ECONOMIC EFFECTS OF PRICING POLICIES AT NORTHERN GEORGIA STATE PARKS: REVENUE, WELFARE, DIVERSITY AND ECONOMIC IMPACTS

by

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(Under the Direction of J. M. BOWKER)

ABSTRACT

Georgia State Parks face fiscal constraints. Higher entrance fees represent a useful approach for park management to enhance fiscal sustainability. However, increased access costs can be expected to reduce visitation if park recreation is a ordinary good. Actual declines are contingent on visitors' price sensitivity, and will determine both revenue collection and local economic impacts. Additionally, higher entrance fees may affect visitors of different ethnicity disproportionately. This study uses previously collected data to estimate visitor price elasticity at several state parks in northern Georgia using revealed preference methods. Results from revealed preference (TCM) analysis allow the effect of various entrance fee structures on park revenue, local economic impacts and different segments of park visitors to be estimated. These results are expected to better inform park management concerning the likely economic effects of entrance fee policy alternatives.

INDEX WORDS: Economic Impacts, Expected Revenue, Park Diversity, State Parks, Travel Cost Method, User Fees

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DEDICATION

For my Dad – I miss you everyday.

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CHAPTER 1

INTRODUCTION

In an era marked by declining state government transfers, state parks face increasing fiscal constraints. User fees are a park management strategy frequently employed to generate revenue and close gaps left in operating budgets caused by decreasing appropriations from state general revenue funds. Increasing fees, however, can also affect visitor demand. If recreation at state parks can be considered a ordinary good, increasing the price of attendance is likely to reduce site visitation, all else being equal (Freeman 2003). In addition, certain segments of visitors may be more affected by higher fees than others. Management objectives at most state parks include some variation of promoting site visitation and user diversity, as well as achieving a greater degree of financial self-sustainability and generating local economic impacts.[1] If user fees affect visitation, these objectives may conflict. This study uses econometric techniques to estimate the net and distributional effects of a hypothetical user fee increase on site visitation and revenue generation at three state parks in Northern Georgia. The results may be of interest to park management when developing strategies to close budget gaps left by declining transfers from state governments.

A brief examination of state park financial performance during the most recent recession (December 2007 – June 2009) comprises the next section of this introductory chapter. It is followed by an overview of park management response to the fiscal constraints which became much more prevalent. The mechanisms, both internal and external, through which parks generate

[1] For example, see: Ca. Dept. of Parks and Rec. 2013; Cortez 2012; Mo. State Parks, 2013.

revenue are then explored with a specific focus on user fees. The final section of the introductory chapter outlines the objectives of this study and the organization of the remaining chapters.

State Parks and the Most Recent Recession

Pressure to make better use of financial resources, or "to do more with less," has been a recurrent theme throughout the history of America government (Fredrickson 1996; Hood 1991; Osborne 1993). The most recent recession intensified this trend, as governments at all levels faced increased demand for public services while the revenues with which to provide those services deteriorated. An array of revenue enhancing and expenditure trimming strategies was the most common response, as balanced budget requirements generally prevented states from financing operations with a deficit (Jonas 2012). [2]

Certain departments within state governments were more affected by expenditure cuts than others. State park divisions, in particular, faced severe fiscal constraints. In 2011, state of Washington completely stopped supporting its parks and Idaho's department of State Parks and Recreation lost 80% of its government funding (Baker 2011). Although total state expenditures in Georgia dropped by 14% between 2009 and 2012, funding for its state parks decreased by over 46% during that period (Essig 2011; Tagami and Salzer 2011). Seventy California state parks were on the brink of closure due to budget shortfalls in 2012. Last minute negotiations with private parties secured funding and operators for the majority of these parks, however two were eventually forced to completely cease operations (Fimrite 2012). Reduced state government appropriations during the recession left many state park divisions with substantial budget gaps, and compounded existing problems, such as an aging infrastructure and mounting maintenance backlogs (Walls 2013).

[2] With the exception of Vermont, which is not subject to a balanced budget requirement.

State parks management responded to heightened fiscal constraints with a variety of traditional strategies and a collection of innovative methods. Traditional approaches generally involved a mix of revenue enhancements and expenditure cuts. Personnel costs were trimmed with layoffs, furloughs, hiring freezes, and workforce attrition. Georgia State Parks and Historic Sites Division (GASPHSD) eliminated 169 positions from its payroll between 2008 and 2011 (Gill and Hester 2013). Over 40% of the state park rangers in Washington were laid off between Christmas and New Year's Eve in 2011 (Schrader 2011). Similarly, GASPHSD recently sought to remove all the rangers from the parks it operates ("Georgia Hustles" 2010). As workforce reductions became more common, the use of volunteer labor became much more prevalent. Georgia Department of Natural Resources (GADNR) commissioner Chris Clark noted the parks division became much more reliant on volunteers to perform basic park functions; in fact, he said that at many parks "the folks cleaning the bathrooms are our volunteers" ("Georgia Hustles" 2010).

In addition to trimming personnel costs, most state parks also sought to reduce other operating costs. This was accomplished through measures such as limiting hours of operation, maintenance deferrals, eliminating particular functions or services offered, and in some cases ceasing park operations altogether. Georgia's parks division was instructed by the state senate to ensure their lodges and golf courses were financially self-sufficient by 2013, a directive which was accomplished through a combination of layoffs, reduced maintenance, price increases, and privatization at the facilities ("Georgia Hustles" 2010). Although no Georgia state parks were completely shut down, certain operations and amenities at parks were limited, hours of operations at many sites have been trimmed, and maintenance often deferred. Operating hours at the Etowah Indian Mounds site, for example, were reduced from six to four days, and volunteer labor replaced many positions which were eliminated (Nesmith 2011; Tagami and Salzar 2011).

To close the budget gaps that followed the recession, state parks augmented these types of expenditure cuts with revenue-generating strategies. Methods included a number of traditional approaches, such as fee increases, contracting-out operations, and seeking alternative private sector assistance. State park management also developed some more innovative methods to raise funds. Cloudland Canyon State Park in Georgia examined the possibility of a trail connection with the City of Chattanooga's Downtown Riverwalk area, as well as developing several unique amenities, such as zip lines, yurts, and a disc golf course, to increase visitation (Burkholder 2013). In California, Topanga State Park began offering wine-tasting kiosks; Marshall Gold Discovery Park established an annual blues festival; and Jack London State Historic Park ran a Broadway-style production to generate additional revenues (Fimrite 2012).

These types of responses to heightened fiscal constraints implicitly required state park management to rebalance park system goals and objectives in order to remain financially sustainable. A reduction in services offered at Louisiana state parks, for example, could conflict with their goal of increasing visitor participation in interpretive programs and at park events (LA Office of State Parks 2011). Support of Alaska's tourism industry through operations at Denali State Park may be limited if park management restricted hours of operation (AK DNR 2006). An increase in admission fees at Arizona state parks could lead to a decrease in visitation, causing difficulty for the agency to maintain the $250 million in local economic impacts it generates every year (AZ State Parks 2012). More often than not, however, park managers attempted to balance objectives and to strategically direct expenditure cuts and revenue enhancement policies toward areas where the impact on park system goals would be minimized (Erikson 2009). Nevertheless, some tradeoffs between goals were inevitable.

State Park Funding: External Revenue Sources

State park operations are generally funded by some matrix of state government appropriations, park-generated revenues, and to a lesser extent, dedicated funding sources and external contributions. Walls (2013) estimates that state government transfers supported around 34% of park operating budgets in 2011. The funds raised by parks themselves covered 39%. Dedicated funding mechanisms and various types of external contributions financed the remainder. In Georgia, slightly less than half of the GASPHSD operating budget is financed by state general fund appropriations. Dedicated funding sources play a minimal role, and the balance of the budget is supported by park-generated revenues, such as parking, camping and entrance fees ("Georgia Hustles" 2010).

Despite their nominal role in financing most state park budgets, dedicated funds, such as earmarked taxes and various permit receipts, provide parks a large degree of revenue stability. Annual park entry passes are the most prevalent of these mechanisms. Residents in Washington and Montana are presented with the opportunity to purchase admissions passes when paying automobile licensing and registration fees, a pairing which has led to strong sales in those states (Walls 2013). In 2001, California and Arizona attempted to implement a similar strategy with referendums bundling annual park entry fees with vehicle registration charges. Initiatives in both states were unsuccessful (Walls 2013). Perhaps unfortunately for the state parks using these mechanisms, some research indicates dedicated funding sources negatively correlated with general fund transfers. "Total funding [after establishing a dedicated funding source] either stays the same, implying that dedicated tax revenues simply replace general fund revenues one-for-one, or rises only by a small amount, which still suggests a drop in general fund revenues" (Walls 2013, p. 10). Nevertheless, state park systems in many states continue to rely on dedicated funding sources for budget support.

Although many urban parks receive substantial private philanthropic donations, state parks have historically benefitted very little from this type of external funding. Most have placed little effort into securing charitable contributions, and some state park systems lack even the basic mechanism through which to accept donations (Walls 2013). However, during the most recent recession, securing this type of funding became a much more utilized revenue generating strategy for parks. Many individual parks have established "friends" groups that provide philanthropic support, and some have created nonprofit units for charitable fundraising and to actively compete for grants (Walls 2013). Georgia's natural resources agency recently created a nonprofit agency to apply for educational grants in support of its state parks division (Duncan 2010). In New York, the Palisades Park Conservancy raises funds for parks run by the Palisades Interstate Park Commission (Walls 2013).

In addition to efforts in securing charitable donations and grants, a greater reliance on private sector firms for external funding became a more common strategy for state parks during the most recent recession. In some cases, this reliance involved marketing efforts or corporate sponsorship. In Georgia, the state parks division has generated revenue from corporate sponsorship of programs and events for many years, and recently issued a request for proposals to develop a strategic plan for sponsorship of entire parks ("Georgia Hustles" 2010). In addition, there exists a task force created to evaluate other aspects of park operations that could be offered for corporate marketing in the state, and an agent contracted to sell advertising on park websites and brochures (Stiers 2013). New Hampshire's park system partnered with PepsiCo, Inc., allowing the company to distribute beverages at the parks in exchange for funding an education and awareness program (Leal, Fretwell and Lippke 1997).

Outsourcing certain operations to the private sector, especially those labor intensive, allows parks a greater degree of flexibility with regard to personnel, and reduces the portion of budgets allocated to salaries, wages, and benefits (More 2005). Some states have gone so far as to outsource the operation of entire parks. For example, GASPHSD director Becky Kelly found the time opportune for "testing new models and trying new partnerships" after exhausting countless strategies to close the agency's budget gaps ("Some GA Parks" 2013). Consequently, Georgia's parks division recently contracted a private firm to operate five state parks (Gill and Hester 2013). After threatening to close more than 70 state parks in California, the legislature passed a temporary appropriations bill to buy time for the Department of Parks and Recreation to find parties willing to fund or operate the parks, including private companies. The state partnered with outside organizations to run 26 of the parks, and external funding was secured for all but two of the parks that were forced to close (Beamish 2013; Fimrite 2012).

Contracting out park operations to private providers is preferred only if the costs involved in site operation outweigh the *full* costs associated with monitoring and enforcing a private sector contract. In some cases contract maintenance may prove to be difficult and expensive, such as when the value of contracted services are relatively small and where measuring performance through agency review problematic (Walls 2013). Additionally, private contractors have often been shown to rely heavily on low-wage labor and provide limited worker benefits, the long-run social costs of which are somewhat uncertain (More 2005).

In general, a heavy reliance on external funding of any type could be problematic for state park management. Walls (2013) warns that an overreliance on private donations or dedicated funding sources can have a detrimental long run impact on state park operations, as those types of revenue are likely to crowd out government funds.[3] State park management could find itself in a situation where the gains from effort allocated to securing external funding are partially or fully offset by a decrease in appropriations from the state – essentially resulting no net gains in revenues.

State Park Funding: Park-generated Revenue

Despite the positive benefits associated with the stability of dedicated funding sources and possible efficiency gains from contracting park operations out to the private sector, the correlation with decreased general fund transfers may prove them to be a counter-effective strategy for closing state park budget gaps. If this is the case, park-generated funds may represent the most resilient source of funding. This type of revenue includes daily entrance fees; charges for activities such as fishing, swimming, or golfing; user fees for shelters, campgrounds, and other facilities; rental charges for equipment such as boats and golf carts; and other fees for various services provided and amenities offered at state parks. Fees of this type levied on park visitors offer management the ability to generate revenue without relying on external agents for support.

Fee pricing is both a technically difficult and politically sensitive aspect of state park management. The structure of visitor charges has historically been somewhat ad-hoc, adhering to historical norms and precedent rather than guided by theory. When theory *has* dictated pricing policy, neoclassical models of supply and demand have been the foundation (Crompton 2011). Unfortunately, visitors often do not respond to pricing in the manner that traditional economic models would predict. Crompton (2011) suggests management adopt a more cognitive-based

[3] Considering that state government appropriations have as of lately been on the decline, this potential problem may be overstated.

approach to pricing schemes, where the psychological processes that determine visitor behavior and response to user fees are given more weight. That is, Crompton feels that park visitors are more likely to adjust behavior when confronted with emotional rather than financial appeals. With these considerations the seemingly irrational behavior of park visitors, when confronted with pricing regimes, can be reconciled with traditional neoclassic economic models and their predicted responses.

Although their theoretical foundations may be somewhat delicate, the revenues generated from visitor fees are substantial. Between 1980 and 1994 the portion of state park budgets covered by user fees rose from 17% to 33% (Leal, Fretwell and Lippke 1997). That level increased to 39% in 2011 (Walls 2013). There were 16 state park systems that generated more than half of their operating budget from user fees in 1997. In fact, state parks in both New Hampshire and Vermont financed their entire budget with fees – receiving no external support from the state general fund revenues (Leal, Fretwell and Lippke 1997). Three years after the Texas legislature eliminated most funding for its parks, fee-generated revenues more than doubled. Receipts in 22 parks were actually higher than expenditures (Leal, et al. 1998).

A successful user fee regime depends on a number of considerations, most importantly the degree to which visitors consider the charges fair and therefore acceptable (Park et al. 2010). Price acceptability hinges on social equity considerations, as this is the basis by which visitors evaluate fairness. These considerations include compensatory equity, or the degree to which disadvantaged groups are priced out of visiting the park, and egalitarian equity, which concerns the equal treatment of all visitors. If a charge structure violates perceptions of these norms, it is likely to be deemed unfair and unacceptable to visitors (Crompton 2011). Fee structures considered unfair or unreasonable may generate widespread complaint, reduced park agency support, and even open hostility to the agency and its parks (Park et al. 2010).

Fundamentally, the entire concept of user fees at state parks has social equity implications. More (2005) finds similarities between a park funded entirely by user fees and the market structure of a public utility. Users are responsible for the cost of service provision and non-users pay nothing. This type of organization incorporates the user pays principle, as only those who benefit from park use are responsible for its finance. In absence of user fees, the cost of providing parks is effectively distributed across the entire tax base, creating a burden even for non-visitors regardless of their willingness or ability to pay (Miller 1998). The counter-argument to this reasoning is that public parks are held in trust for all citizens, and having the *option* of park use is a benefit enjoyed by everyone. Positive spillover effects associated with public parks, such as increased proximate land values and pollution assimilation services, also confer broad benefits to society. Burdening specific segments of citizens (park users) more than others (non-users) for park provision could therefore be considered inequitable. Further, if parks are held in a trust for all citizens, then segmentation of a specific user base is impossible (Park et al. 2010). The use of visitor fees is inherently unfair according to this reasoning. So, how one perceives the benefits of state parks distributed affects the degree to which user fees are considered socially equitable, and therefore fair and an acceptable policy.

The extent to which fee revenue is perceived by users to remain with the park where collected is another important factor in price acceptability. Park et al. (2010) found that returning receipts to parks for investment in new facilities or site maintenance ranked among the highest determinants of price acceptability and social equity. In a study of mountain bikers at Tsali Recreation Area, Bowker and English (2002) estimate that over three-fourths of visitors would accept a higher user fee if the revenues were used for park improvements. In addition, some claim that allowing parks to retain fee receipts incentivizes efficient operation and makes management more responsive to visitor demand (More 2005; Walls 2013). Citing an instance when Yellowstone management closed a profitable campground to "save" money, Leal, et al. (1997), find the detachment of park revenues from budget appropriations allows management to ignore these types of basic economic realities. "The campground eared more than it cost to operate, but since the revenues went to the treasury, not to the park, the managers had little incentive to keep it open" (p. 7). According to this logic, allowing user fee receipts to remain with the park could make management more cogent of the financial implications of operational decisions. If fee revenues have minimal budget implication, then management has little incentive to use them effectively.

An equitable and acceptable user fee system that returns revenues to the park is likely to be acceptable to visitors, and gives management the ability to fund operations independently from external sources. However, several potential problems accompany their use. In addition to generating revenue, fees also ration park use. In cases where there exists no congestion, and the park is therefore a fundamentally nonrival public good, this is an inefficient outcome. "Public goods that are nonrival in consumption should have a zero price, and many aspects of parks, such as hiking and biking trails, scenic views, and the like, are nonrival" (Walls 2013, p. 25). A reliance on visitor charges also leaves parks vulnerable to market fluctuations[4] and could promote facility development and greater commercialization if management expands infrastructure to capture higher revenues of this type (More 2005).

