Temporal Stability of Recreation Choices

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Introduction

This paper accomplishes two goals. It addresses a frequent criticism of economic studies that they are rarely replicated and validated. It also evaluates the stability of coefficient and willingness to pay (WTP) estimates for recreation services over time. To address these questions, we estimate a model presented in Haab and McConnell's (2003) widely used textbook, using two datasets from different time periods, but concerning the same study area. We then compare the estimation results and evaluate the temporal stability of preferences that drive recreation choices. The two datasets are on trips made by Delaware residents to beaches in the Mid-Atlantic region: Delaware, New Jersey, Maryland and Northern Virginia. The first dataset was collected using a mail survey in 1997 and the second dataset was gathered through an Internet survey in 2005. Besides the time periods, and the survey methods, there are also significant sample size differences between the two datasets. In the 1997 sample, 400 people made at least one day trip, while in the 2005 dataset, only 50 people visited the beaches of interest.

The issue of stability of consumer preferences over longer time periods is of particular interest in environmental economics and environmental policy. More specifically, benefit cost analyses often make use of WTP estimates from previous time periods with the assumption that consumers respond to environmental factors in a similar way over time. These benefits transfers for environmental goods and services are often used to save time and costs of valuing sites for which there is little information by transferring available information from studies already completed in another location or time period. Since most of the benefits transfer studies are spatial there has been more research concerned with the spatial differences in values (Brower, 2000; Loomis et al., 1995; Kirchhoff et al., 1997; Scarpa et al., 2002). However, just as there is no reason for values of environmental goods to be constant and easily transferable over different geographical locations, it cannot be assumed that consumer preferences and values for environmental goods are constant over time (Zandersen et al., 2005; Brouwer and Bateman, 2005). This study attempts to explicitly test this assumption.

The remainder of the study is organized as follows. We begin by discussing the behavioral and econometric models and other studies in the literature that have tested the temporal stability of preferences when accounting for the scale of the data sources. The datasets are then described, followed by the empirical specification of the model. The parameter estimates of the two site choice models are presented and compared. Then we describe the simulation of several policy scenarios and compare the resulting willingness to pay distributions. In the final section we provide a conclusion.

Random Utility Model

The site selection decisions are modeled with a random utility model (RUM). The RUM is a well established method for modeling consumer choices. It is widely used in nonmarket valuation as a tool for valuing environmental quality and access in dollar terms. Individuals have utilities for recreation choices like beaches. A RUM framework assumes that on every choice occasion the individual compares the indirect utility functions associated with the available alternatives and chooses the site with the greatest utility. These utilities are known by the individual with certainty. From the researcher's point of view, the indirect utility function for individual i for each alternative j is defined as in

$$V_{ij} = \beta x_{ij} + \varepsilon_{ij},$$

$$Var[\varepsilon_{ij}] = \sigma^2,$$

where x_{ij} is a vector of site characteristics, and travel cost to reach the beach site, ε_{ij} is a random error assumed to be known to the individual but unknown to the researcher, β is an estimated parameter. From the researcher's point of view individual recreation choices are probabilistic. The probability that the researcher observes an individual choosing site j is

$$\text{Prob}(j) = \text{prob}(V_j > V_k) \text{ for all k.}$$

Different choice models are derived from different assumptions about the distribution of the error term. Assuming that the error component is independently and identically distributed (IID) Gumbel leads to the multinomial logit model (MNL). The choice probabilities in a MNL, as shown in Ben-Akiva and Lerman (1985) are:

$$P_{ij} = \frac{\exp(\mu\beta x_{ij})}{\sum_{linC_n} \exp(\mu\beta x_{il})},$$

where $\mu > 0$ is a scale parameter of the Gumbel distribution and $V_{ik} = \mu\beta x_{ik}$. The variance σ^2 of the random component of the utility function is $\pi^2/6\mu^2$. The scale parameter is proportional to the inverse of the standard deviation (Ben-Akiva and Lerman, 1985; Louviere, Hensher, and Swait, 2000). The IID assumption of the MNL restricts all error terms to have equal scale parameters and therefore equal variances for the disturbances of the utility functions. The ordering of the utilities will not be affected by this common scaling of utilities, and for identification the scale parameter is usually normalized to 1. For a given dataset the estimated parameters of the choice model will actually be $\mu\beta$ and if the researcher assumes $\mu = 1$, the estimated β coefficients will confound true taste effects and scale. Thus, it is impossible to separately identify the scale effect within a given dataset.

