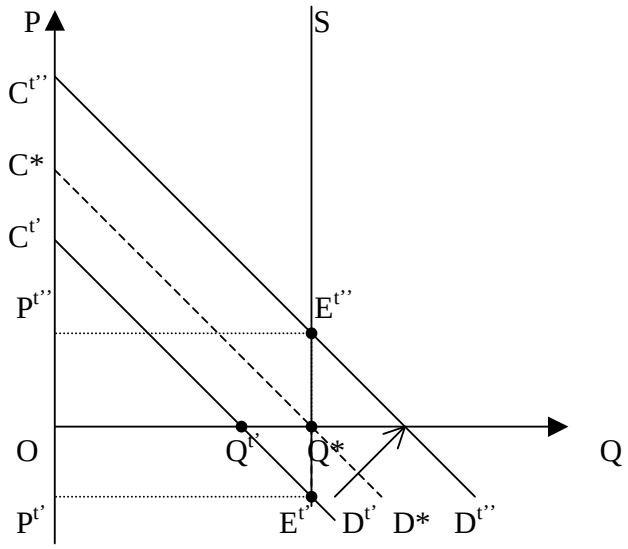

Figure 2. Pareto Improvement of an Over-satiated Amenity with an Increasing Demand over Time.

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