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[4] It should be noted however, that recessionary effects on state park visitation are mixed. Some parks may actually experience higher visitation rates (See: Miller 2010; Ross 2009; "SC Parks Shine" 2009).

More importantly, the funds generated by additional user fees could be offset by a decline in park visitation. If recreation at state parks is a ordinary good, an increase in the price of attendance, other factors held constant, will result in decreased visitation. Further, certain segments of visitors may be more affected by a higher price point than others. Most of the concern over the distributional impacts of park fees has focused on lower income groups, however, these charges could have disproportionate effects on various ethnicities and age groups, as well as visitors that participate in different activities (More and Stevens 2000; Schneider and Budruk 1999). If higher user fees affect visitors differently, the social equity of the charge system could suffer. Additionally, if lower income citizens are priced out from attendance, the remaining public funding for the park effectively subsidizes wealthier visitors (More 2005).

If park attendance declines when a user fee is employed, the management goal of attaining fiscal self-sustainability could conflict with objectives related to promoting park visitation and diversity. Given that local economic impacts from state parks are largely determined by site visitation, user fees may also affect goals related to these. Under these circumstances, park managers could benefit from a more complete understanding of the interactions between fees, visitation and revenues. This requires knowledge of park-specific demand curves to estimate the likely effects of raising fees on site attendance, which ultimately determines the effectiveness of this type of revenue-generating strategy (Kriesel, Landry and Keeler, 2005).

Study Purpose and Objectives

The relationship between user fees and site visitation could have substantial implications on park management objectives. A higher fee structure may generate greater revenues to assist management in attaining goals related to financial self-sufficiency. However, certain segments of park visitors may be unwilling to pay additional costs to utilize the resource as it is currently provided. Management goals related to increasing park visitation and user diversity, as well as generating local economic impacts, could be impaired if some visitors proved to be highly price sensitive.[5] Park managers and policy-makers could benefit from a more comprehensive understanding of visitor price response to increased user fees in order to optimize their use.

The purpose of this study is to address this potential disconnect between state park management policy and its likely economic outcomes. In particular, the effects of an increased entrance fee on management objectives related to increasing visitation and user diversity will be explored at several state parks in northern Georgia. The aggregate and distributional effects of the policy on visitor demand will be estimated, and its revenue-generating potential analyzed. The product of this study will be a model which will allow park management to estimate the likely economic effects of pricing-related policy alternatives in the region. The hope is to provide a greater degree of ex-ante insight into the economic effects of park policy and its interaction with management goals.

To achieve these objectives, it will be necessary to:

1. Estimate visitor demand at three North Georgia state parks with data collected by Green, Larson and Whiting.
2. Determine price sensitivity (elasticity) of demand for visitors using revealed preference methods.

[5] Many recreational demand studies have found users to be relatively price inelastic, suggesting a fee increase would not be completely offset by a visitation decline (See Bowker, Bergstrom and Gill 2007; Leeworthy and Bowker 1997; and Betz, Bergstrom and Bowker (2003), for example). However, price effects could be heterogeneous with respect to visitor segments. Bowker and Leeworthy (1998), for example, estimated demand for Hispanic visitors to the Florida Keys to be more elastic demand than whites, implying their visitation rate would decrease more rapidly when faced with a fee increase.

3. Estimate changes in park visitation resulting from hypothetical entrance fee increases.
4. Estimate revenue and changes in local economic impacts that could be generated by the fee considering expected changes in park visitation.
5. Determine which visitor groups, if any, may be more highly affected by this fee.
6. Make policy recommendations based on these findings.

Organization of Study

This study is comprised of five chapters. The opening chapter presents an overview of state park fiscal constraints and management response, with an emphasis on revenue-generation through user fees. The first chapter also provides a description of the purpose and objectives of this study. Chapter two presents the theoretical foundations for estimating visitor demand to state parks which will be necessary to estimate price response to a hypothetical increased entrance fee at three state parks in Northern Georgia. Attention will also be given to the theory and practice of estimating economic impacts. The third chapter presents the methodology utilized in this study, including the survey instrument, variable construction, model specification, functional form, and estimation. The data summary statistics and econometric model estimation results are detailed in the fourth chapter, as well as the policy-relevant applications using those results. The final chapter discusses the research findings and policy implications for management, provides suggestions for future research, and acknowledges the limitations of this study.

CHAPTER 2

THEORETICAL BACKGROUND

State parks entertain approximately 720 million visitors each year (Walls 2013). Demand for outdoor recreation, a common use for parks, has been progressively increasing for the last fifty years, and now represents between two and four percent of total consumer spending in America (Phaneuf and Smith 2005). The basis for classifying recreation at state parks as an economic good lies in the willingness of consumers to pay for access to outdoor recreation at these sites. These payments include direct charges for admission and use of park facilities, the costs of goods purchased for recreation activities associated with the site (e.g., boats, soccer balls, and hiking equipment), and the indirect costs and expenses associated with travel and transportation to the parks. These types of expenses are motivated by recreational opportunities at the parks, and can therefore be considered complementary. Consumer demand for recreation at state parks is supported by this relationship (Phaneuf and Smith 2005).

This chapter provides the theoretical foundation upon which the economic investigation in the remaining chapters is based. Economists view recreation at state parks as a commodity demanded by visitors, therefore subject to traditional economic analysis - albeit with less than conventional methods. Consumer theory is the first subject addressed in this chapter. It serves as the foundation for demand and value estimation of economic goods under the rubric of utility maximization. The unique nature of recreation demand as a nonmarket good and the methods by which those types of goods are measured are then discussed. Methods relevant to this study are the travel cost method (TCM) and economic impact analysis. From these, the likely economic effects of higher user fees at state parks may be estimated. The final section this chapter outlines the practical application of consumer demand theory with respect to the purposes of this study. This treatment of theory provides the groundwork necessary for the next chapter of the study, which delves into the methodology and model specification used in estimating demand for the state parks under analysis in this study.

Consumer Demand

The theoretical framework for modeling consumer demand for recreation at state parks begins with the idea that *rational* consumers will maximize their utility conditional upon certain constraints. Utility is achieved through consumption of goods and services, or commodities, some of which are related to recreation. The maximum utility that can be reached is constrained by limited resources, such as time, income, and the availability of commodities (Freeman 2003). The consumer must, therefore, optimize consumption choices in order to maximize utility subject to these scarce resources and relative constraints – a condition that establishes the economic problem.

Possible consumption choices consumers can make are represented by consumption bundles, which consist of various quantities of all available commodities. Assuming consumers have specific and well-ordered preferences concerning those commodities,[6] alternative bundles can be ranked according to the amount of utility, or satisfaction, each provides. This relative ranking allows consumer preferences to be specified by utility functions, representing the degree

[6] Well-ordered preferences being those in which the consumer preference axioms of completeness, reflexivity, transitivity, and continuity are observed. These provide the necessary and sufficient conditions for consumer preferences to be considered rational, and thus be specified by a utility function. Other helpful axioms for rational representation of consumer preferences include non-satiation, diminishing marginal rate of substitution (or strict convexity), and strong monotonicity (Varian 2010).

of preference satisfaction each commodity within a bundle provides to a particular consumer (Freeman 2003).

For example, if $\boldsymbol{X}$ is a vector of available quantities of goods and services that comprise consumption bundles, ($\boldsymbol{X} = \boldsymbol{x_1}, \ldots, \boldsymbol{x_i}, \ldots, \boldsymbol{x_n}$), then consumer tastes and preferences may be represented by a utility function:[7]

$$\boldsymbol{U} = U(\boldsymbol{X}). \tag{2.1}$$

Consumer preferences determine the level of utility a consumer secures from each commodity; and the utility function maps these preferences to each available commodity. The utility a consumer acquires from each consumption bundle, then, is determined by the quantity of each good represented by the commodity bundle and the consumer's utility function (Freeman 2003).

Among the properties of well-ordered preferences is that of substitutability among available commodities. Commodity substitution refers to the relationship between elements of a consumption bundle whereby a decrease in the quantity of one commodity can be offset by an increase in the quantity of another(s) in order for the consumer to be no worse off because of the change (Freeman 2003). Utility is preserved, in this case, by substituting among the various commodities within the bundle. The marginal rate of substitution (MRS) measures the amount of a commodity that may be substituted for another commodity while holding a consumer's utility constant.

Mathematically, the marginal rate by which good $\boldsymbol{x_1}$ may be substituted for $\boldsymbol{x_2}$ is defined:

$$\boldsymbol{MRS} = -\frac{\frac{\partial U(\boldsymbol{X})}{\partial \boldsymbol{x_1}}}{\frac{\partial U(\boldsymbol{X})}{\partial \boldsymbol{x_2}}}\ . \tag{2.2}$$

[7] Equations (2.1) – (2.7) are based on Freeman (2003), pp. 47-49 equations (3-1) – (3-4), and pp. 99 – 101 equations (4-3) – (4-5).

If the substitutability axiom holds, there can be any number of consumption bundles that satisfy a consumer's preferences while providing an equal amount of utility. This condition is represented graphically by indifference curves, which are the locus of available consumption bundles that offer a constant level of utility for given tastes and preferences. Since all the points along the curve provide the same utility, the consumer is said to be indifferent between which bundle in the locus is chosen. For example, in the context of recreation demand at state parks, a likely substitute may be engagement in similar recreational opportunities offered at a regional rail-trail (Betz, Bergstrom and Bowker 2003). In this case, a consumer will satisfy preferences by balancing recreation demand for the two sites such that a utility bundle that consists of proportionate amounts of each is consumed.

Indifference curves are best depicted in a two-commodity space, with $\boldsymbol{x_1}$ representative of the good under analysis, and $\boldsymbol{x_2}$ either a composite of all other goods in the consumption bundle or another particular commodity under examination. From the preceding example, let $\boldsymbol{x_1}$ represent recreation at state parks and $\boldsymbol{x_2}$ recreation at a regional rail-trail. In Figure 2.1, a consumer's indifference curves are represented by $\boldsymbol{U_i}$, $i=1,2,3$. Each curve indicates a different level of utility, constant along each curve, and increasing on an *ordinal* scale in a direction outward from the origin such that $\boldsymbol{U_1 < U_2 < U_3}$. The consumer substitutes between recreational locations ($\boldsymbol{x_1}$ and $\boldsymbol{x_2}$), which results in the selection of different consumption bundles that lie on a particular indifference curve. Choices favoring relatively more recreation at state parks ($\boldsymbol{x_1}$), for example, will shift the consumption bundle towards the $\boldsymbol{x_1}$ axis along an indifference curve (movement from point **A** to point **B** in Figure 2.1). Choices of consumption bundles that consist of a relatively greater amount of recreation at regional rail trails imply movement along an indifference curve towards the $\boldsymbol{x_2}$ axis (movement from point **B** to point **A** in Figure 2.1).

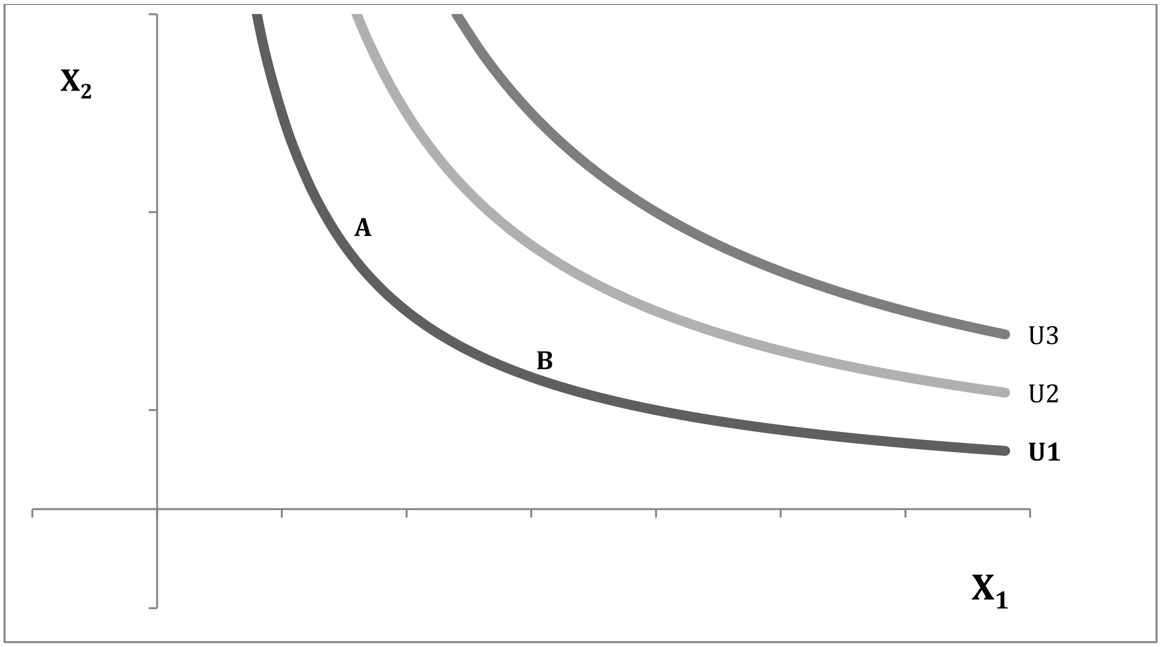


Figure 2.1 – Indifference Curves (U1 < U2 < U3).

As mentioned previously, the maximum amount of utility a consumer may enjoy is limited by various constraints, income being the most prominent.[8] The total amount of money he or she can allocate to the purchase of utility-yielding commodities is represented by a budget constraint. This restricts expenditures to the consumer's available income. Assuming positive and constant prices ($\boldsymbol{P = p_1, \ldots, p_i, \ldots, p_n}$) associated with each commodity ($\boldsymbol{X = x_1, \ldots, x_i, \ldots, x_n}$), a utility maximizing consumer will allocate income ($\boldsymbol{M}$) among commodities, such that a budget constraint may be represented by:

$$\boldsymbol{M} = \sum_{i=1}^{n} \boldsymbol{p_i} \cdot \boldsymbol{x_i}, \qquad (2.3)$$

where

$\boldsymbol{M}$ = available income, and

$\boldsymbol{p_i}$ = market price of good i.

[8] Note that there can be any number of constraints to consumer utility maximization. This study will focus on income and time.

This budget constraint limits all of the possible consumption bundles from which a consumer may choose to a subset that is affordable. A utility-maximizing consumer will then choose the bundle within that subset such that all income is exhausted, and the budget constraint (equation (2.3)) is satisfied.

In a two-commodity space, the income constraint is represented geometrically by a budget line:

$$M = p_1 x_1 + p_2 x_2, \tag{2.4}$$

where

x_1 = the commodity under analysis, and

x_2 = a composite commodity representing all other goods within the bundle.

Rearranging the terms provides:

$$x_2 = \frac{M}{p_2} - \left(\frac{p_1}{p_2}\right) \cdot x_1. \tag{2.5}$$

Thus, the budget line has a slope of $-p_1/p_2$ and intercept M/p_2. It stretches from point **A** to point **B** in Figure 2.2. Available income is represented by the distance between the origin and the budget line, the bounds of which comprise the set of affordable consumption bundles. The outward expanding indifference curves are constrained by income. In other words, the consumer cannot afford to purchase commodity bundles on indifference curves above the budget constraint (i.e., U_2 or U_3). The point of tangency between the budget line and indifference curve U_1, (x_i^*), represents the optimal point of consumption. This is the maximum level of utility that may be attained for given preferences and constraints. At this point, the marginal rate of substitution between the goods (represented by the slope of the indifference curves) and the economic rate of substitution, or price level (represented by the slope of the budget line), are equal.

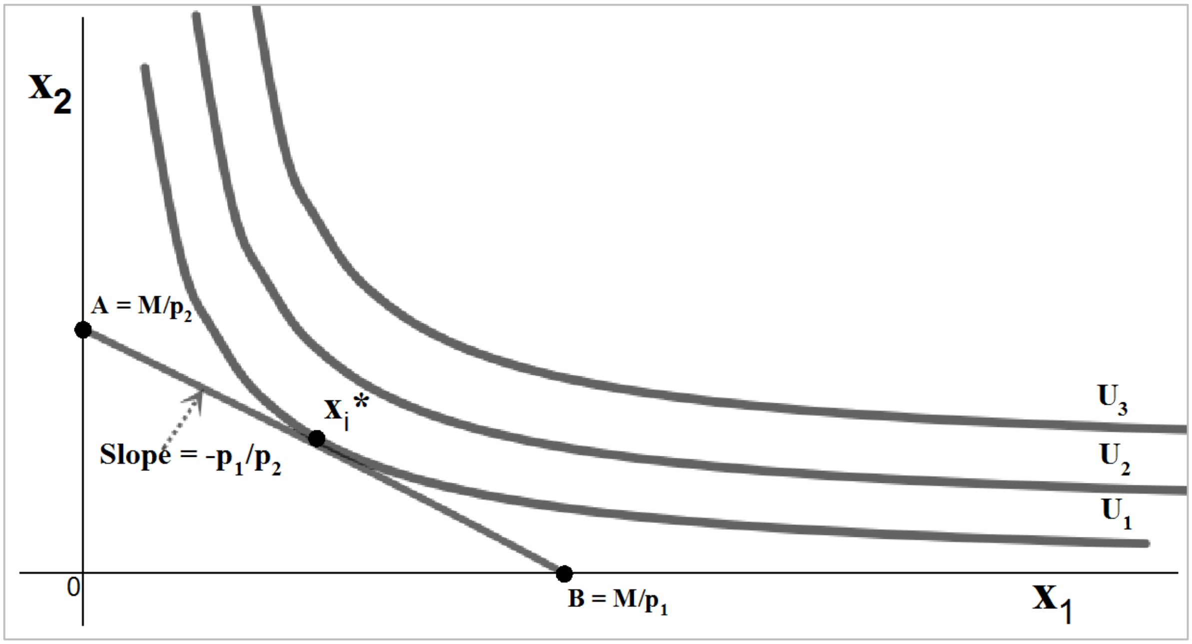


Figure 2.2 – Utility Function and Budget Constraint.