This identification issue exists also with other generalized extreme value models, for example, the nested logit. The nested logit (NL) achieves a partial relaxation of the IID assumption for subsets of alternatives. It is useful in modeling substitution among alternatives when some alternatives are similar to other alternatives in the unobserved factors. The NL allows for the variances of the disturbances and the scales of the utilities to be different across subsets of alternatives while maintaining the IIA within the alternatives in the same nest. If the scale parameters are equal then the NL becomes a MNL. Assuming a special type of a generalized extreme value distribution for the random term, the nested logit (NL) probability formula is derived. Dropping the subscript for individual, the probability to choose alternative j in nest k in a two level tree is:

$$P_j = P_k P_{j|k} = \frac{\exp\left(\alpha z_k + \left(1/\mu_k\right) IV_k\right)}{\sum_{m \in C_r} \left(\alpha z_m + \left(1/\mu_m\right) IV_m\right)} \frac{\exp\left(\mu_j \beta x_j\right)}{\sum_{l \in C_n} \exp\left(\mu_l \beta x_l\right)},$$

where $IV_k = \ln(\sum_{l in C_k} \exp\left(\mu_l \beta x_l\right))$ is the inclusive value of nest k. z_k are variables that vary across nests, x_j are variables that vary within nests, μ_j is the scale parameter associated with j[th] elemental alternative at the lowest level of the tree, μ_k is the scale parameter associated with k[th] branch. However, since all scale parameters μ_j within a nest are equal for every j in k, we will have $\mu_k = \mu_j$. A more detailed discussion and the derivation of the probability formula for three-level NL trees are available in (Hensher and Greene, 2000; Louviere et al., 2000).

Since, with a single data source only μβ can be estimated, it is not possible to directly compare coefficient estimates from different datasets or models. The observed differences in the estimated parameters may be true taste differences, variance-scale differences, or perhaps both.

A statistical test is required to determine if parameters are equal between data sets after accounting for scale differences (Swait and Louviere, 1993; Louviere et al., 2000).

The recognition that the scale parameter is an integral part of behavior when combining and comparing data sources is notable in the marketing and travel demand modeling literature, e.g. Swait and Louviere (1993), Louviere et al. (1993), Louviere (1994), Hensher et al. (1998), Severin et al. (2001). Even though most studies combine revealed and stated preference data sources, the methods can be extended to any combination (Louviere et al. ,2000).

Several studies have attempted to test the temporal stability of preferences accounting for scale. Severin et.al (2001) test the stability of parameters for retail outlet choices both over time and over space. After explicitly accounting for the variance-scale differences of the revealed preference data sources from different time periods and geographical locations, they find that the underlying preferences for shopping centers are relatively stable in both dimensions. In an urban travel demand study, Mannering et.al (1994) find that traveler's activity choices are not temporally stable for the time period examined. However, their results have to be taken with care, since they may be unable to capture the true day-to-day variations in choice of travel activities, because of data limitations. As they point out, the datasets modeled come from two-day diaries in a two-wave survey. Brouwer and Bateman, (2005) address the stability of WTP estimates for flood control and wetland conservation over 5 years, using contingent valuation data. They find significant differences in WTP estimates, but the underlying preference determinants remain stable.

Data

The current study examines the issue of temporal stability of coefficients and willingness to pay estimates using two datasets on beach trips. The trips are made by Delaware residents to Mid-Atlantic beaches in 1997 and 2005. Both datasets are collected at University of Delaware. The 1997 dataset has been used widely, see Haab and McConnell (2002, Example 27), Parsons (2003), Parsons and Massey (2003), Parsons, Massey, and Tomasi (1999). The behavioral data were gathered in a mail survey sent to 1306 randomly selected Delaware residents. Of these, 220 were returned unopened to the sender. Five hundred ninety three surveys were completed and returned, yielding a response rate of 55%. Some of the responses were determined to be incomplete or inconsistent, which resulted in 565 usable responses. From these 565 people, 400 made at least one day trip during the survey period. Three of the 400 beachgoers reported more than 250 trips. In this analysis we use the data on trips reported by the remaining 397 people. The choice set in the 1997 study included 62 Mid-Atlantic beaches in New Jersey, Delaware, Maryland and Virginia. In addition, data on beach characteristics was collected. Massey (2001) has a detailed description of the data and the survey. The 1997 dataset used in this study is publicly available on a website to supplement Haab and McConnell (2002). Individual characteristics data for respondents is available on a website to supplement Parsons (2003).

The second dataset comes from a random Internet survey in 2005 distributed among residents of Delaware, New Jersey, Maryland, Pennsylvania, New York, Virginia, West Virginia, Ohio, and the District of Columbia. The questionnaire in 2005 was similar to the one used in 1997. However, in 2005 respondents were sampled from a larger set of states to assess more reliable user valuations of recreational benefits enjoyed by all visitors to beaches in the Mid-Atlantic region. Knowledge Networks conducted the survey between December 15, 2005 and

January 10, 2006. The firm maintains an online panel of respondents that is representative of the full U.S. population. The survey was administered to 2619 panel participants from all 9 states. There were 2193 responses, resulting in a response rate of 84%. Among them 2070 visited a beach for recreation or pleasure at least once in their life and were eligible to participate in the survey. This study uses only part of the full 2005 dataset. A comparison of preferences of Delaware residents over time was not the main purpose of the data collection and thus out of the 2070 respondents only 85 came from Delaware. Out of the 85 Delaware residents who responded to the survey, 50 spent at least one day at the beaches of interest. Trip data from these 50 respondents in 2005 is merged with the beach characteristics collected in 1997 to form the 2005 dataset used in this study. The beach choices in the 1997 and 2005 datasets are matched except for two New Jersey beaches which were not included in the 2005 survey. Thus, the choice set in the 2005 data included 60 beaches.

Trip cost in both datasets is measured as the sum of travel costs, time costs, and beach fees. Round trip distance and time spent in travel were calculated using PC Miler based on the fastest travel time. Travel cost in the 2005 dataset is calculated as forty-five cents times round trip distance plus tolls. In the 1997 data round trip distance is multiplied by thirty five cents. The opportunity cost of time is calculated by multiplying the round trip travel time by one third of a wage per hour. The wage per hour proxy is derived by dividing annual income by 2080. The 2005 trip costs are recalculated in 1997 dollars using the CPI. The round trip travel cost is

$$TC = 2\,(\mathrm{c})\,(\mathrm{d}) + 2\left(1/3\right)\left(\mathrm{I}/2080\right)\left(\mathrm{d}/\mathrm{mph}\right),$$

where c is cost per mile, d is distance from the zip code of the population center of the respondent's place of residence to the location of the main entrance of each beach as defined subjectively by latitude and longitude using Mapquest and beach visits. Sample statistics and number of single day trips for both datasets are presented in Table 1. Characteristics of the sampled households for both time periods are given in Table 2. The higher percent of households taking trips and the higher number of average trips per household may be indicating the presence of some avidity bias in the 1997 data. Since the survey was sent to randomly selected Delaware residents by mail, it may be that more avid beach goers responded to the survey. In contrast, the 2005 survey was distributed among panelists recruited by Knowledge Networks, who have a long term relationship with the firm. The last two columns in Table 2 present the outcomes from a non parametric Mann-Whitney test and a parametric two sample t-test, which test the statistical significance of the differences in characteristics between the two time periods. Respondents in both years have similar characteristics. Using the nonparametric test, respondents differ significantly only with regard to their work time flexibility with respondents in 1997 having significantly more flexible time than respondents in 2005. Using the parametric test, households differ by the number of children under 10 years old. Compared to 1997, a larger number of households in 2005 have children under 10 years old.

Visitation statistics for the 15 most visited beaches for both years are presented in Table 3. The trips to these 15 most visited beaches account for over 90% of all trips in the samples. The most popular beaches in both 1997 and 2005 are Rehoboth Beach, Cape Henlopen State Park, and Bethany Beach in Delaware and Ocean city in Maryland. Trip statistics for all beaches are given in Table 1 in the Appendix. Twenty four beaches in New Jersey and one beach in Delaware were not visited at all in 2005. In 1997 this is the case for four beaches. However, the visitation patterns to the beach sites are similar across the time periods as evidenced by Figure 1. As expected, Delaware residents visit Delaware beaches more often.

Site Choice Model Specification

This study follows the model specification in Haab and McConnell (2002) p. 209-212. They estimate and present the results from a two level nested logit model using the 1997 data. The 62 beaches are organized in North and South nests. Forty-six New Jersey beaches enter the North nest and sixteen beaches in Delaware, Maryland and Virginia enter the South nest. The Delaware Bay serves as a natural boundary between the two nests. It seems likely that there will be higher substitution among alternatives in a nest rather than alternatives in different nests. The nested logit accommodates this interrelationship in a natural modeling process. We estimate the model using the 2005 data. The North nest in the 2005 model includes forty-four alternatives and the South nest includes the same sixteen alternatives as in the 1997 model.

The probability to choose a beach site is a function of trip cost and thirteen site characteristics.

$$P_j = P_k P_{j|k} = \frac{\exp\left(\left(1/\mu\right)\mathrm{IV}_k\right)}{\sum_{m=1,2}\left(\left(1/\mu\right)\mathrm{IV}_m\right)} \frac{\exp\left(\mu\beta x_j\right)}{\sum_{l=1,2,..Cm}\exp\left(\mu\beta x_l\right)},$$

where $\mathrm{IV}_m = \ln\left(\sum_{l=1,2...Cm}\exp\left(\mu\beta x_l\right)\right)$ is the inclusive value of nest m = 1,2; $C_1 = 47$ and $C_2 = 13$ for 2005; $C_1 = 49$ and $C_2 = 13$ for 1997 and $V_{jk} = \beta x_{jk}$. Variable definitions of the x vector and their means are presented in Table 4.

Following Haab and McConnell (2002) we specify the indirect utility function to be linear in the parameters. The inclusive value coefficients (or the variance-scale ratios) are set to be equal, so only one value of 1/μ is estimated. We use the RU2 normalization in the estimation of the nested logit model (Hensher and Greene (2002)). Haab and McConnell (2002) use the RU1 specification. The RU1 normalization is equivalent to RU2 up to the scale factor when the parameters of the inclusive values at the same level are restricted to be equal across nests. The division of the RU1 coefficients to the estimated inclusive value results in the RU2 coefficients. Both normalizations are utility consistent, but the coefficients (and standard errors) from the RU1 normalized model have to be adjusted by the coefficient of the inclusive value if they are to be used directly. However, if the coefficients are used to only calculate WTP as in Haab and McConnell (2002) this is not an issue, because the scale factor cancels out in the ratio of the implicit prices. In the case of the comparison between the 97 and 05 nested logit coefficients, both normalizations are utility consistent, because we restrict the log sum coefficients (or scales) for North and South nests to be equal. However, if the scale factors are not constrained to be equal across a level, the RU1 normalization may be utility inconsistent. In a future project, we will be interested to estimate the ratio of the scale factors of the two datasets using a joint nested logit model. Since we will not restrict the log sum coefficients for the two datasets to be equal, the RU2 normalization will be preferred. Therefore, we use the RU2 normalization for this study.