Mathematically, this economic problem is an application of constrained optimization. Given a set of exogenously determined prices, the consumer maximizes utility by choosing the optimal amount of each commodity based on individual tastes and preferences. Utility is constrained by available income:

$$\text{maximize } \boldsymbol{U} = U(\boldsymbol{X})$$

$$\text{subject to } \boldsymbol{M} = \textstyle\sum_{i=1}^{n} \boldsymbol{p_i} \cdot \boldsymbol{x_i}. \qquad (2.6)$$

The solution is the set of ordinary, or Marshallian demand functions for each commodity. These express the optimal quantity of each good the consumer demands at given prices and with limited income:

$$\boldsymbol{X_i} = x_i\,(\boldsymbol{P}, \boldsymbol{M}),\ i = 1, 2, \ldots, n. \qquad (2.7)$$

Substituting these values back into the utility function yields the indirect utility function, which gives consumer utility as a function of prices and income, assuming the individual has chosen optimal quantities of each good:

$$V_i = v_i(\boldsymbol{P}, \boldsymbol{M}). \quad (2.8)$$

Price Effects

As functions of prices and income, ordinary demands are conditioned on the values of those two parameters. If prices change, the slope of the budget line will change. If income changes, the budget line will shift inward or outward. In either case, the utility maximizing bundle, as represented by the tangency between the budget line and an indifference curve, will differ from the previous static optimum. This study focuses on the effects of a fee change on visitor demand at state parks. Therefore, the following discussion will focus on the comparative statics of a price change.

Using the same variables as in Figure 2.2, if the price of $\boldsymbol{x_1}$ ($\boldsymbol{p_1}$) is allowed to vary, with income ($\boldsymbol{M}$) and cross-prices ($\boldsymbol{p_2}$) fixed, the budget line will either rotate inward (for a price increase) or outward (for a price decrease) from the $\boldsymbol{x_2}$ intercept. Figure 2.3 shows a price increase in $\boldsymbol{x_1}$, from $\boldsymbol{p_1}''$ to $\boldsymbol{p_1}'$. The budget line tilts inward from point ***C*** to point ***B.***, implying less purchasing power for the consumer. Additional price increases in $\boldsymbol{x_1}$ will advance the budget line further in the same direction. Assuming $\boldsymbol{x_1}$ is an ordinary good, as its relative price increases, the quantity demanded decreases with respect to $\boldsymbol{x_2}$.[9] The utility maximizing commodity bundle shifts from point **F** ($\boldsymbol{x}^{**}$) to point **D** ($\boldsymbol{x}^{*}$), where the proportion of $\boldsymbol{x_2}$ to $\boldsymbol{x_1}$ is higher. The MRS between the commodities determines the amount of $\boldsymbol{x_2}$ substituted for $\boldsymbol{x_1}$ to reach point **D**.

Figure 2.3 shows both the slope of the budget line and its distance from the origin have both changed in response to the price increase. This result indicates a price increase will have two types of effects: the relative price of one good rises (as indicated by the change in slope of the budget line) and the consumer's purchasing power is lessened (as evidenced by the inward shift of the budget line). Assuming $\boldsymbol{x_1}$ is an ordinary good and the substitution axiom holds, as its

[9] In the case where $\boldsymbol{x_1}$ is a Giffen good, the quantity demanded will increase in response to a price increase.

price increases, its quantity demanded will decrease relative to $\boldsymbol{x_2}$ (a shift from point F to point E in Figure 2.3). This is known as the substitution effect. In addition, a price increase allows the consumer less money to spend on both commodities (a shift from point G to point D in Figure 2.3**).** This is the income effect of a price change.

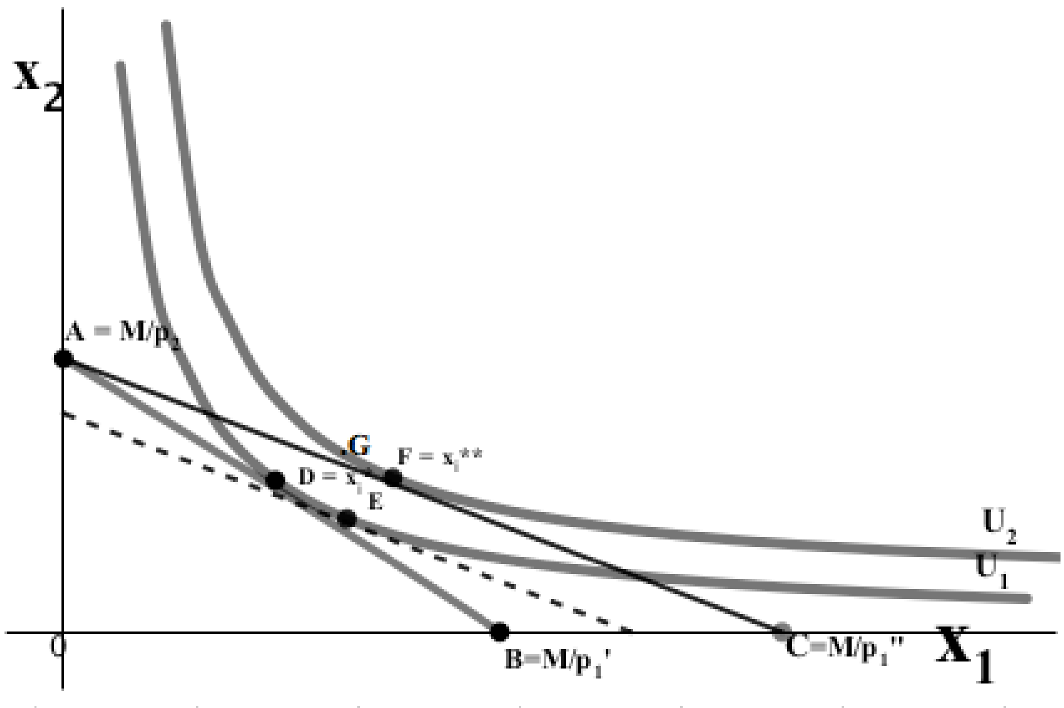


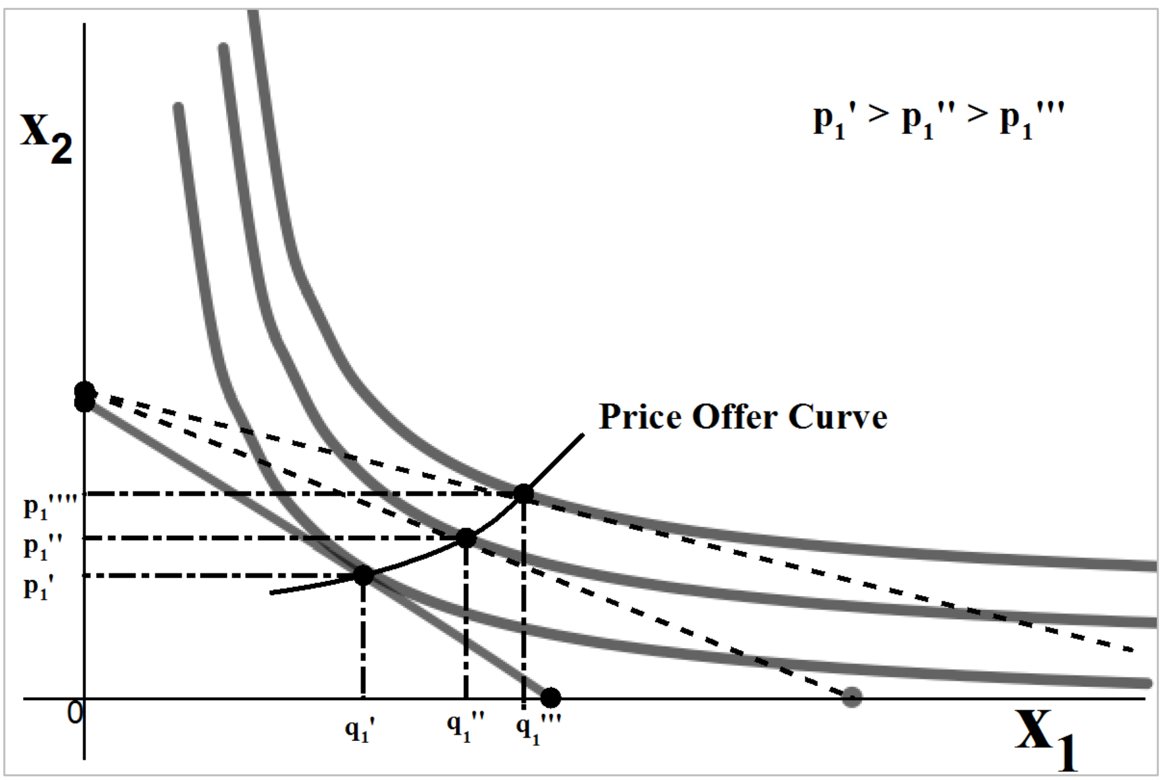
Figure 2.3 – Substitution and Income Effect of a Price Change.

Mathematically, the Slutsky equation decomposes the total effect of a price change into the substitution and income effects (Freeman 2003, p. 49):

$$\frac{\partial x_2(\boldsymbol{P},\boldsymbol{M})}{\partial \boldsymbol{p_1}} = \frac{\partial h_2(\boldsymbol{P},\boldsymbol{U})}{\partial \boldsymbol{p_1}} - \frac{\partial x_2(\boldsymbol{P},\boldsymbol{M})}{\partial \boldsymbol{M}} \cdot \boldsymbol{x_1}. \tag{2.9}$$

The left-hand side of Equation (2.9) is the total effect of a price change. The first term on the right-hand side is the substitution effect and the last term is the income effect. Thus, the total effect of a price change is determined by the variation in relative demand between the commodities and by the adjustment in consumer purchasing power, i.e., the substitution and income effects.

As can be seen in Figure 2.3, the optimal commodity bundle changes as the price of the goods varies, as evidenced by the shift from Point **F** (x_i^{**}) to Point **D** (x_i^{*}). The price offer curve traces out the quantities demanded at different prices for the commodity under analysis (x_1) in a two-commodity space, while holding income (M) and cross-prices (p_2) constant. On it lie the optimal points of consumption for marginal changes in p_1. This relationship can be mapped to own-price and quantity space, resulting in the ordinary, or Marshallian, demand curve. This curve represents a consumer's demand for the commodity under analysis (x_1) as a function of its own price (p_1), holding income (M), cross-prices (p_2) and preferences constant. Figure 2.4 traces the ordinary demand curve for x_1, (x_1 ($p_1 \mid p_2$, M)), from the price offer curve. The ordinary demand curve has several properties related to economic value that will be discussed in the next section of this chapter.



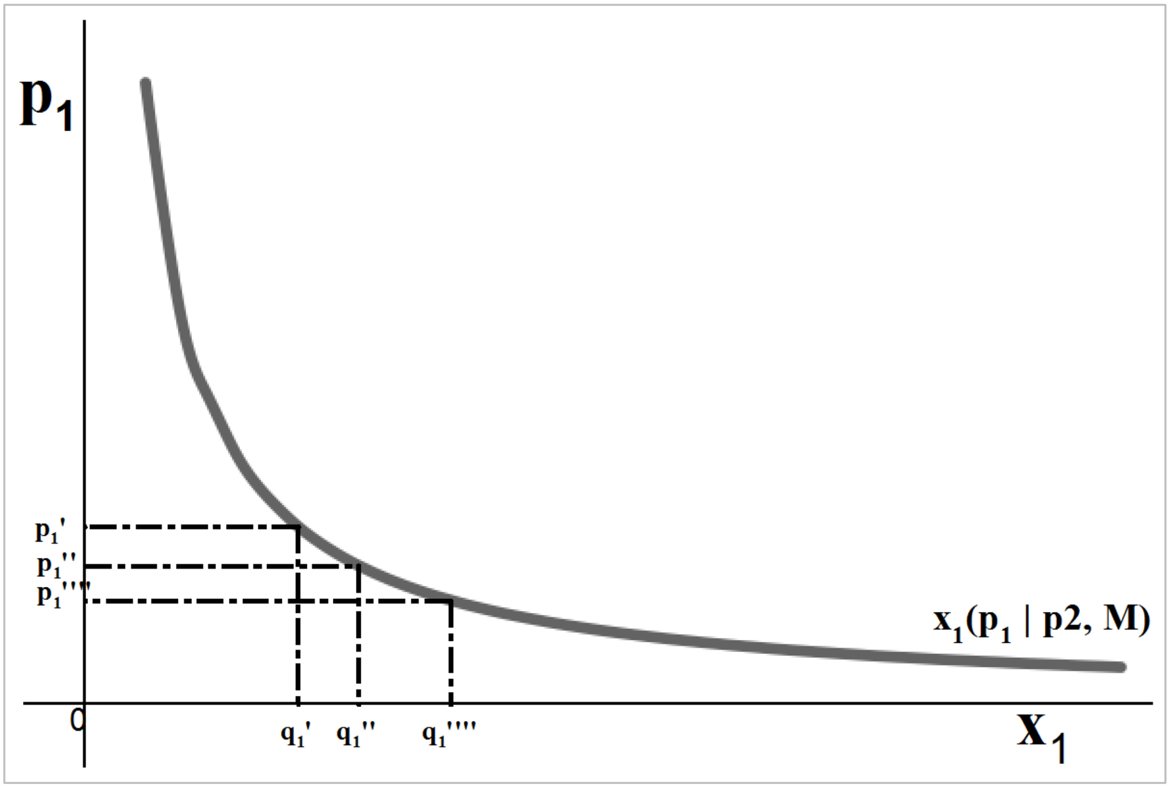


Figure 2.4 – The Price Offer Curve and Ordinary Demand Curve

Economic Value

Freeman (2003) derives a concept of economic value from neoclassical welfare economics, whereby the value of something stems from its ability to affect individual or collective well-being. In Figure 2.3, the utility maximizing bundle shifts from ($\boldsymbol{x_i}^{**}$) to ($\boldsymbol{x_i}^{*}$) after the price increase - a point that lies on a lower indifference curve. The decrease in achievable utility signals that the consumer's preferences are less satisfied than before. If well-being is defined in terms of the satisfaction of individual preferences, and utility measures the extent to which an individual's preferences are satisfied, something of value is then implied by the shift in consumer utility after the price change.

Following this logic, the decisions that individuals make when substituting between goods to satisfy preferences reveal their relative value for each good. As consumers make substitution choices, relative trade-off ratios between commodities can be observed from their decisions. These ratios are referred to as marginal rates of substitution (MRS), which measure the rate at which a consumer substitutes between commodities while utility remains fixed. From these, it is possible to determine economic value (Freeman 2003).

MRS can be expressed in terms of willingness to pay (WTP) or willingness to accept (WTA) payment, each of which measures the income necessary to make a consumer indifferent to a change in circumstances (i.e., utility remains constant), though in a slightly different manner. In terms of an improvement in circumstances such as a price decrease, WTP measures the amount that a consumer would pay for the improvement; WTA measures the minimum payment necessary for the consumer to forego the improvement. The opposite is true for a situation leading to decreased utility (Haab and McConnell 2002).

WTP and WTA are both based on the idea of substitutability in preference relations (Freeman 2003). Tradeoffs between payments and utility are implied by a consumer's willingness to change circumstances; and a monetary value on a utility change can be inferred from the level of payment necessary to make the consumer indifferent between circumstances. Therefore WTP and WTA may be measured by income.

The economic value for changes in a natural resource may be derived from the effects of that change on human welfare (Freeman 2003). If WTP is the preferred measure of demand[10], the economic value of recreation at state parks is the sum of all visitors' WTP for use of those services. To estimate the value of an increase in admission fees to state parks, the shapes of the marginal WTP curves for the sites before and after the price change must be determined. The

[10] For marginal changes, the differences between WTP and WTA are minimal, but for large changes they may be significant (Haab and McConnell 2002). This study examines the effect of an incremental increase in user fees at state parks, a charge that is expected to have significant but limited effects. This, and the notion that stated preference methodologies may be theoretically incompatible with WTA measures, leads to WTP as the preferred measure of economic value. See Haab and McConnell (2002), p. 9 for more detailed explanation.

change in economic value is equal to the area between the original and new demand curves (Freeman 2003).

As noted previously, ordinary demand curves measure the quantity of a good demanded as its price varies, holding income and all relative cross-prices constant. This relationship may also be interpreted as the various prices a consumer would be willing to pay for different quantities of the good, again, holding income and the relative prices of all other goods in the commodity bundle constant. Thus, ordinary demand and marginal WTP measure the same value.

The price consumers actually pay for a good is often less than the amount they would be willing to pay, resulting in a type of bonus referred to as consumer surplus (Freeman 2003). Figure 2.5 shows a linear Marshallian demand curve for commodity x_1. Total WTP for the good is represented by the entire area under the demand curve, or **AC0**. The value of consumer's surplus is equal to the area under the demand curve, but above the horizontal price level, or ABD.

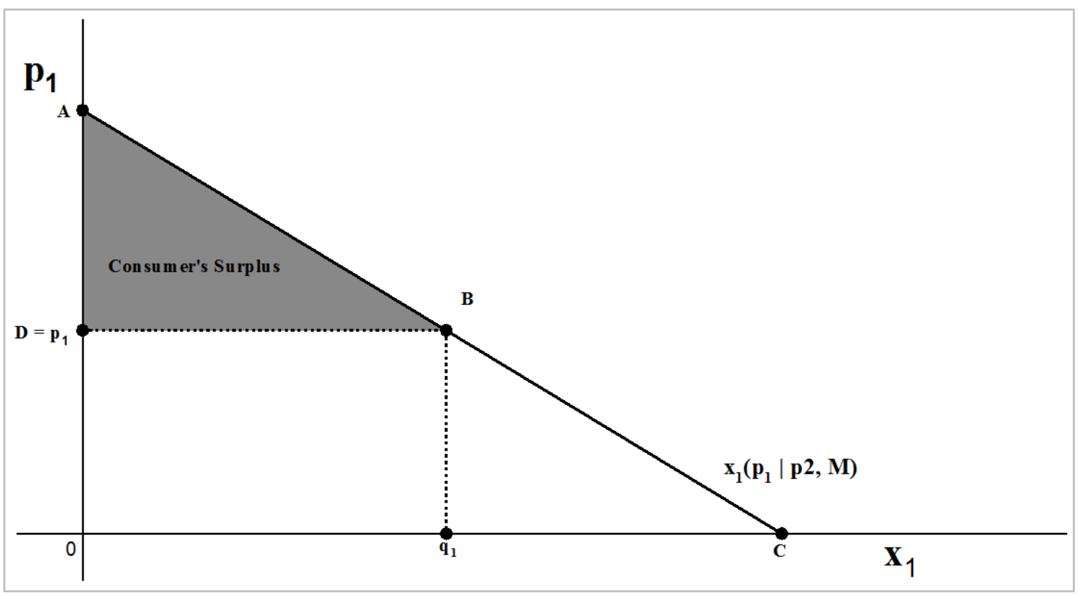


Figure 2.5 – Consumer Surplus.

Observing actual price-quantity market transactions seems a fairly straightforward method to estimate ordinary demand for a commodity; and measuring economic value by determining consumer's surplus from these demand functions a logical extension. However, measurement of economic value by consumer's surplus suffers a theoretical limitation. Specifically, MRS measures the rate at which a consumer substitutes one commodity for another while preserving the same level of utility. If economic value is to be inferred from MRS, utility must remain constant when estimating these trade-off ratios. Marshallian demands that supply ordinary consumer's surplus measures lack the requirement that utility remain fixed for a price change.

In Figure 2.3, for example, the utility-maximizing commodity bundle after the price increase, $\boldsymbol{x}^*$, is located on a lower indifference curve. While the substitution effect indicates the relative amounts of $\boldsymbol{x_1}$ and $\boldsymbol{x_2}$ consumed after the price decrease, the income effect restricts consumer purchasing power after the price increase. It is the income effect, then, that lessens consumer utility from a price decline.

The correct welfare measure for the MRS is one that measures *only* the substitution effect. Hicks-compensated demand curves ignore the income effect of a price change, indicating the change in quantity demanded while utility remains constant. By fixing utility at a certain level, Hicksian measures essentially net out the income effect of a relative price change, and measure only commodity substitution. Income may vary so long as the individual remains on the same indifference curve as prior to the price change (Freeman 2003). This is the theoretically-consistent measure of MRS.

The measures of compensating variation (CV) and equivalent variation (EV) flow from Hicks-compensated demand curves in the same way that consumer's surplus estimates are derived from the Marshallian demand functions. That is, they are measured by the area under the relevant demand curve an above the price level. They indicate the amount of money required to return a consumer to the original level of utility after a price change (CV), or to consume at the new level of utility with the initial price set (EV) (Freeman 2003). Although these Hicksian-derived measures of economic value are the theoretically appropriate welfare indicator, they suffer from a practical problem. As functions of prices and a constant utility, they require a measurement of both. Unfortunately, the concept of utility is unobservable. Without an index of utility, Hicks-compensated demand functions cannot be specified (Haab and McConnell 2002).

So, while it is possible to readily estimate income-constant Marshallian demands with observable combinations of prices and quantities demanded, these are theoretically inferior to Hicksian demands, which are practically difficult to estimate. Measuring economic value, then, seems a theoretically implausible goal.[11] A large volume of research is dedicated to overcoming this problem. Willig (1976) assessed the scale differences between consumer's surplus and measures of economic value based on compensated demand. The share of consumer income devoted to the commodity under investigation and the individual's income elasticity of demand drive most of the discrepancy. If income elasticity is reasonably small, and both the size of the price change and proportion of total income allocated to the commodity are not too large, Willig presents a set of bounds from which consumer's surplus may be approximated for Hicksian measures with minimal error (Freeman 2003). Others researchers have attempted to recover Hicksian demand functions from observed Marshallian demands, either by integrating back to a consumer's expenditure function or through Taylor series approximations (Haab and McConnell 2002).

[11] Note that when the marginal utility of income is constant, which is not very often the case, Marshallian and Hicksian demands are equivalent (Freeman 2003).

Although researchers have been able to estimate more accurate and theoretically appropriate measures of economic value based on Hick-compensated demands, the disparities between these and the more easily estimated consumer's surplus measures have been shown empirically to be somewhat minor (Freeman 2003). This is especially true for recreation demand, where the income effect tends to be rather small and expenditures represent a minor fraction of consumer income. Haab and McConnell (2002) note that, "these careful investigations have made researchers more comfortable in using the areas under Marshallian demand curves as close approximations of the more exact areas under Hicksian demand curves" (p. 13). Standard practice in contemporary applied economic research is to approximate Hicksian measures of economic value with consumer surplus, noting the error in measurement.[12]

Price Elasticity of Demand

Another policy-relevant measure derived from consumer demand is price elasticity; which evaluates the extent to which quantity demanded is responsive to a change in price.[13] Specifically, it is a unitless measure of demand sensitivity to changes in the price of a commodity, calculated as the percentage change in quantity demanded divided by the percentage change in price (Varian 2010, pp. 274-275):

$$\boldsymbol{\varepsilon} = \frac{\Delta \boldsymbol{q}/\boldsymbol{q}}{\Delta \boldsymbol{p}/\boldsymbol{p}} = \frac{\%\Delta \boldsymbol{q}}{\%\Delta \boldsymbol{p}} \tag{2.10}$$

As measures of quantities demanded at different prices, Marshallian demands have all the information necessary to calculate this measure (Leeworthy and Bowker 1997).

The inverse relationship between price and quantity demanded for ordinary goods results in a negative price elasticity of demand, however, elasticities are most often discussed in terms

[12] For example, see: Grijalva et al. (2002); Bowker, Bergstrom and Gill (2007); Leeworthy and Bowker (1997).
[13] Note also that demand elasticities can be calculated with respect to income. This study focuses on the effect of an entrance fee change on state park visitation, therefore only the price elasticity of demand will be discussed.

of their absolute value. Goods with a price elasticity of demand equal to one are referred to as unit elastic. The change in quantity demanded is equivalent to the change in price for these goods. An elasticity greater than one indicates that demand is price sensitive. A price change for these types of goods will be more than offset by a change in quantity demanded. An elasticity bounded by one and zero is referred to as inelastic, and consumers displaying these types of preferences are less sensitive to price changes (Varian 2010).

The availability of substitutes is a primary determinant of price elasticity. If a commodity has a number of close substitutes, consumers will most likely respond to an increase in its price by shifting demand toward those substitutes. Commodities without many substitutes are more likely to have inelastic demands (Varian 2010). With respect to recreation demand, the role of substitutes can be significant. Unique sites offering activities and amenities not found in places elsewhere, such as the Grand Canyon, tend to have relatively inelastic demands (Hjerpe and Kim 2007). Recreation at sites which have fairly common profiles can be expected to have demands relatively more elastic, signaling that consumers would recreate elsewhere if the cost for site access increased.[14] The diversity of available recreational sites and activities results in similar diversity among substitution opportunities and price elasticities of demand. Loomis and Walsh (1997) cite a range of elasticities in recreation demand studies ranging from |0.2 to 2.0|.

One of the more management-relevant uses of elasticity estimates is for revenue prediction. Assuming admission fees are the only source of park revenue, total revenue is the product of the number of visitor units (e.g., individual, group, family, or car) and the fee. An increase in the fee level would most likely result in decreased visitation. An estimate of price

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[14] Note that the inverse is also true – if the price of a site with many substitutes fell, one would expect consumer demand to increase for the site relative to similar sites.

elasticity allows visitation levels after the fee increase to be predicted.[15] Total revenue can then be calculated. If demand is elastic ($|\varepsilon| > 1$), the change in visitation will more than offset the fee increase; and, assuming all other factors remain constant, total revenue will decrease. Alternatively, a price increase will generate additional revenue if visitors' demand is inelastic ($0 < |\varepsilon| < 1$), again assuming that everything else stays the same. For example, if visitor price elasticity at Fort Mountain State Park in Georgia were estimated to be -0.4 at the current entrance fee of $5, a fee increase of 50% to $7.50 would be expected to result in a 20% decrease in visitation. If visitation were currently 100,000 units per year, one would expect a decline to 80,000 after the fee increase, resulting in $100,000 of additional revenue. These types of estimates could be quite relevant to managers addressing financial sustainability at state parks.

Nonmarket Valuation

For measures of recreational site economic value and price elasticity to be recovered, the parameters of a demand model must be estimated. Consumer demand theory links the unobservable utility function and observable combinations of prices and quantities of commodities purchased. This link allows researchers to model demand based on consumer behavior and to estimate model parameters with observed data from which these measures may be determined (Bowker et al. 2009). Unfortunately, the estimation of demand for recreation at state parks is not straightforward. Freeman (2003) notes many of the service flows from natural resources are not traded in competitive markets at observable quantities and prices, and their economic values may be very different from any type of market value to which they are attached. Without price and quantity data, demand functions for these types of *nonmarket goods* cannot be

[15] The inverse may not be true when elasticities are estimated using on-site samples. That is, a price decrease cannot be assumed to increase visitation precisely how such an elasticity would predict. This is because non-visitors may have reasons other than price for not using the park.

estimated (Freeman 2003). Recreation at state parks likely falls into this category of goods or services.

Nonmarket goods typically exhibit varying degrees of characteristics related to nonrivalry and nonexclusivity that differentiate them from market goods (Freeman 2003). Usually this is partly due to a common-access component that limits the ability to restrict their usage once provided. In addition, consumption of most nonmarket goods by one individual does not constrain their use by other individuals, reflecting the feature of nonrivalry. Externalities related to these characteristics generally preclude markets from pricing nonmarket goods according to their economic values and allocating them efficiently (Freeman 2003).

This is not to say that there exists no method to value nonmarket goods. These processes do, however, require researchers to carefully craft proxies for price and quantity variables in order to estimate Marshallian demand functions with traditional econometric techniques (Bowker et al. 2009). The assumption of weak complementarity is the usual method by which the prices of nonmarket goods are proxied by market variables with observable characteristics and certain methods of demand estimation. This concept proposes a relationship between the two such that if the market variable is not consumed, the nonmarket good is not valued. This implies a choke price for the nonmarket good at which point consumer demand dissipates. Assuming this relationship between the goods allows willingness to pay for nonmarket goods to be proxied by estimating demand for private goods with observable features (Haab and McConnell 2002). Other methods of nonmarket demand estimation employ different quantity and price proxies.

Stated and Revealed Preference Data

Data for estimating demand for nonmarket goods are obtained either by observing the decisions that individuals make concerning these goods or through asking people hypothetical questions about those decisions (Freeman 2003). These approaches are referred to as revealed and stated preference methods, respectively.

Revealed preference methods for developing data about nonmarket goods are based on the proposition that observing individual's choices among alternative bundles of goods and services reveals utility maximizing behavior subject to practical constraints. Specifically, consumer behavior is modeled such that an individual's choices among market and nonmarket goods are linked to relevant prices and constraints. From this, substitution relationships between goods may be estimated, and inferences about preferences and welfare associated with nonmarket goods can be drawn (Freeman 2003). Models for specifying these relationships include the travel cost method (TCM), hedonic wage and property models, and the household production model. Each of these assesses the economic value of nonmarket goods through revealed preference data in a slightly different manner.

Individuals' responses to hypothetical questions concerning real world scenarios provide nonmarket data using stated preference methods. The responses are used to create a hypothetical market for nonmarket goods through which commodity substitution can be inferred and measures of value estimated (Haab and McConnell 2002). Once again, behavioral models relate these responses to preferences and consumer choice, providing the theoretical link required for economic analysis. Contingent behavior (CB), contingent valuation (CV), choice-based and referendum format models are among the more common stated preference techniques.

This study utilizes revealed preference data analyzed using the travel cost method to estimate recreation demand.

The Travel Cost Method

The travel cost method (TCM) is a technique frequently used to analyze recreational revealed preference data. A weak complementarity relationship is assumed between the necessary expenses incurred while travelling to a site and visitors' choice to consume recreation there. These travel costs serve as a proxy for price, and include both travel-related expenses and the opportunity cost of time (Phaneuf and Smith 2005). Visitation is used as proxy for quantity demanded. Different individuals incur different costs for access to sites, and variation in visitation response to these costs provides the basis for estimating recreation demand (Freeman 2003). That is, the observed necessary travel costs for site access and the number of site visits at each cost serve as price and quantity demanded proxies for Marshallian demands. Visitors' ordinary demand curve for site access, then, shows the number of visits demanded as a function of the cost of site access and other relevant socioeconomic variables (Haab and McConnell 2002).

Following Freeman (2003, pp. 419 - 423), the TCM begins with the idea that consumers maximize utility by consuming market and nonmarket commodities, one of which is recreational trips to a particular site. Utility is constrained by income and total available time, such that the consumer's constrained maximization problem becomes:

$$\text{maximize } \boldsymbol{U} = U(\boldsymbol{X}, \boldsymbol{r}) \quad , \tag{2.11}$$

subject to

$$\boldsymbol{M} + \boldsymbol{p_w} \cdot \boldsymbol{t_w} = \boldsymbol{X} + \boldsymbol{c} \bullet \boldsymbol{r}, \tag{2.12}$$

and

$$\boldsymbol{t^*} = \boldsymbol{t_w} + (\boldsymbol{t_1} + \boldsymbol{t_2}) \bullet \boldsymbol{r}, \tag{2.13}$$

where

$\boldsymbol{X}$ = a vector of market goods consumed (the numeraire with price 1),

$\boldsymbol{r}$ = number of recreational trips to the site,

$\boldsymbol{M}$ = exogenous income,

$\boldsymbol{p_w}$ = the wage rate,

$\boldsymbol{c}$ = cost of a trip,

$\boldsymbol{t^*}$ = total discretionary time,

$\boldsymbol{t_w}$ = hours worked,

$\boldsymbol{t_1}$ = round-trip travel time, and

$\boldsymbol{t_2}$= time spent on site.

Note that the full cost of each trip consists of access fees (if any) and the cost of travel, which includes opportunity costs associated with travel time and time spent on site. Opportunity costs are reflected by the $(\boldsymbol{t_1} + \boldsymbol{t_2}) \cdot \boldsymbol{r}$ term in Equation (2.13).

Full costs of a recreational trip ($\boldsymbol{p_r}$) can be represented by:

$$\boldsymbol{p_r} = \boldsymbol{fee} + \boldsymbol{p_d} \bullet \boldsymbol{d} + \boldsymbol{p_w} \bullet (\boldsymbol{t_1} + \boldsymbol{t_2}), \tag{2.14}$$

where

$\boldsymbol{fee}$ = access fees,

$\boldsymbol{p_d}$ = per-mile cost of travel, and

$\boldsymbol{d}$ = round-trip distance to the site.

Incorporating the opportunity cost of time into the full cost of a trip allows the time constraint to be substituted into the income constraint, yielding:

$$\boldsymbol{M} + \boldsymbol{p_w} \cdot \boldsymbol{t^*} = \boldsymbol{X} + \boldsymbol{p_r} \bullet \boldsymbol{r}. \tag{2.15}$$

Maximizing Equation (2.11) subject to the constraint in Equation (2.15) yields the Marshallian demand function for visits:

$$\boldsymbol{r} = r(\boldsymbol{p_r}, \boldsymbol{M}). \tag{2.16}$$

Including demographic variables (***d***), individual socioeconomic characteristics (***z***), and possible substitute sites ($\boldsymbol{p_s}$) as arguments in visitation demand for a visitor (***j***) results in a general TCM site demand specification:

$$\boldsymbol{r_j} = r_j(\boldsymbol{p_r}, \boldsymbol{M}, \boldsymbol{d}, \boldsymbol{z}, \boldsymbol{p_s}). \tag{2.17}$$

Calculation of economic value based on compensated demand functions is theoretically preferred. However, as discussed previously, these are generally unavailable for applied economic research. Approximating the economic value for nonmarket goods with measures derived from Marshallian demand functions is the most common practical approach (Freeman 2003). The Marshallian demands derived from the TCM, Equation (2.17), allow measures of economic value and price elasticity of demand to be estimated.