Parameter Estimates of Site Choice Models 1997 and 2005

The results for the two nested logit models are presented in Table 5. The 1997 coefficients differ from the estimates in Haab and McConnell (2002) because individual weights have been used to account for sample stratification; only people with less than 250 trips are used for estimation and different nested logit normalization is used. All coefficients except park, restroom and parking from the 1997 model are significant at 5% and have the expected signs. The restroom variable is significant at 10% and is positive as expected. The same is not true for the coefficients estimated with the 2005 data. Considering the small sample size of the 2005 dataset insignificant coefficients and unexpected signs are not a surprise. The coefficients on travel cost in both models have the expected negative sign and are significant at 1 percent.

Length, boardwalk, park, high rise, park within the beach and parking are insignificant at 5%. The variables amusement, private, wide, narrow, surf and restroom are significant at 5%, and have the expected sign. The coefficient on Atlantic city is significant but has a negative sign. The inclusive value parameters are significant and utility consistent for both models.

Comparison of Parameter Estimates

Differences of parameters between the 1997 and 2005 data sources may be a result of different sample sizes, different survey methods for data collection, and true taste change over time. The 1997 dataset is much larger than the 2005 dataset. Furthermore, the 1997 data is collected by a mail survey distributed randomly among Delaware residents while the 2005 data is collected by an Internet survey distributed randomly among contracted panel participants. Moreover, there are 7 years between the two time periods and tastes may have changed.

Since estimated parameters confound true preference and scale effects, direct comparison is impossible without accounting for variance-scale effects. The question is if $\mu_{97}\beta_{97} = \mu_{05}\beta_{05}$. Rearranging this equality, $\beta_{05}=(\mu_{97}/\mu_{05})\beta_{97}$. That is, if the parameters from the two datasets are equal they should lie near a line through the origin with a slope equal to μ_{97}/μ_{05}.

Louviere et al. (2000) discuss two methods to estimate model parameters and variance scale ratios. The first method employs a manual grid search to estimate the coefficients and the relative scale factor, which maximizes the log likelihood function of the pooled data. This sequential method results in consistent estimates but underestimated standard errors. The second method is a full information maximum likelihood (FIML) method to obtain the estimates using an artificial nested logit tree structure.

Swait and Louviere (1993) propose and demonstrate the sequential estimation. They suggest as a first step to graph the coefficients of the two models against each other. Figure 2 shows a graph of the NL coefficients. The large dispersion of the points suggests that the model estimates are likely very different. The points in the northwest and southeast quadrants represent coefficients with opposite signs. Figure 3 shows only the coefficients with the same signs graphed against each other. All coefficients, except narrow, high rise, and restroom, seem to lie on a line going through the origin. The parameter for narrow seems to be of greater relative importance in the 2005 than in the 1997 model.[1]

The preliminary evidence in the figures above suggests that the joint equality of all coefficients across the two time periods will be rejected. The slope of the lines reflects the ratio of the scale factors which is the inverse of the relative variance of the unobserved factors in the datasets. The scale of the 1997 data source is about 2.3 times higher than the scale of the 2005 data. That is, the unobserved portion of utility has a lot more variance in 2005 than in 1997. This is expected because there are fewer beachgoers in the 2005 dataset.

Given the small sample size of the 2005 data, we further explore its impact. We check using the 1997 data if parameters estimated with fewer observations are stable. We do this by estimating 50 nested logit models using randomly drawn samples from the 1997 datasets. Considering the sample of 50 beachgoers in 2005, each of the samples drawn from the full 1997 dataset contains the trips made by randomly chosen 50 beachgoers. All of the 2005 estimates fall within the ranges estimated with the draws from the 1997 data. Except for price and the inclusive

[1] Figures 2 and 3 alone are insufficient to test the hypothesis of taste stability and data source variance inequality (Swait and Louviere, 1993). We do not formally test the equality of the coefficients here because the emphasis is on the equality of implicit prices and willingness to pay measures.

value coefficients which are always significant, the rest of the estimates exhibit some instability when sample size is reduced. Amusement, private, surf, high rise, wide, narrow and length are still significant with 95% level of confidence in more than half of the estimations. However, boardwalk, park, restroom, park within and parking are significant in less than 50% of the estimated regressions. Table 6 presents some statistics for the coefficients estimated from these reduced samples. The last two columns report the coefficients and corresponding t-statistics from the 2005 model. Within the variables that are significant in more than 50% of the estimated regressions, only high rise and length are not statistically significant in 2005. Price, amusement, private, surf, narrow and wide are highly significant and have the same direction of impact on the indirect utility of beachgoers.

Figure 4 shows the coefficients that are significant in more than 50% of the regressions, estimated from the full 1997 data plotted against the coefficients estimated from the 2005 data.