Although the TCM offers a fairly straightforward means of estimating demand for recreational sites, its usefulness is restricted by a number of theoretical limitations. The models are restricted to measuring demand for site *use* only, as the relevant population is those who make use of the site for recreation purposes. Passive and non-use values for sites are not recoverable (Zawacki, Marsinko, and Bowker 2000). When used with only revealed preference data, the simple TCM is unable to estimate variation in demand and value for changes in site attributes.[16] This limitation has been overcome by using the model with blended data, such as with the trip response or contingent trip model (Betz, Bergstrom and Bowker 2003; Layman, Boyce and Criddle 1996; Rosenberger and Loomis 1999). The TCM has also been criticized for taking travel costs as an objective measure, when at least some aspects of those costs are most likely determined by the individual (Randall 1994).

[16] Note that more complex TCM models that utilize random utility models across multiple sites or employ a varying parameters approach are capable of valuing demand variation due to changes in site attributes. For example, see Loomis (1988) or Hesseln, Loomis and Gonzalez-Caban (2004).

In addition, a number of often restrictive assumptions must hold fairly well for the TCM to appropriately model consumer demand. Consumer response to changes in the necessary travel costs of reaching a site must be the same as their response would be to changes in price of any market good included in the cost of each trip, such as the price of gasoline. Although there could be utility and disutility associated with the time spent travelling, it is presumed to be evenly balanced and therefore utility-neutral. Time spent on site is assumed to be utility-producing and similar for each recreationist (Haab and McConnell 2002). Each trip is expected to be for the primary purpose of visiting the site under analysis, and usually presumed to be of equal length while on site (Freeman 2003, p. 421).[17] Additionally, the opportunity cost of time is assumed to be appropriately valued by the wage rate, or a fraction thereof (Freeman 2003).

Researchers have spent a great deal of effort modeling data to fit these restrictions while maintaining the theoretical integrity of the TCM, however those related to the value of time and primary purpose trips appear to be particularly problematic. There exists no clear consensus as to the best approach for either in the relevant literature. For example, Zawacki, Marsinko and Bowker (2000) use proportions ranging from zero to one-half of the household wage rate to value time; Bowker, Bergstrom and Gill (2007) from zero to one-quarter. Rosenberger and Loomis (1999) test their models for goodness of fit using opportunity costs ranging from zero to the full wage rate, and find one-fourth optimal. To address multipurpose visitors, some researchers attempt to apportion the joint costs to the different purposes (Leeworthy and Bowker 1997); others simply exclude nonprimary purpose visitors from the estimation sample (Rolfe and Dyack 2010).

[17] The assumptions that each visitor spends and equal amount of time on-site and that time is utility-producing allow the opportunity costs associated with time spent on-site to be dropped from the TCM as implied by the constrained maximization problem in Equations (2.11) and (2.15).

Economic Impact Analysis

The previous discussion of theory in this chapter addresses economic value in terms of benefits to the consumer, state park users in this case. However, the expenses these individuals incur during their consumption of recreational experiences at state parks are accounted for as sales at businesses that cater to visitor demand. Increased sales are a benefit to local economies. In Figure 2.5 (above), if x_1 represents recreational trips to state parks, total visitor expenditures under current access conditions total $p_1 \bullet q_1$, as represented by the area p_1Bq_1O.

A portion of those transactions likely take place with businesses proximate to the parks. When outside visitors spend money in a local economy, that economy experiences economic activity greater than simply the total of expenditures. In order to meet visitors' demand, businesses providing final goods must increase their purchases from input suppliers. Those suppliers, in turn, must increase their inventories - a process which extends down the supply chain in a diminishing fashion until the total demand has been filled. This process creates an economic ripple effect through the local economy in the form of increased sales, profits, jobs, tax revenue and/or income (English et al. 1996). Impact analyses attempt to unwind this ripple effect, and quantify the entirety of local economic activity due to visitor expenditures. In doing so, they are capable of estimating the total effects of increased spending, and resolving questions surrounding the contribution of visitors to the economic development of a region. This section describes the theory and procedure for this type of analysis.

Economic Base Theory

Economic base theory provides the theoretical context for analysis of economic impacts. The general premise is that recreation is a feature of local economies "exported" to non-locals who bring in outside dollars essentially the same way as would exported goods and services from any economy (Bergstrom et al. 1990). While on recreation trips, visitors purchase locally available food, lodging and other similar items. An export transaction is conducted when a nonresident purchases a locally supplied commodity. That transaction injects “new” money into the economy, which generates growth by increasing residents’ wealth (Shaffer, Deller and Marcouiller 2004). Expenditures by local residents generally do not qualify as “new” money; local spending is essentially a transfer of income within an economy (English et al. 1996).

Input-Output Models

The flow of visitor spending must be linked to the local economy in order to estimate its impact. This requires a model of the local economic structure, including relationships between industries and households, and among the industries themselves. Input-Output (I-O) models provide this type of information. I-O models have been characterized as a detailed “snapshot” of a local economy, meaning that its essential components are captured by the model at a certain point in time in a static equilibrium (Shaffer, Deller and Marcouiller 2004). Any externally induced change in final demand (i.e., an export transaction) will trigger a shock that produces local economic impacts as the economy adjusts back to equilibrium.

Technically, these models are mathematical representations of the linkages between the different sectors of a local economy, accounting for the magnitude and direction of all transactions between industries, households, and governments (Stynes 1997). A linkage exists when a change in final demand in one sector affects a change in demand in another. Measurement of the direction and magnitude of these linkages with I-O models allows the economic ripple effect of visitor expenditures to be quantified.

Leakage, Capture and Margins

Particularly for smaller regions, most of the goods that visitors purchase are not manufactured in the local area. It would be an error, therefore, to attribute the full price of those goods to a direct increase in final demand. To resolve this issue, the value of each good must be *margined* before included as a direct effect – meaning that the price must be decomposed into the manufacturing, wholesale, retail and transportation components, with only the portions produced within the local economy attributed to that economy's final demand.

Leakage refers to expenditures a local economy pays to outside industries for goods and services brought back into the region to meet final demand. This is the portion of sales that are margined out from total sales. The local economy does not benefit from the economic impacts of leaked expenditures because their receipts immediately flow back to the external industries from which they are supplied (Hjerpe and Kim 2007). Stynes (1997) estimates that around 30% to 40% of visitors' expenditures immediately leak out of a local area. The remaining 60% to 70% can be thought of as the capture rate, or the amount of gross sales generated by local firms that remain inside the community as final demand. In general, larger metropolitan areas capture a greater amount of expenditures. This is mostly due to greater complexity in their economic structures.

As only locally captured visitor dollars create economic impacts, the more margined spending an economy is able to capture, the larger will be the total economic impact of an outside stimulus. Communities with more diverse economies, where more of the inputs required by firms providing final demand can be sourced locally, generally have greater economic impacts (Stynes 1997). While the capture rate indicates the efficiency of a local economic structure in retaining visitor dollars, high amounts of leakage can provide insight as to where communities should focus their resources to develop their economies in order to generate higher economic impacts (Hjerpe and Kim 2007).

Direct Effects, Indirect Effects and Induced Effects

Total economic impact is comprised of direct, indirect, and induced effects. Direct effects represent the initial exogenous change in final demand as measured by the margined total of outside expenditures in a local economy. In the context of recreation demand, these are the production changes associated with the recreation- and tourism-related sectors that immediately absorb the initial change in visitor expenditures. Generally, most direct effects occur within the lodging, restaurants, transportation, amusement, and retail trade sectors (Stynes, et al., 2000). An influx of off-site overnight visitors to a state park, for example, would trigger a direct economic impact from increased sales in the lodging sector of a local economy, as well as in the service and retail sectors where the visitors are likely to spend additional dollars.

Indirect effects measure the economic readjustments that take place as local firms increase their input purchases from local suppliers to meet new demand. The sectors that supply these inputs, or the backward-linked industries, typically experience an increase in sales, jobs and income as demand for their products increase (Bowker, Bergstrom and Gill 2007). In turn, the sectors supplying inputs to these backward-linked industries must purchase additional goods and services from their suppliers to meet increased demand – a process which extends in a diminishing fashion until the effect is exhausted (Shaffer, Deller and Marcouiller 2004). For example, when park visitors buy food and drinks at local restaurants, those restaurants must increase input purchases from local food purveyors to meet the visitors' demand. The firms that supply these food purveyors will also experience increased demand as the indirect effects of visitor expenditures ripple through the local economy. This pattern repeats among suppliers and producers until the total demand has been met.

Induced effects capture the changes in household wealth as the local economy undergoes economic rebalancing. Meeting visitor demand generates additional local income in the form of increased business profits, higher rents, and/or added compensation for workers. As local income grows, new dollars are spent within the economy, inducing additional rounds of economic impacts indirectly transmitted through the local economy (Bowker, Bergstrom and Gill 2007).

Multipliers

In its most simple form, the economic impact of state park visitation may be estimated by the following formula (Stynes et al. 2000):

$$\textit{Economic Impact} = \textit{Number of Visitors} * \textit{Average Spending per Visitor} * \textit{Multiplier}. \quad (2.18)$$

The product of the number of visitors and their spending, the first two variables on the right-hand side, represents the direct effect of visitor expenditures. Multipliers capture the indirect and induced effects of visitor expenditures. They are calculated by dividing the sum of all of the iterations of direct, indirect and induced effects by the value of the original direct effect (Hjerpe and Kim 2007). As a ratio of indirect to direct effect, they can be framed in terms of gross output, sales, income, employment, or value-added, depending on the unit of measurement (Stynes 1997). English, et al. (1996), estimate the multiplier effects of recreation-related expenditures to fall between 1.5 and 2 times more than the amount initially spent, or the direct effect. Their estimates generally fall within those reported by Chang (2001), although he finds instances of multipliers up to 3.1 in certain regions and for certain industries.

Assumptions and Limitations

Relying on I-O models affects a number of implicit assumptions in economic impact analyses. The linear nature of the models limits input factor substitution in production and does not allow for economies or diseconomies of scale. Linearity also implies that a doubling of visitors or spending also doubles economic impacts, which may or may not be the case. Aggregating firms into different sectors in I-O models assumes their homogeneity– all are assumed to employ the same technology and produce identical commodities. In addition, the impacts are limited to a specific time period (Stynes, et al. 2000). Real world conditions most likely differ from these theoretical abstractions.

There are also several key elements of local economic impacts not assessed when using I-O models. Increased demand can cause price changes within an economy, usually biasing upwards the local cost of living. Visitors may also affect changes in both the quality and quantity of goods offered in a community, as the demand characteristics of visitors and locals are often dissimilar (Stynes 1997). Tourism dependent communities may also experience negative social and environmental effects associated with increased visitation, such as congestion and pollution. These negative factors may dampen economic impacts associated with increased visitation. However, I-O models, in their current form, are unable to account for the impacts of these elements.

One of the research goals of this study is to quantify the variation in economic impacts likely to result from changes in the fee structure at state parks in northern Georgia. As noted previously, an increase in park admission fees is likely to result in decreased visitation. If non-locals are sufficiently price sensitive, local economic impacts generated by their expenditures will decline along with their trip frequency. This study will use elasticity estimates from the demand models to determine the likely reduction in visitation resulting from different park admission fees. This information, along with park-specific per capita economic impact estimates, will allow for the quantification of lessened economic impacts due to increased admission charges.

Application of Theory for this Study

This chapter has addressed the theoretical considerations necessary to estimate economic value in a number of different ways. This particular study addresses a question related to the likely economic effects of a hypothetical increase in admission fees at several state parks in northern Georgia. The empirical study in the following chapters uses data gathered by Green, Larson and Whiting (Larson 2012) to estimate several types of effects using the methods outlined in this chapter. The details of estimating models based on those methods are discussed in the next chapter.

Although the additional admission fee is likely to increase park revenue, park visitation is expected to decrease in response. The degree to which enhanced revenues are offset by visitation decline depends on visitors' price elasticity of demand. Additionally, these price effects may not be homogeneous with respect to different visitor segments. Local economic impacts are also likely to suffer if visitor demand proves to be relatively price sensitive.

Figure 2.6 allows for a visualization of these effects.[18] The demand curve ($\boldsymbol{x_1}$ ($\boldsymbol{p_1} \mid \boldsymbol{p_2}, \boldsymbol{M}$)) shows the quantity of visits to the state parks ($\boldsymbol{x_1}$) as dependent on trip price ($\boldsymbol{p_1}$), holding income ($\boldsymbol{M}$) and all cross-prices ($\boldsymbol{p_2}$) constant. Under current conditions, visitors pay $\boldsymbol{p_1}$ per trip, with an admission fee of ($fee = \boldsymbol{p_1} - \boldsymbol{T}$) and travel expenses $\boldsymbol{T}$. The fee revenue captured by the park management agency is area $\boldsymbol{p_1 CGT}$. The area TGq0 represents total visitor travel expenses. The

[18]**Figure 2.6** is based on an illustration by Teasley, Bergstrom and Cordell (1994).

margined portion of non-local travel expenses captured by local businesses represents the direct effect that initiates economic impacts in the local economy. Consumer surplus is $\boldsymbol{ACp_1}$.

Increasing the admission fee to (*fee'* = $\boldsymbol{p_1}$' – ***T***) results in visitation decreasing to ***q.'*** The decline may or may not be the same for park visitors of different ethnicities. Park management is able to capture additional revenue from visitors' consumer surplus equal to $\boldsymbol{p_1'BFp_1}$. However, the decrease in visitation results in the agency losing revenues equivalent to the area ***FCGH***. Total park revenue is now $\boldsymbol{p_1'BHT}$, which will increase if the additional revenue ($\boldsymbol{p_1'BFp_1}$) is greater than that lost (***FCGH***). This depends on visitors' price elasticity of demand, which determines the decrease in visitation expected to result from an increase in admission fee, or the distance between ***q*** and ***q.'***

The fee increase will also affect local economic impacts. A decline in visitation reduces total visitor trip expenses by an amount equal to the area ***HGqq.'*** The effect of this loss also depends on price elasticity, as well as the relevant multipliers that account for the indirect and induced effects of visitor expenditures. The greater the decline park in visitation (***q'- q***), the larger will be the loss in local economic impacts.

Other concerns include the decline in consumer surplus by an amount equal to area $\boldsymbol{p_1'BCp_1}$, and an increase in deadweight loss of ***BCGH***. The change in consumer surplus can be estimated by subtracting the area $\boldsymbol{p_1'BCp_1}$ from $\boldsymbol{ACp_1}$. This type of information is useful for benefit-cost studies. Measurement of deadweight loss is used for economic efficiency studies.

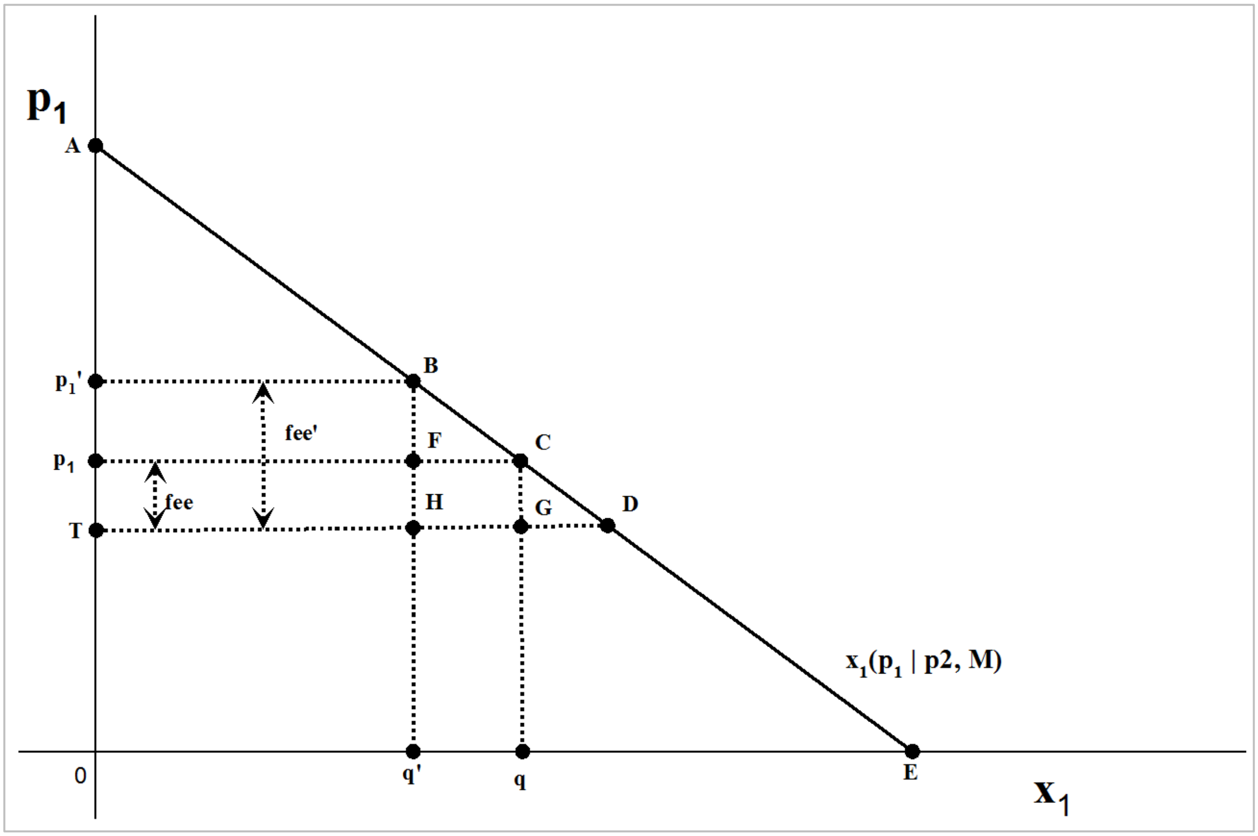

Figure 2.6 – Economic Effects of an Increase in Admission Fee at a State Park.

CHAPTER 3

EMPIRICAL METHODOLOGY

This chapter details the empirical methodology used to achieve the research goals of this study. The first section provides an overview of these goals and the empirical methods employed. The following section presents an overview of the survey instrument and the data used to conduct this analysis. Model specifications and estimation techniques are then described. The results of these estimations are presented in chapter four.

Research Goals

Primary objectives of this study concern the economic effects of Georgia Parks, Recreation, and Historic Sites Division (GAPRHSD) management policies with respect to Georgia State Park visitors and communities proximate to the parks. Specifically, the effects of various admission fee structures on the benefits the parks confer to recreational users and on the economies of nearby communities are considered. Additionally, the possibility of differential price response by certain ethnicities of park visitors is explored. Results should better inform park managers and state policymakers on the likely economic consequences of changes in park admission fee policy.

Methods to achieve the research goals involve modeling visitor behavior with respect to admission fee policy and estimating the effect of different fee structures on park visitation. This requires use of primary data. Time and resource constraints prevented the implementation of a data collection program. Rather, this study uses a previously unexamined portion of a dataset collected by Green, Larson and Whiting from a sample of Georgia state parks in 2010 (Larson 2012). From these data, estimates of visitation response to admission fee policy were modeled, and inferences related to the objectives of this study are made.

Data

This section reviews survey design and its implementation. Data collection details are provided in Larson (2012), with additional information supplied Green (personal communication 2013). On-site data were collected as part of the *Georgia State Parks Diversity Project* (GSPDP) via intercept survey between Memorial Day and Labor Day weekends in 2010 (May 19 – Sept. 6) at Fort Mountain, Fort Yargo and Red Top Mountain State Parks in northern Georgia (Figure 3.1). These parks were selected as representative of northern Georgia state parks, are among the most popular in the state, and provide a wide range of similar recreational activities.

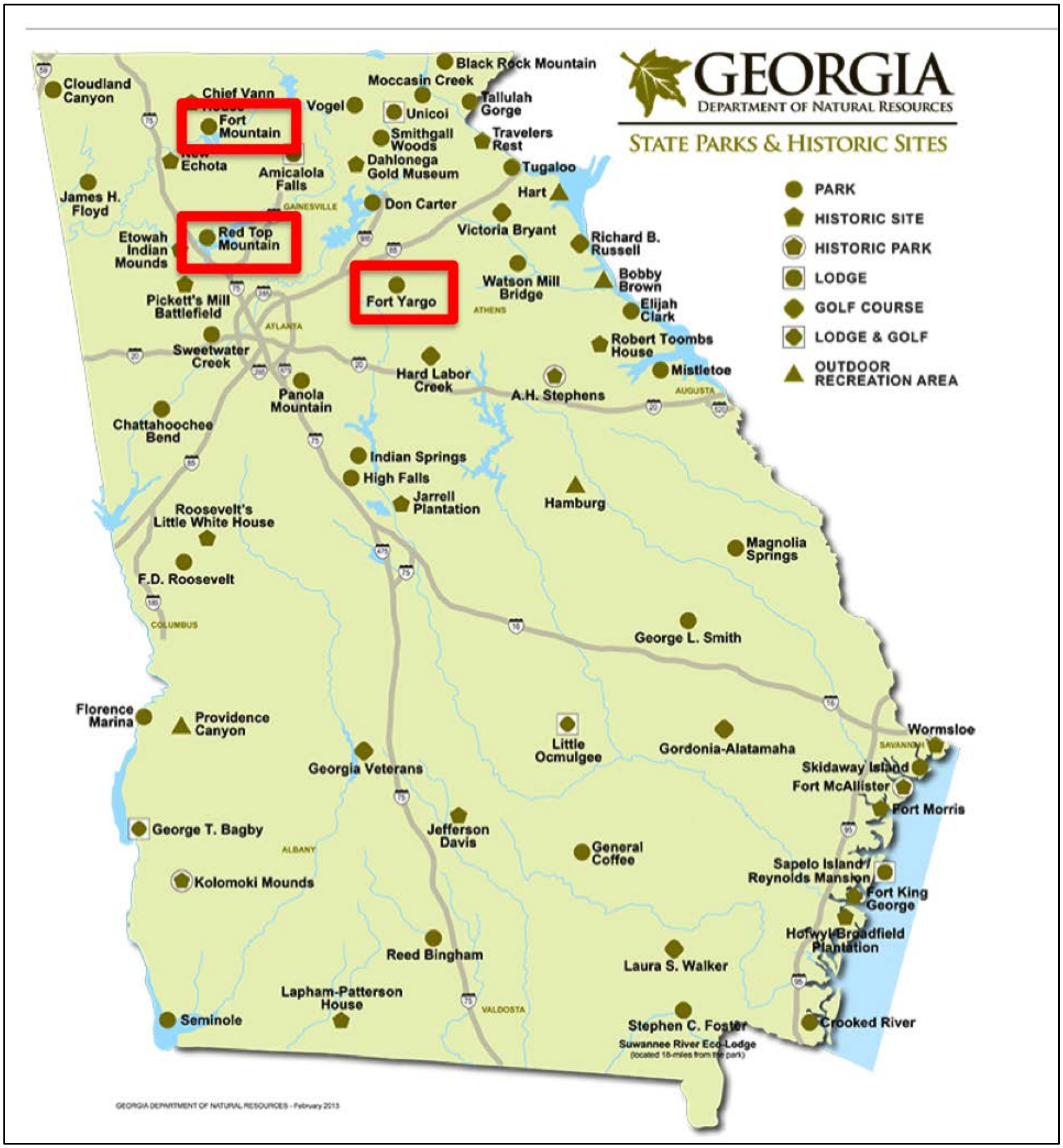

Figure 3.1 – Fort Mountain, Fort Yargo, and Red Top Mountain State Parks (GASPHSD 2013).

A 2010 pilot study pretested the survey instrument; later refinement resulted in five different versions of the questionnaire. Each survey module contained questions related to a specific aspect of park visitation, and common to all versions of the survey were questions related to general respondent characteristics. Survey module one was designed to capture information related to visitors' outdoor recreation preferences; module two, constraints to park use; module three, user fees and place attachment; module four, physical activity preferences; and module five, children's patterns of park use. Questions common to all versions were designed to elicit information on respondents' visitation frequency and socioeconomic characteristics; including gender, age, race/ethnicity, education, household size, income and residential location.

Data collection took place during visitor interviews at popular day use and campground areas in the parks referred to as "recreation hotspots" (Larson 2012). Survey administrators stationed at these locations approached every visitor, and those 18 years of age or older were asked to participate in a brief survey about state park use. Those who agreed were given a version of the survey instrument, which varied randomly and was available in Spanish or English. The days of week and times of day that the interviews took place varied non-systematically (see Table 3.1). Administrators were available on location to answer respondents' questions. The intercept survey response rate was 91.5%, with 1,548 surveys collected at Fort Mountain, 1,700 at Fort Yargo, and 1,944 at Red Top Mountain. There was a slight nonresponse variation in age group and ethnicity between those sampled at day use areas and campgrounds.

Table 3.1 – Sampling Occasions (Larson 2012).

Onsite Survey Sampling Calendar, Summer 2010

State Park	Weekdays	Wednesdays	Weekend Days	Holiday Weekends
Fort Mountain	June 4 July 8 July 16	June 16 July 28 August 4	June 5-6 July 17-18 August 14-15	Labor Day (September 4-6)
Fort Yargo	June 24 July 27 August 12 August 20	June 9 July 14 July 21 August 25	June 19-20 July 10-11 August 28-29	Memorial Day (May 29-31)
Red Top Mountain	June 14 August 6 August 12	June 2 September 1	June 12-13 June 26-27 August 1 August 7-8	Independence Day (July 3-5)

Although the parks included in this sample were believed to be representative of northern Georgia state parks, the generalizability of this study's results is limited due to the nonrandom nature of the sampling frame. Sampling was limited to peak season at specific locations within the parks. Larson (2012) estimates this sampling strategy excluded 20% of park users, however the true number is unknown. The behaviors and preferences of excluded visitors are not represented in the sample. If these are significantly different from the visitors that were interviewed, analyses using this sample may be biased. At the very least, however, these data are representative of summer visitors to Fort Mountain, Fort Yargo and Red Top Mountain State Parks that frequent those parks' most common features. Care should be taken in generalizing results outside of this sampling frame.

Sample Descriptive Statistics

This section describes the sample characteristics of the GSPDP dataset (Larson 2012).[19] Results are presented in Table 3.2.

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[19] The various models employed in this study utilize different subsets of this sample. The descriptive statistics for each may vary accordingly.

Fort Mountain State Park visitors in the sample were overwhelmingly white (78.1%) or Hispanic (16.7%). Although most were on their first (45.9%) or second (20.0%) visit, visitors averaged 3.2 visits to Fort Mountain over 12 months. Mean household income for park visitors was $56,110. The average age was 35 years old, and about three-fourths (75.4%) of visitors took kids to the park. Females represented 55.7% of the sample. Around three-fourths (75.6%) of visitors lived in households with three or fewer other people, with an average household size of 3.6. More than half (53.2%) of the Fort Mountain sample had a college degree.

Slightly more than half (54.3%) of Fort Yargo State Park visitors in the GSPDP sample were white. Hispanic visitors comprise 31.9%. Only 28.6% of the Fort Yargo sample were on their first visit in 12 months; 19.2% were there for the second time. The mean number of annual visits was almost six, about double that of the other two parks. Average household income was $48,400, and the average visitor was 31 years old. Over four-fifths (83.5%) of Fort Yargo visitors brought kids. Females made up 58.6% of the park's sample. The average household size was 4.2. Less than half (44.7%) of respondents had an education beyond the high school level.

About half (50.7%) of Red Top Mountain State Park visitors in the sample were white, and 28.8% were Hispanic. Most were at the park for the first (48.2%) or second (20.1%) time in 12 months, with the mean number of annual trips 3.5.[20] Visitor income averaged $58,400, and the mean age was 31. A little less than three-fourths of Red Top Mountain visitors (71.5%) brought kids. The average household size was almost four (3.9). Females represented 56.1% of the sample, and 57.9% graduated college.

These sample characteristics suggest there may be dissimilarities in visitor populations at each of the parks. For example, it appears that visitors sampled at Fort Yargo were more likely to

[20] Three respondents reported 100 annual trips to Red Top Mountain, which biases upwards the mean number of trips.

be Hispanic than those at the other parks. The proportion of white visitors at Fort Mountain exceeds Fort Yargo by 23.8% and Red Top Mountain by 27.4%. Fort Yargo respondents were relatively less educated, earned less income, and appear to have visited the park more frequently than the rest of the sample.

Pooling data in such situations is sometimes problematic. However, the modeling objectives of this study are better served with the data across the parks pooled. There is precedent for such an approach in the recreation demand literature. Siderelis and Moore (1995) pooled data from several different sites to estimate the net economic value of American rail-trails. Leeworthy and Bowker (1997) pool survey data from multiple sites in the Florida Keys to estimate recreation demand in the region. Loomis (1989) pools data from two national parks to estimate the effects of timber harvesting and road building on fisheries and recreation. Additionally, Larson (2012) uses a pooled approach to assess characteristics, preferences, motivations and benefits of physical activity and recreation at the state parks in this sample with the GASPDP dataset. This study assumes the differences in sample characteristics across parks are insignificant and pools all observations. A pooled multisite model is estimated in a single-site framework with park-specific dummy variables included to account for any between-park heterogeneity that may affect estimates.

Descriptive statistics for the pooled sample are as follows. Average respondent age is 32, and 21.9% are under the age of 18. Whites represent more than half of the sample (60.1%); Hispanics around a quarter (26.2%). Visitors are more female (56.8%) than male, and most are have a college degree (52.3%). Average income is $54,500. Groups average 7.3 people in size, with 3.1 kids. Most respondents visited the park in which they were interviewed four times in the previous year.

Table 3.2 – Summary Descriptive Statistics (n=5192).[21]

Variable	Fort Mountain	Fort Yargo	Red Top Mountain	Pooled Sample
Avg. Age	34.5	31.4	31.4	32.3
Avg. Income	$56,100	$48,400	$58,400	$54,500
% White	78.1	54.3	50.7	60.1
% Hispanic	16.7	31.9	28.8	26.2
% Male	55.7	58.6	56.1	56.8
Avg. HH Size	3.6	4.3	3.9	3.9
Mean # Visits	3.2	6	3.5	4.2
Mean Group Size	6.9	7.6	7.2	7.3
Mean # Kids in Group	2.9	3.7	2.8	3.1
% Completed College	53.2	44.7	57.9	53.0

Individual Travel Cost Model

Deriving the policy-relevant measures to achieve the objectives of this study requires visitor demand to these state parks be modeled. The travel cost method (TCM) allows demand for recreational sites to be modeled either as aggregate market demand through a zonal approach (ZTCM), or as the sum of all site users' individual demands with an individual model (ITCM) (Freeman 2003).[22] The ZTCM is the original form of the travel cost model, the idea for which is attributed to Howard Hotelling, and its development to Jack Clawson (Phaneuf and Smith 2005). The ZTCM approach delineates the visitor population into different zones based on the distance from their residence to the site under analysis. Each zone involves different travel costs to reach the site, and variation in zonal visitation is assumed to be a function of those costs (Haab and McConnell 2002). Demand for each zone is estimated based on this relationship, and those demands are aggregated to reach the site's market demand.

The ZTCM is criticized for its unrealistic assumption of heterogeneity in travel costs and for the use of aggregate socioeconomic characteristics within zonal populations (Loomis and

[21] Note that mean group size appears relatively high because large groups of visitors that traveled in vans and busses are included in the sample.
[22] Although it is possible to model demand for multiple sites with a varying parameters single site approach, random utility models (RUM) are most often used for these purposes.

Walsh 1997). The ITCM is able to avoid these arbitrary restrictions by focusing the unit of consumption on the individual visitor rather than the entire population of visitors from each zone (Freeman 2003). With this approach, site demand (i.e., visitation) becomes a function of individual travel costs, tastes, preferences and socioeconomic characteristics. Market demand, then, is the sum of all the individual demands of site users. This approach is more theoretically consistent with consumer demand theory and has improved the statistical efficiency of travel cost demand modeling (Bowker and Leeworthy 1998).

Although the ITCM provides a richer and more efficient estimation of site demand, its data requirements are considerably greater than the ZTCM. Most often it requires an individual or household survey (Loomis and Walsh 1997). Additionally, the individual focus provides several modeling difficulties, particularly when using survey data collected on-site. State of the art econometric methods, which will be discussed later in this section, are available to address these problems with considerable effectiveness.

The GSPDP data (Larson 2012) are generated from individual responses to an on-site survey instrument, therefore the ITCM is selected for this study. Specifically, a regional demand model is adopted where the state parks sampled are assumed to be representative of northern Georgia state parks (Phaneuf and Smith 2005). This allows the recreation trip data for each park to be pooled and a single-site demand model estimated. Inferences from this model are assumed to be representative of northern Georgia state parks. From this point forward, the ITCM will be referred to as simply the TCM.

TCM Model Specification

As detailed in Chapter Two, the TCM exploits the weak complementary relationship between site visitation and travel costs to model Marshallian demand. The number of trips each consuming unit (e.g., individual, group, family) takes to the site serves as a proxy for quantity demanded, and the necessary costs involved with each trip for price. Variations in their relationship serve as price-quantity market interactions. Additional determinants of demand (e.g., consumer tastes, preferences and socioeconomic characteristics) are included to control for heterogeneity within a sample and approximate *ceteris paribus* conditions. Once these and any other relevant variables are specified, visitor data may be used to estimate Marshallian site demand functions. Measures of economic value and elasticity are derived from these estimates, and inferences concerning park management alternatives suggested. This section details the specification of relevant TCM variables used in this study. The results of the TMC analysis are presented in Chapter Four.

Unit of Consumption

Visitor trip-taking behavior to these state parks in this sample is likely to be determined by the traveling unit, rather than the individual. This assumption is supported by the fact that 96.5% of the sample visited the park with at least one other person, and the sample average group size is seven people. Therefore, the unit of consumption used in this study is the traveling unit or group.[23] This specification remains consistent with the ITCM, as only individual responses to the intercept survey are considered. However, these responses are assumed to be representative of group characteristics and preferences.[24] If needed, individual measures such as consumer surplus per person per trip can be recovered from this specification by scaling results by group size accordingly after estimation.

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[23] Although the individual is the most common unit of consumption in the TCM literature, the group specification adopted in this study is not unique. See, for example, Bowker, Bergstrom and Gill (2007), Englin, Boxall and Watson (1998); and Loomis (1997). In demand theory, it is analogous to household demand.

[24] This type of assumption, where respondent characteristics or preferences are assumed to be representative of the group or household, is common in travel cost studies. Collecting more detailed information about multiple people from one respondent would greatly burden the survey process (Amoako-Tuffour and Martínez-Espiñeira 2012).