Next we graph the parameters that are significant in more than 50% of the estimated regressions excluding narrow. Figure 5 suggests these parameters are the same in both data sources when accounting for scale.

To compare the magnitudes of the coefficients we also report in table 7 the means, standard errors and range of the implicit prices from the 50 regressions, and implicit prices estimated from the 2005 and 1997 data. As evidenced by the ranges of the implicit prices, there is a large variation in the mean values, when small samples are used for estimation. The 2005 implicit prices for length, boardwalk, amusement, park, wide, surf, high rise, park within, and parking fall within these ranges. Implicit prices for private, narrow, and restroom fall outside of the ranges estimated using the smaller sample sizes from the 1997 data.

Simulations of Policy Changes

The RUM allows the estimation of welfare changes resulting from increases or decreases in the quality of recreational sites. Positive welfare effects may be the result of additions of new alternatives or improvements in the attributes of existing alternatives. In addition, welfare losses due to closures of one or more sites can be evaluated.

The expected consumer surplus in a choice situation is the utility in dollar terms that the consumer receives. However, the analyst can only estimate the expected consumer surplus. If ε_{ij} is GEV distributed and utility is linear in income, the expected consumer surplus becomes:

$$E(CS) = \frac{1}{\beta_y} \ln(\sum_{m=1}^{K} (\sum_{l=1}^{Cm} \exp(\frac{V_l}{\theta_m}))^{\theta m}) + C$$

The change in consumer surplus or willingness to pay (WTP) is calculated as:

$$WTP = \frac{1}{\beta_y} \ln(\sum_{m=1}^{K} (\sum_{l=1}^{Cm} \exp(\frac{V_l^1}{\theta_m}))^{\theta m}) - \ln(\sum_{m=1}^{K} (\sum_{l=1}^{Cm} \exp(\frac{V_l^2}{\theta_m}))^{\theta m}) ,$$

Where β_y is the marginal utility of income, K is the number of nests, C_m is the number of alternatives in nest m, V_l^1 and V_l^2 denote the indirect utility before and after the change.

Using the coefficients from the nested logit models we estimate the access values for groups of beach sites in both 1997 and 2005. Since the WTP is calculated as a ratio of estimated coefficients, we simulate approximate distributions of WTP estimates using a Krinsky-Robb procedure with 2000 draws (Krinsky and Robb, 1986). To test whether the two WTP estimates are significantly different we adopt the method of convolutions proposed by Poe, Severance-Lossin, and Welsh. This method allows formal testing of differences between approximate empirical distributions and is less likely to lead to a type II error than other methods (Poe, Severance-Lossin, and Welsh, 1994).

We simulate per person per trip and per person per season access values for four site closure scenarios: 1. Rehoboth, which is the most visited beach in both years; 2. Northern Delaware beaches, which includes beaches from Indian river to Cape Henlopen State Park; 3. Southern Delaware beaches, which include beaches from Fenwick to Indian river; 4.All Delaware beaches.

Per person per trip and per person per season access values and 95% confidence intervals for the WTP differences between the two time periods are reported in Table 8 and Table 9. The 95% confidence intervals estimated using the method of convolutions show that all per person per trip WTP distributions are significantly different at the 5% level. However, the null hypothesis of equality of per person per season WTP distributions can only be rejected in the scenario when Southern Delaware beaches are lost. Thus, there is not enough evidence to reject the equality of the WTP distributions in the cases when Rehoboth beach, Northern Delaware beaches, and all Delaware beaches are closed.

Next, we apply the RUM to value changes in site quality. All Delaware beaches are simulated to erode in width to 75 feet or less. Per person per trip dollar average loss from beach erosion to all DE beaches in 1997 is $2.63; in 2005 it is $22.90. Beach nourishment for all New Jersey beaches less than 75 feet wide is also considered. Tables 10 and 11 present the per person per trip and per person per season welfare changes. Beach nourishment has a positive effect on the welfare of beachgoers and the effect is much larger in the 2005 data. The impact of beach erosion to Delaware beaches on the marginal willingness to pay is negative and again stronger in 2005.

Conclusion

This study estimated two random utility models of recreation to Mid-Atlantic beaches in different time periods. Despite the significant sample size differences it found that consumer preferences show evidence of qualitative stability over time. Higher travel cost, a private beach, presence of high rises, and beach width less than 75 and more than 200 feet decrease utility of beach users in both 1997 and 2005. Amusement park nearby and good surfing location have a positive and significant effect on utility in both time periods, regardless of the sample size used for the estimation of the models. However, significant differences in the magnitudes of the estimated coefficients and willingness to pay measures are found to be mainly due to differences in the sample sizes of the two datasets.