Researchers often use alternative specifications for the unit of consumption in travel cost studies, the most common of which is the individual (Bowker, English and Donovan 1996; Grijalva et al. 2002; Hesseln et al. 2004; Hynes and Green 2013; Zawacki, Marsinko and Bowker 2000). This is appropriate when modeling demand for sites or activities where participation and costs are largely personal, rather than social in nature. An alternative specification is the "person trip" (Leeworthy and Bowker 1997; Martinez-Espineira and Amoako-Tuffour 2012). Here, a trip by an individual respondent is scaled by the size of the traveling unit, such that a group of five visiting a site represents five person trips. This specification is helpful in samples characterized by low dispersion in the number of annual trips (Leeworthy and Bowker 1997). Preliminary analysis of the GSPDP sample reveals wide variation in the number of annual group trips, which negates the necessity for this type of adjustment.[25]

Dependent Variable ('*trips*')

As a proxy for quantity demanded, the number of group trips during the previous 12 months to the park where the survey respondent was interviewed was the dependent variable in this TCM analysis.[26] Data were generated from the following question that appeared in the intercept survey:

1. Including today, how many times have you visited Fort Yargo in the past 12 months? ______ visits

Figure 3.2 – Visitation Survey Question (Larson 2010).

Using trips as the dependent variable in a travel cost model can lead to endogeneity in the price variable if opportunity costs are considered in its construction. Specifically, if the amount of time spent on-site is jointly determined with the number of trips taken, there exists overlap

[25] 61.0% of the sample took more than one trip during the previous year.

[26] Again, individual responses are assumed to be representative of group preferences. Also, the current trip is assumed to be representative of all previous trips in the past 12 months. Both of these assumptions are common conventions in the TCM literature.

between the price and quantity variables and price becomes endogenous to the model (Phaneuf and Smith 2005). Most researchers avoid this problem by assuming each visit to be of equal length for every individual, and specify the dependent variable as a recreation experience of a fixed measure of time (Haab and McConnell 2002; Parsons 2003). The survey instrument used in this study does not gather information about the length of time respondents spent at the parks.[27] Therefore, as is common practice in the TCM literature, the dependent variable was specified as a group trip to the site for a fixed length of time (i.e., each respondent is assumed to be a day use visitor on-site for a common number of hours).

Independent Variables

Own-Price (‘*tcost*’)

Remaining consistent with consumer theory, this study included own-price as a primary determinant of group trips. However, as discussed in the section concerning nonmarket goods in Chapter Two, the public good characteristics typical of recreational trips to state parks generally prevent their exchange in markets at explicit prices. That is, the prices associated with recreation at state parks are not readily observable, and where available, generally do not reflect the costs and benefits of providing those services. The TCM model uses more easily observable trip costs as a proxy for own-price to overcome this limitation.[28] A critical assumption with this convention is that individuals react to variation in trip costs similarly as they would the prices of

[27] There is information in the data concerning the interview location. Those which took place at campgrounds are most likely indicative of overnight visitors.

[28] Randall (1994) objects to the use of trip costs as a proxy for own-price, arguing many aspects of travel costs are chosen by the individual rather than taken as a given. His objection is as follows. For the most part, individuals lack the ability to influence market prices. With travel costs, this may not be the case. For example, as residential location is a major contributing factor to trip costs, if an individual chooses to live in an area proximate to a site and then proceeds to take more trips than she would have otherwise, her travel costs to that site are affected by residential location decision. If this is the case, her travel costs are both subjective and endogenously determined. In these situations, the basic premise of travel costs as a proxy for the price of recreational trips fails. However, despite this and similar criticism, the TCM has remained commonplace in the recreation demand literature for over half a century (Phaneuf and Smith 2005).

market goods. If recreational trips to state parks are an ordinary good, this assumption means that an increase in trip costs will result with individuals taking fewer trips.

Full trip costs (i.e., own-price) in TCM modeling typically include travel-related expenses and the opportunity costs associated with time spent traveling (Freeman 2003).[29] Travel-related expenses are most often limited to transportation costs and the various fees visitors face in reaching a recreation-site, however some studies include costs for additional expenses incurred while in transit (Parsons 2003). Zawacki, Marsinko and Bowker (2000), for example, include two variants in their price variable construction – one with food, lodging and other various trip expenses; the other with only the necessary costs of travel. The opportunity cost component of trip costs is detailed in the next section of this chapter.

Assuming automobile travel, the measurement of transportation expenses is a relatively straightforward calculation of distance traveled and vehicle operating costs. Average per-mile operating expenses for the cost component of full-trip costs are typically sourced from the United States Department of Transportation (DOT) or AAA published studies. These include both fuel costs and vehicle maintenance expenses. The round-trip road distance between each respondent's origin and the site visited can be estimated with survey data, or the respondent can be asked directly for the distance traveled. This represents the distance component of full-trip costs. The product of this and per-mile operating expenses, along with the sum of any other necessary trip-related expenses the researcher decides relevant (e.g., entrance or guide fees) results in the transportation expenses component of the price variable (Parsons 2003).

The distance component of transportation expenses in this study is obtained from the GSPDP visitor survey, which provides information on both respondents' self-reported distances

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[29] As noted previously, on-site time is assumed to be of fixed length and identical for every group. Therefore, the opportunity costs related to on-site time are not relevant to TCM models.

and zip codes. Parsons (2003) notes that perceived costs are often different from the actual costs that consumers face; and that individuals most often make decisions based on subjective cost perceptions. That is, visitors make trip decisions based on how much they think the trip will cost rather than its actual cost. Following this logic, visitors' self-reported distance may better represent behavioral considerations than an objective measure of distance derived from residential zip code information. Therefore, reported distance is the preferred measurement of the distance component of full-trip costs in this study. It should also be noted that the reported distance question in the visitor survey is framed in terms of miles traveled to reach the state park *today*, which may mitigate problems associated with multi-purpose trips discussed later in this section.

Survey modules two and three contain the reported distance question. Observations taken from those surveys are used in this TCM analysis. For observations missing responses to this question (2.2% of observations in modules 2 and 3), distance was imputed from zip code data using the commercially available PC Miler software (streets version 17). The software is used to calculate one-way road distance between the centroid of each respondent's residential zip code and the state park where interviewed.

Per-mile vehicle operating costs are the second component of travel-related expenses. Estimates for these are usually sourced from DOT or *AAA* publications (Rosenberger and Loomis 1999; Layman, Boyce and Criddle 1996; Bowker, Bergstrom and Gill 2007), however researchers sometimes use values for these derived from survey data. For example, Leeworthy and Bowker (1997) calculated sample average per-mile costs from an expenditure survey taken by visitors to the Florida Keys. Similarly to the previous discussion of reported distance, respondent-reported vehicle costs may be a more theoretically consistent measure of these costs in a behavioral context. As noted previously, the survey instrument used in this study gathered no information concerning respondents' expenditure information. *AAA*'s 2010 average vehicle operating cost of $0.1674 per mile is used instead (AAA 2010).[30]

Opportunity Costs ('*tcostopp'*)

Time is a scarce commodity. This, and the notion that time spent traveling to a recreational site could instead be allocated to other utility-producing purposes, implies that time is valuable (Freeman 2003). Benefits of the next best opportunity to which time could be allotted is referred to as the cost of time, or the opportunity cost of a trip (Parsons 2003). These costs represent the second component of full trip expenses.

Economic theory suggests opportunity costs should be valued positively and included in a demand model. The travel cost literature varies widely in the valuation of these costs. Under the assumption that time spent working may be traded for recreation at the margins, time costs are commonly valued at some portion of hourly wages (Phaneuf and Smith 2005). This assumption is predicated on the idea that individuals adjust the number of hours allocated to work to the point where their marginal wage is equal to the benefit gained from an additional hour of recreation (Parsons 2003).

Realistically, this situation is unlikely for many individuals. Those with fixed work schedules, salaries and vacation allotments may not be capable of exchanging labor for recreation. Persons outside of the workforce (e.g., students, retirees, stay-at-home parents and the unemployed) face similar restrictions. For these groups, the marginal cost of time is not directly related to their wage rate. Leeworthy and Bowker (1997) investigated this issue by querying survey respondents on their ability to earn income rather than visit the Florida Keys, finding

[30] This estimate includes the costs of gas, oil, tires and maintenance for the average sedan, and is consistent with other studies in the travel cost literature.

around 85% cannot do so. Ovaskainen, Neuvonen and Pouta (2012) found similar results. Two-thirds of their sample was unable to make such exchanges, most noting the next best use of their time to be another leisure activity or some type of unpaid household labor. Additionally, they found 35% of their sample considered travel time a trip benefit, and only 6% considered it a burden.

Despite these and similar objections, valuing opportunity costs at a fraction of the hourly wage rate is common practice in the travel cost literature.[31] However, there exists little agreement among researchers concerning the appropriate percentage to use. Most provide several different specifications, ranging from zero to the full value of hourly wages.[32] This allows readers to see the effects of various time values. For example, Zawacki, Marsinko and Bowker (2000) use proportions ranging from zero to one-half of the household wage rate; Bowker, Bergstrom and Gill (2007) from zero to one-quarter. Bowker et al. (2009) use one-third of the household wage rate and the federal minimum wage in their time cost specification. Rosenberger and Loomis (1999) test their models for goodness of fit using several opportunity costs ranging from zero to the full wage rate, and find one-fourth optimal. Several researchers estimate time costs directly from survey data (Martinez-Espineira and Amoako-Tuffor 2012; Englin and Shonkwiler 1995; Feather and Shaw 1999). However, Phaneuf and Smith (2005) note these efforts most often result in estimates falling within the same range as other arbitrary methods (e.g., fractions of the wage rate).

Opportunity costs are likely to vary by individual, with their true value known only by that person. Unless estimated otherwise, the choice of opportunity cost value is ultimately an ad-

[31] Freeman (2003) notes that while most surveys ask respondents about pre-tax wage rate, after-tax rates are a more theoretically appropriate measure.
[32] It should be noted, however, Feather and Shaw (1999) show individuals with fixed workweeks may actually value leisure time at a rate higher than the hourly wage.

hoc decision made by the researcher. Acknowledging the problematic nature of common wage-based time costs, this study estimates models with and without these costs. Following Bowker et al. (2009), group opportunity costs are valued at the 2010 federal minimum wage and scaled by the number of people in the traveling group. This specification assumes that each member of the traveling unit values time at an equal and common rate.

The inclusion of opportunity costs in the travel costs variable specification increases the values this variable takes. This results in more negative travel cost parameter estimates, thereafter estimated elasticities take smaller values in absolute value and consumer surplus estimates are higher (Freeman 2003). Thus, the zero time cost model should be considered a conservative estimate of visitor demand, and model specifications including time costs should be considered upper bound estimates.

Own-Price Variable Construction

Following Rosenberger and Loomis (1999), the travel cost proxy for the own-price variable in this study ('*tcost'*) was constructed using Equation (3.1). Reported distance is doubled to obtain the round-trip distance each respondent traveled. It is multiplied by $0.1674, the *AAA* 2010 average per-mile automotive operating cost, and summed with the park admission fee to arrive at the trip-related portion of the travel cost variable. [33] For the models without time costs, this is the complete construction of the own-price variable and represents the full travel costs of a group trip.

Construction of the own-price variable for models assuming a positive value for time ('*tcostopp'*) requires additional calculations. Opportunity costs are valued at $5.15 per hour, the 2010 Georgia minimum wage. Following Zawacki, Marsinko and Bowker (2000), the distance

[33] Admission fees at all Georgia State Parks are $5.00 per vehicle. Note that during the sample frame (Memorial Day 2010 to Labor Day 2010), park admission fees were not charged on Wednesdays. The 'fee' level for respondents that visited on these days is zero. Additionally, visitors can purchase annual admission passes for a $50.00.

each group traveled to reach the park is divided by an average speed of 50 mile per hour then doubled, resulting in an estimate of round-trip travel time. Travel time is multiplied by $5.15 and scaled by the number of adults in the traveling unit to arrive at an estimation of time costs for each group trip. This is summed with trip-related expenses and the park admission fee to complete the price variable specification for the opportunity cost models.

$$\boldsymbol{TC_i = ('tcdist'_i)(2)(0.1674) + fee + 5.15 * grpsizeadj * (\frac{2*tcdist_i}{50})}, \quad (3.1)$$

where

TC_i = full trip costs for visitor i ,
$tcdist_i$ = distance visitor i traveled to reach the park visited,
fee = park admission fee, and
grpsizeajd = number of adults in traveling party.

Several other specifications of opportunity costs were considered in TCM model estimations. These used a value for those costs based on the estimated hourly household wage, or some fraction thereof. Following Loomis (1997), average household wage was approximated by dividing the sample average household income ($55,337) by 2000 – the estimated total number of hours worked by each individual in the household every year. This resulted in an estimate for the average household hourly wage of $27.69.

Substitute Site (‘*subsite’*)

Consumer theory suggests demand for a commodity is a function of its own-price, income, and the price of related goods and services. When the real price of an ordinary commodity increases, theoretically, individuals are expected to shift consumption towards related commodities that serve as substitutes. With respect to recreation at a state park, an increase in the cost of park access, be it through user fees or travel expenses, is likely to cause visitors to shift trips to alternative locations offering similar recreational opportunities (e.g., recreational rail-trails, as discussed in Chapter Two). These types of substitutes exist for most recreational sites, and a properly specified demand function will model this type of behavior (Phaneuf and Smith 2005).

The treatment of substitute sites is an unresolved topic in the travel cost literature. There exist a number of different methods for modeling substitution; none of which have been proven superior. It is, however, widely understood that failure to account for this behavior in a demand model specification leads to biased results. Specifically, the own-price parameter will be biased toward zero, leading to more inelastic price response estimates and higher consumer surplus estimates (Freeman 2003). Additionally, the own-price parameter will exhibit higher variability, which complicates hypothesis testing and weakens the inferences that may be drawn from the data (Bowker et al. 2009).

Construction of substitute site variables usually involves measuring the travel costs associated with one or more alternative sites. These are places nearby offering similar amenities or recreational opportunities, frequently visited by the sample, and/or locations the analyst expects to be likely substitutes for the site under analysis. If specific sites can be identified, substitute site variables are constructed similarly to the model's proxy variable for own-price. Often resource constraints prevent the identification of specific substitute locations. Surveys may be limited in length and respondents limited in attention to gather this information. In these situations, a second-best alternative is to query the sample on the availability and their use of substitute sites. A binary variable is then used to identify those who exhibit substitution behavior.

Various treatments of the substitute site variable are found in the recreation demand literature. In their analysis of National Forest demand, Bowker et al. (2009) assumed the most proximate national park to each individual's residence that was *not* visited a likely substitute. Betz, Bergstrom and Bowker (2003) considered two existing rail-trails in Georgia likely substitutes for a proposed new trail in the state. Layman, Boyce and Criddle (1996) followed a similar strategy in their study of salmon sport fishing in Alaska, identifying the next closest rivers offering similar fishing experiences as substitutes for the river under analysis. Studies using binary variables for substitution behavior include Bergstrom, Bowker and Gill 2007; Leeworthy and Bowker 1997; and Teasley, Bergstrom and Cordell 1994. Kriesel, Landry and Keeler (2005) used a substitute variable that takes the value of zero if the respondent did not exhibit substitution preferences, and takes a value equal to the number of visits by which the respondent would shift demand if substitution preferences were present. Occasionally researchers opt to forgo the use of a substitute variable altogether. This is common when considering sites that may be substitutes for each other, or those offering very unique amenities (Englin and Shonkwiler 1995; Siderelis and Moore 2005).

The inclusion of specific sites as substitutes in a model assumes that individuals in the sample are cognizant and make use of those sites when exhibiting substitution behavior. It is also possible, however, that visitors shift trips to locations or activities unknown to the analyst if costs associated with the current site increase. As well, individuals may cancel recreation activities entirely rather than travel to substitute destination (Phaneuf and Smith 2005). Ultimately, only individuals themselves know the sites or activities to which they substitute demand. Unless the survey instrument captures this information directly, researcher-defined substitute sites are inherently arbitrary. However, consumer theory suggests that demand models include a substitute variable, so choices concerning these sites/definitions must be made regardless of how imperfect they may be. Following Teasley, Bergstrom and Cordell (1994) and Leeworthy and Bowker (1997), this study controlled for substitution with an indicator variable. It took the value of one if the respondent believes there to be substitutes available for the state park visited, and a value of zero if not.

The dummy variable '*subsite*' was constructed from visitor responses to different Likert-scale survey questions that appeared in the survey modules:

6. Please indicate whether each of the following obstacles or barriers is a reason that **KEEPS YOU** from visiting Fort Yargo as often as you would like. **(Circle ONE response for each item.)**

Obstacle	Not a Reason		Minor Reason		Major Reason
I prefer to recreate elsewhere (where?): ___________________________	1	2	3	4	5

Figure 3.3 – Substitute Question, Survey Module Two (Larson 2012).

10. Please indicate whether you DISAGREE or AGREE with the following statements concerning your opinion of Fort Yargo State Park. **(Circle ONE response for each statement.)**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
There are other places nearby where I can easily do the things I do at Fort Yargo.	1	2	3	4	5

Figure 3.4 – Substitute Question, Survey Module Three (Larson 2012).

Responses of two or higher on the question found in survey version two (Figure 3.3**)** and of four or five in version three (Figure 3.4) were expected to indicate available substitutes are considered by respondents. The '*subsite*' variable took a value of one for these responses, zero otherwise. This approach is not a perfect measure of substitution. The responses are taken from different survey questions, which, although similar in nature, are likely to capture different types of substitution preferences. Although this approach does not directly model the price of substitute sites, it is expected to capture visitor preferences concerning site substitution, albeit in an imperfect way.