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Table 1: Summary statistics of trips

	1997	2005
Total number of households	565	85
Households with at least one day trip	397	50
% of households with trips	70%	59%
Total number of trips (weighted)	6016	548
Average trips per household	15.15	10.97

Table 2: Summary statistics of respondent characteristics

Characteristic	1997 data MEAN	2005 data MEAN	Mann-Whitney Z value (Prob > Z)	t statistic (Prob T>t)
Age	48	50	-1.39 (0.16)	-1.25 (0.21)
Kids under 10	0.27	0.45	-0.54 (0.59)	-3.00 (0.00)
Kids under 16	0.21	0.20	1.12 (0.26)	0.11 (0.91)
Flexible time	0.58	0.21	6.38 (0.00)	6.59 (0.00)
DE Vacation home owner	0.04	0.05	-0.36 (0.72)	-0.36 (0.72)
NJ Vacation home owner	0.04	0.00	1.93 (0.05)	1.94 (0.05)
Retired	0.24	0.28	-0.76 (0.45)	-0.76 (0.45)
Student	0.05	0.04	0.64 (0.52)	0.64 (0.53)
Work part time	0.10	0.15	-1.33 (0.19)	-1.33 (0.19)
Work at home	0.06	0.09	-1.04 (0.30)	-1.04 (0.30)
Volunteer	0.03	0.02	0.41 (0.68)	0.41 (0.68)

Table 3: Fifteen most visited beaches in 1997 and 2005.

BEACH	1997 PERCENT	TRIPS	BEACH	2005 PERCENT	TRIPS
Rehoboth Beach	26.11%	1571	Rehoboth Beach	24.89%	136
Cape Henlopen SP	12.21%	735	Ocean City,MD	10.91%	60
Ocean City,MD	8.67%	522	Cape Henlopen	10.04%	55
Bethany Beach	8.43%	507	DE Seashore SP	7.09%	39
Dewey	6.77%	407	Dewey	6.99%	38
DE Seashore SP	5.26%	317	Fenwick Island	6.91%	38
Fenwick Island	4.27%	257	Bethany Beach	6.71%	37
Atlantic City	3.35%	202	Fenwick Island	5.01%	27
Fenwick Island SP	2.62%	157	Atlantic City	2.49%	14
North Shores	2.55%	154	Assateague	2.27%	12
Cape May	2.22%	134	Cape May	1.67%	9
Assateague	1.88%	113	North Bethany	1.53%	8
North Bethany	1.76%	106	Ocean City	1.41%	8
Ocean City	1.75%	105	Sea Isle City	1.13%	6
Indian Beach	1.60%	96	Margate	1.13%	6

Table 4: Variable definitions

Variable Name	Variable Description	Mean for 1997	Mean for 2005
Continuous			
Price	Travel cost	$122	$131
Length	Natural Logarithm of length of beach in miles	0.62	0.66
Dummy			
Boardwalk	Boardwalk present	0.40	0.42
Amusement	Amusement park nearby	0.13	0.13
Private	Private access	0.26	0.23
Park	State, Federal park or wildlife refuge	0.10	0.10
Wide	Beach width > 200 feet	0.26	0.27
Narrow	Beach width < 75 feet	0.15	0.15
Atlantic city	Atlantic City	0.02	0.02
Surf	Good surfing location	0.35	0.37
High rise	Presence of high rises	0.24	0.25
Park within	Part of beach is park	0.15	0.15
Restroom	Restroom facilities available	0.39	0.40
Parking	Parking available	0.45	0.47

Table 5: Coefficient estimates

Variable	1997 Coefficients	T-Stat.	2005 Coefficients	T-Stat.
Price	-0.04	-44.02	-0.03	-8.27
Length	0.12	7.36	0.10	1.55
Boardwalk	0.25	4.94	-0.10	-0.56
Amusement	0.47	11.87	1.09	4.63
Private	-0.37	-10.75	-0.86	-3.61
Park	-0.01	-0.22	0.10	0.44
Wide	-0.19	-7.06	-0.41	-3.06
Narrow	-0.19	-4.21	-1.20	-2.55
Atlantic city	0.19	3.31	-0.64	-2.46
Surf	0.26	8.99	0.44	3.86
High rise	-0.23	-7.51	-0.17	-1.29
Park within	0.21	3.83	-0.27	-1.59
Restroom	0.08	1.83	0.67	3.05
Parking	0.05	1.06	-0.24	-1.09
Incl. Value	0.49	36.32	0.69	8.84

Table 6: Coefficients estimated from 50 draws from 1997 data compared to 2005 coefficients

Variable	% Sign. at 5%	Mean	Max	Min	Coef.05	T-Stat
Incl. Value	100%	0.53	0.86	0.06	0.69	8.84
Price	100%	-0.04	-0.03	-0.06	-0.03	-8.27
Amusement	92%	0.59	2.04	-0.11	1.09	4.63
Private	90%	-0.45	-0.07	-1.12	-0.86	-3.61
Surf	86%	0.28	0.75	-0.87	0.44	3.86
High rise	66%	-0.28	0.11	-0.96	-0.17	-1.29
Narrow	62%	-0.43	0.23	-1.50	-1.20	-2.55
Length	60%	0.14	0.39	-0.06	0.10	1.55
Wide	54%	-0.19	0.16	-0.63	-0.41	-3.06
Boardwalk	44%	0.25	0.76	-0.35	-0.10	-0.56
Atlantic city	40%	0.28	0.98	-0.73	-0.64	-2.46
Park	34%	-0.04	0.92	-0.79	0.10	0.44
Restroom	28%	0.05	0.61	-0.68	0.67	3.05
Parking	28%	0.06	0.94	-0.74	-0.24	-1.09
Park within	26%	0.21	1.30	-0.60	-0.27	-1.59

Table 7: Comparison of implicit prices

Implicit price	Mean	Std. Dev.	Max	Min	05 price	97 price
Length	3.19	2.50	10.41	-1.38	3.57	3.07
Boardwalk	5.85	4.80	17.92	-5.98	-3.64	6.33
Amusement	14.00	8.89	49.96	-2.91	38.51	11.73
Private	-10.39	4.64	-1.22	-23.19	-30.20	-9.25
Park	-0.76	8.65	18.55	-19.67	3.42	-0.34
Wide	-4.49	4.82	5.62	-15.41	-14.49	-4.61
Narrow	-9.90	8.31	5.72	-26.25	-42.21	-4.69
Surf	6.65	5.53	15.98	-15.47	15.50	6.47
High rise	-6.69	5.81	2.79	-23.49	-6.11	-5.81
Park within	4.68	6.63	20.73	-10.57	-9.54	5.17
Restroom	1.41	5.32	15.21	-12.85	23.68	1.92
Parking	0.90	7.08	17.76	-15.03	-8.38	1.36

Table 8: Per person per trip losses due to closures of Delaware beaches (in dollars)

	2005 data				1997 data				95% Conf. Interval WTP_{97}-WTP_{05}	
Lost Beaches	Mean	Std.	Low	High	Mean	Std.	Min	Max	Low	High
Rehoboth	-5.28	0.83	-8.40	-2.73	-3.12	0.09	-3.45	-2.81	0.60	3.88
North Delaware	-13.57	1.57	-19.34	-8.30	-8.99	0.16	-9.48	-8.44	1.68	7.88
South Delaware	-4.32	0.53	-6.68	-2.86	-1.11	0.04	-1.27	-0.98	2.28	4.33
All Delaware	-24.20	2.65	-35.58	-13.08	-12.44	0.23	-13.23	-11.62	6.82	17.17

Table 9: Per person per season losses due to closures of Delaware beaches (in dollars)

	2005 data				1997 data				95% Conf. Interval WTP_{97}-WTP_{05}	
Lost Beaches	Mean	Std.	Low	High	Mean	Std.	Min	Max	Low	High
Rehoboth	-66.61	10.48	-6.12	35.62	-53.13	1.57	-59.68	-47.98	-6.12	35.62
North Delaware	-173.07	19.23	-15.03	60.56	-152.36	2.86	-163.65	-143.48	-15.03	60.56
South Delaware	-54.16	6.99	0.64	28.46	-40.74	1.21	-46.20	-36.84	0.64	28.46
All Delaware	-317.26	33.94	-43.23	92.40	-294.48	5.73	-314.09	-275.85	-43.23	92.40

Table 10: Per person per trip value of changes in site characteristics (in dollars)

	2005 data				1997 data				95% Conf. Interval WTP_{97}-WTP_{05}	
Policy:	Mean	Std.	Low	High	Mean	Std.	Min	Max	Low	High
Nourishment to NJ beaches	0.46	0.14	-0.70	0.97	0.06	0.01	0.02	0.10	-6.12	35.62
Erosion to DE beaches	-22.91	7.89	-46.16	13.67	-2.63	0.60	-4.45	-0.72	-15.03	60.56

Table 11: Per person per season value of changes in site characteristics (in dollars)

	2005 data				1997 data				95% Conf. Interval WTP_{97}-WTP_{05}	
Policy:	Mean	Std.	Low	High	Mean	Std.	Min	Max	Low	High
Nourishment to NJ beaches	3.63	1.19	-2.28	8.44	0.48	0.10	0.13	0.88	0.86	5.66
Erosion to DE beaches	-298.45	103.28	-619.50	83.20	-47.73	10.70	-79.90	-9.63	-443.2	-32.45

Figures:

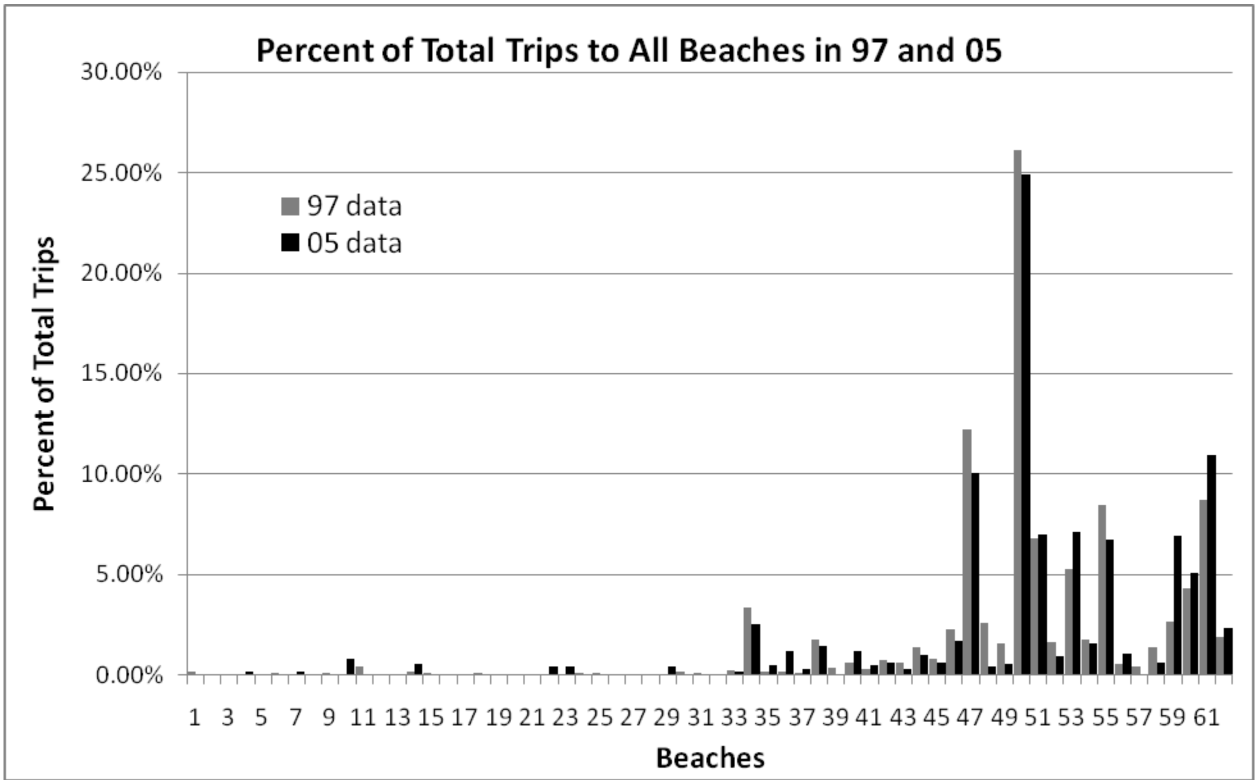

Figure 1

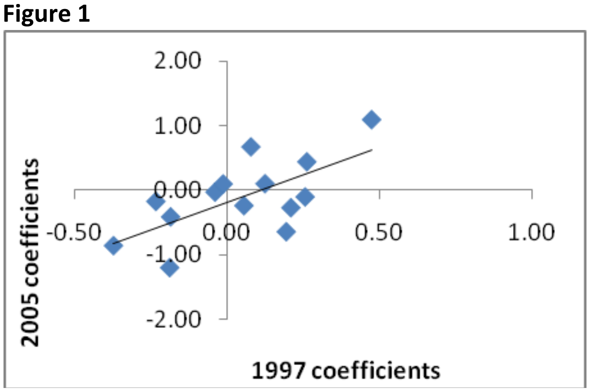

Figure 2

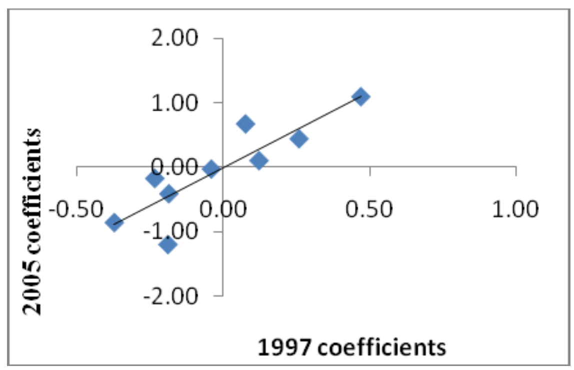

Figure 3

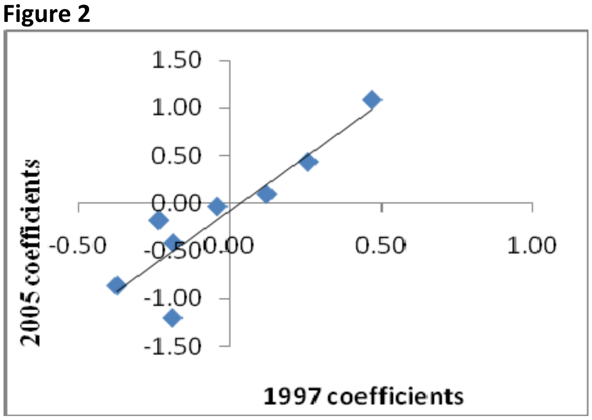

Figure 4

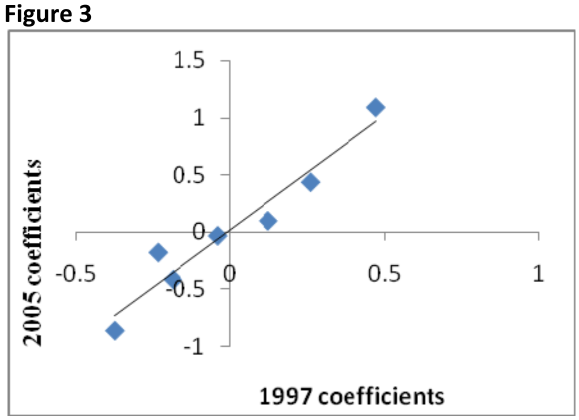

Figure 5