Visitor Socioeconomic Characteristics

Recreation demand models usually include a set of socioeconomic variables to control for heterogeneity within samples. These are most often modeled as demand shifters, however they may also be included as price interaction terms, as is the case with a varying parameters approach. Specific variables differ by study, but usually some combination of income, age, gender, household size, education and/or ethnicity are included (Parsons 2003).

Income (‘*income*’)

As discussed in chapter two, Marshallian demands are functions of prices and income. Accordingly, income is included in this model. It is measured in $1000’s, and derived from responses to the following survey question:[34]

14. Please indicate your total household income range before taxes last year. **(Check ONE box.)**		
☐ $25,000 or less	☐ $25,001 to $50,000	☐ $50,001 to $75,000
☐ $75,001 to $100,000	☐ $100,001 or more	☐ Refuse to answer

Figure 3.5 – Household Income Survey Question (Larson 2012).

As is common in the TCM literature, responses to this question are converted from interval to continuous data by assigning each response to the midpoint of reported income category (e.g., a response of $75,001 to $100,000 is recorded as $87,500).[35] Following Haab, Whitehead and McConnell (2000) and Kim, Shaw and Woodward (2007), missing income observations (7.5% of the sample) are replaced with a value imputed from an auxiliary log-linear ordinary least squares regression of reported income on ethnicity, age, education and gender.[36] Imputed values are transformed using the same process as reported values. Slightly over 20% of the sample refused to answer this question.[37]

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[34] Household and traveling group are assumed similar enough to proxy group income with household income.
[35] This procedure introduces measurement error into the income variable, which is not controlled for in this analysis.
[36] Regression results: ln(income) = 10.88 + 0.56(white) - 0.30(hisp) - 0.07(age) + 0.002(age2) - 0.00001(age3) + 0.54(college) + 0.10(male); $R^2 = 0.25$
[37] A dummy variable indicating observations where income was imputed proved insignificant in preliminary models, confirming the expectation that this income replacement procedure does not lead to significant biases in this sample. The distribution of income for these respondents may not be systematically different from the remainder of the sample.

Ethnicity (‘*white,*’ ‘*hisp,*’ ‘*black,*’ ‘*asian,*’ ‘*amindian,*’ and ‘*other*’)

One of the primary research objectives of this study is to determine if user fees have differential effects on state park visitors of different ethnicity. Leeworthy and Bowker (1997) find evidence of this in visitors to the Florida Keys. Ethnic dummy variables are constructed to examine this issue in the sample of northern Georgia state park visitors. Data for these variables are taken from responses to the following survey question:

10. What is your race/ethnicity? (**Check ALL that apply.**)

☐ White or Caucasian ☐ Black or African American ☐ American Indian

☐ Hispanic/Latino (specify origin): ☐ Asian (specify origin): ☐ Other (specify origin):

______________________________ ______________________________ ______________________________

Figure 3.6 – Ethnicity Survey Question (Larson 2012).

Again, individual responses are assumed to be representative of the group. Replies indicating multiple ethnicities from the “Other (specify origin)” category assigned to the ethnicity first reported. For example, a response of “Black-Asian” is coded as Black (Larson 2012). The travel cost dataset is 66.6% White; 2.7% Hispanic; 7.3% Black; 2.5% Asian; 1.2% American Indian; and 1.7% of those that responded reported ethnicities not falling into any of these categories. Dummy variables for each category were created.

In order to assess variation in price elasticity and consumer surplus estimates due to respondent ethnicity, a varying parameters approach to the TCM specification is adopted (Bowker et al. 2009; Bowker and Leeworthy 1997; Hesseln, Loomis and Gonzales-Caban 2004). With this approach, models are estimated with ethnicity dummy variables and dummy-travel cost interaction terms. The dummy variables act as slope shifters, indicating differential trip demand between ethnicities. Slope interaction terms allow the price relationship to vary based on ethnic characteristics. The effect of ethnicity on consumer surplus and price elasticity may be derived from the interaction term coefficients (Zawacki, Marsinko and Bowker 2000). The research question concerning differential price effects between ethnicities can be addressed using these results.

Education (‘*college*’)

Education level is expected to be a determinant of park visitation. In a meta-study of park demand, Doucouliagos and Hall (2010) find visitation and education positively correlated. Other researchers find mixed results. Layman, Boyce and Criddle (1996), for example, discover an inverse relationship between the two. Other researchers find education insignificant in their models, possibly due to collinearity with income (Martinez-Espineira and Amoako-Tuffor 2012; Ellingson and Seidl 2007). Following Betz, Bergstom and Bowker (2003), this study uses a dummy variable to model visitors’ education level that takes the value of one if the individual graduated college, zero otherwise. Data is acquired from the following survey question:

12. What is the highest level of education you have completed? **(Please check ONE response.)**
☐ Some high school ☐ High school or GED ☐ College, tech. school, or other advanced degree

Figure 3.7 – Education Survey Question (Larson 2012).

Age (‘*age*’)

Various age groups are likely to use Georgia state parks for different recreational purposes. Younger visitors may be more attracted to vigorous recreational activities, such as swimming and mountain biking. Older visitors may more enjoy the scenery and relaxation offered at parks. These types of heterogeneous preferences may induce different demands for these age groups. An age variable is included in the model to control for these types of effects. Data is obtained from a question directly asking respondents their age.[38]

[38] Note that the sampling frame includes only visitors over the age of 18. Responses indicating ages less than 18 are excluded from this analysis.

Gender ('*male*')

Gender is a common socioeconomic variable used in demand studies, as participation in certain recreational activities is often biased more towards one gender than the other. Bowker et al. (2009), for example, use a gender dummy variable to explain recreation at National Forests. Bowker, Bergstom and Gill (2007) and Grijalva et al. (2002) both use a gender variable in their outdoor recreation demand studies. Male visitors at northern Georgia state parks may prefer to use the parks more often for physical activities and outdoor sports. Females may frequent the parks more often for alternative reasons, such as group activities and entertaining children. Including a gender indicator variable ('*male'*) is expected to control for effects such as these. It takes the value of one if the respondent is a male, zero if female.

Group Size ('*grpsize*')

As noted previously, visitation decisions concerning northern Georgia state parks are likely the result of group, rather than individual choices. Therefore, group size is expected to be an important demand determinant. All else equal, larger groups are likely to demand less visits, as these types of groups generally incur greater expenses when traveling. There are practical reasons to include a group size variable as well. Studies using the household or traveling group as the unit of consumption often need to include this variable in order to scale group estimates to individual level for aggregation (Bowker, Bergstom and Gill 2007). This is not necessary for individual unit of consumption specifications (Layman, Boyce and Criddle 1996). This study includes group size as a covariate for these reasons.

Visitor Tastes and Preferences

Visitors may also have heterogeneous tastes and preferences that affect trip demand. Researchers often include covariates in demand models to account for these differences. Hynes and Greene (2013), for example, include an indicator variable for environmental organization membership to explain visits to a coastal trail in Ireland. Layman, Boyce and Criddle (1996) ask visitors their opinion regarding motorboats, which they believe affects demand for Chinook Salmon fishing in Alaska. Studies valuing larger sites often incorporate activity variables to control for variation in demand between visitors there for different reasons (Bowker, Bergstrom and Gill 2007; Bowker et al. 2009; Siderelis and Moore 1995). Other specifications of taste and preference variables are abundant in the recreation demand literature.

Annual Admission Pass Holder (‘*annpass’*)

Whether or not the group holds an annual admission pass to the parks is expected to affect demand. All else equal, these groups most likely visit the park more frequently than other groups. In their study of Jekyll Island visitors, Kriesel, Landry and Keeler (2005) estimate models with and without season pass holders to assess for differences between the two groups. In the sample used for this study, annual pass information is available only for respondents presented with the third survey module. A dummy variable (‘*annpass’*) is constructed that takes the value of one if the respondent purchased a pass, zero if not. The affect of this variable on trip demand is assessed using data generated by survey module three.

Free Admission Day Visitors (‘*freeday*’)

In 2010, GASPHSD offered free admission to all state parks on Wednesdays. Almost 16% of the GSPDP sample were interviewed on a Wednesday. These groups may have different demands for park trips than those paying daily admission fees. An indicator variable (‘*freeday*’) is included in the models to control for possible heterogeneity in demand preferences. It takes the value of one if the group visited on a Wednesday, zero otherwise.

Table 3.3 –Variable Summary.

trips	Annual number of group trips taken to the park.
tcost	Travel costs: round-trip distance to the park multiplied by $0.1674/mile + $5 admission fee; no opportunity costs.
tcostopp	Travel costs plus time costs valued at the 2010 Georgia minimum wage ($5.15), scaled by the number of adults in the group and travel time.
subsite	Substitute site dummy variable indicating whether or not respondent feels there are available substitutes for the park visited.
income	Annual household income ($1000's).
hisp	Hispanic dummy variable = 1 if respondent is Hispanic, = 0 otherwise.
black	Black dummy variable = 1 if respondent is Black, = 0 otherwise.
age	Respondent's age.
college	Education dummy variable, = 1 if respondent graduated college, = 0 otherwise.
male	Gender dummy variable = 1 if respondent is male, = 0 otherwise.
FM	Dummy variable for Fort Mountain visitors = 1 if surveyed at Fort Mountain, = 0 at anther park.
FY	Dummy variable for Fort Yargo visitors = 1 if surveyed at Fort Yargo, = 0 at anther park.
RTM	Dummy variable for Red Top Mountain visitors = 1 if surveyed at Red Top Mountain, = 0 at another park.
grpsize	Size of traveling group.
freeday	Dummy variable = 1 if respondent visited park on a Wednesday, = 0 otherwise.
annpass	Dummy variable = 1 for annual pass holders, 0 otherwise.

Travel Cost Method Model Specification and Functional Form

On-site surveys allow researchers to obtain a sample consisting entirely of site users, as every respondent is an active visitor. Acquiring a sample with a reasonable number of site users through at-large survey methods is considerably more difficult, especially if the site under analysis has limited visitation (Parsons 2003). On-site samples, however, are subject to a number of unique data issues. The number of observed trips is a non-negative integer, and is both truncated at zero and endogenous stratified. These data characteristics are problematic if using trips as a dependent variable in demand models, as is the case with the TCM.

Zero truncation and integer non-negativity refer to the positive and discrete distribution of the quantity of trips taken by each respondent. Each has visited the site at least once (the trip when interviewed), so the distribution of trips begins at one. The number of trips taken is also a count of whole numbers, so it is recorded in an integer rather than continuous distribution (Parsons 2003). Respondents cannot record zero or a negative number of trips, neither can they report taking fractions of trips. Hence the data are a zero-truncated count of positive whole numbers.

Population estimates and inferences derived from site demand models are biased when these characteristics are unaccounted for (Creel and Loomis 1990). The preferences of those who do not make use of the site (nonparticipants) are not represented in on-site samples. Demand is estimated using only participant data. Estimated intercepts are biased upwards in this case, indicating higher demand than if nonparticipants were included in the sample. Variable parameter estimates are also biased, as are any calculations made using their values (Parsons 2003).

Count data models account for non-negative integer data, thereby improving statistical efficiency when estimating models using on-site data (Loomis 2003). These models specify the dependent variable (number of trips taken) as a series of discrete choices, which accounts for distributions that are positive and non-continuous. The dependent variable mean is assumed to be a function of model covariates (Haab and McConnell 2002). The Poisson distribution lends itself to this approach. Following Haab and McConnell (2002, equations 7.13, 7.14 and 7.17), the basic Poisson probability density function for a single site recreation demand model is given by:

$$\Pr(\boldsymbol{r_j}|\boldsymbol{x_j},\boldsymbol{\beta}) = \frac{e^{-\lambda_i}\lambda_j^{r_j}}{r_j!}, j = 0,1,2,\dots,N, \tag{3.2}$$

where

$\boldsymbol{r_j}$ = number of trips taken by individual *j*,

$\boldsymbol{x_j} =$ the set of model explanatory variables,

$\boldsymbol{\lambda_j} = \exp(\boldsymbol{x_j \beta})$ = the mean *and* variance of the distribution, and

$\boldsymbol{\beta}$ = model coefficients to be estimated.

The parameters of this specification are estimated with a Poisson likelihood function, which determines the probability of observing the number of trips taken by each respondent in the sample:

$$l(\boldsymbol{\beta}|\boldsymbol{x_j},\boldsymbol{r_j}) = \prod_{j=1}^{T} \frac{\exp(-\exp(\boldsymbol{x_j\beta}))(exp(\boldsymbol{X_j\beta})\boldsymbol{r_j})}{\boldsymbol{r_j}!}, \tag{3.3}$$

and the estimated log-likelihood function is:

$$\ln(l(\boldsymbol{\beta}|\boldsymbol{x_j},\boldsymbol{r_j}) = \sum_{j=1}^{T}[-e^{\boldsymbol{x_j\beta}} + \boldsymbol{x_j\beta r_j} - \ln(\boldsymbol{r_j}!)] \tag{3.4}$$

Equality of the conditional variance and mean under the Poisson distribution is often too restrictive for recreational datasets. Visitation at recreational sites is often characterized by a small number of high-frequency visitors, as well as a large number of individuals who take very few trips. This results in a condition where the sample mean number of trips is exceeded by its variance – a form of heteroscedasticity referred to as overdispersion. Forcing the Poisson assumption of equidispersion in mean and variance on this type of data subjects a model to misspecification (Englin and Shonkwiler 1995). The Poisson estimator is still consistent, but the standard errors are underestimated, leading to problematic hypothesis testing where the chances of Type I error are increased (i.e., a true null hypothesis falsely rejected) (Haab and McConnell 2002).

Negative binomial models relax the equidispersion constraint by including an additional parameter ($\propto$) to capture the unobserved differences in sample visitation frequency. Different parameterizations for $\propto$ exist, Cameron and Trivedi's (1998, p.71, equation 3.26) gamma distributed NEGBINII is common (subscript *j* suppressed):

$$\Pr(r|\boldsymbol{x},\boldsymbol{\beta}) = \frac{\Gamma(\boldsymbol{r}+\propto^{-1})}{\Gamma(\boldsymbol{r}+1)\Gamma(\propto^{-1})}\left(\frac{\propto^{-1}}{\propto^{-1}+\boldsymbol{\lambda}}\right)^{\propto^{-1}}\left(\frac{\boldsymbol{\lambda}}{\propto^{-1}+\boldsymbol{\lambda}}\right)^{r}, \qquad (3.5)$$

where

$\propto \geq 0$, and is the overdispersion parameter,

$\boldsymbol{\lambda}$ = distribution mean, defined as previously ($\exp(\boldsymbol{x_i\beta})$);

$Var(\boldsymbol{r}|\boldsymbol{x},\boldsymbol{\beta}) = \boldsymbol{\lambda}(1+\propto\boldsymbol{\lambda})$.

If $\propto= 0$, no overdispersion exists in the data, and Equation (3.4) collapses to the standard Poisson distribution. Values of $\propto > 0$ indicate overdispersion, and a negative binomial model is appropriate (Haab and McConnell 2002).

An adjustment can be made to the Poisson and Negative Binomial estimators to correct for endogenous stratification (Shaw 1988; Englin and Shonkwiler 1995; Martinez-Espineira and Amoako-Tuffour 2008). The Poisson becomes:

$$\Pr\left(\boldsymbol{r_j}|\boldsymbol{x_j},\boldsymbol{\beta}\right) = \frac{e^{-\lambda_j}\lambda_j^{r_j}}{r_j!}\left(\frac{1}{1-e^{-\lambda_j}}\right), j = 0,1,2,\ldots,N,$$

and the negative binomial (subscripts omitted):

$$\Pr(r) = \frac{\Gamma(\boldsymbol{r}+\propto^{-1})}{\Gamma(\boldsymbol{r}+1)\Gamma(\propto^{-1})}(\propto\lambda)^{r}(1+\propto\lambda)^{-(r+\propto^{-1})}.$$

Endogenous stratification, or avidity bias, is another characteristic of on-site samples that can cause problems in demand estimation. This refers to a choice-based sampling strategy where respondents are stratified according to a feature endogenous to the sample (Martinez-Espineira et al. 2006). The choice to participate (visit) in an on-site sample is made by each respondent, and the probability of inclusion in the sample is directly related to participation. Therefore, an on-site sample is endogenously stratified according to a decision made by respondents (Haab and

McConnell 2002). For example, an individual who visits Fort Mountain State Park four times during the summer is four times more likely to be interviewed by researchers than someone who visits only once.

Estimators that fail to account for endogenous stratification in on-site samples yield biased coefficient estimates, as the preferences for avid visitors are overrepresented. These individuals are generally less price sensitive than less frequent visitors, resulting in more inelastic sample demands. Consumer surplus estimates will be biased upwards in this case, and site demand will be overstated (Loomis 2003).

Shaw (1988) developed a correction procedure to address the problem. He shows avidity bias proportional to the number of trips taken, and develops a Truncated Stratified Poisson estimator that accounts for the bias. Given $r_j = r_j^*$ if $r_j^* > 0$, if the population density function for individual j is $f(\boldsymbol{r}_j^*|\boldsymbol{x}_j)$, the relevant density function in an on-site sample is:

$$f(\boldsymbol{r}_j|\boldsymbol{x}_j) = \frac{\boldsymbol{r}_j\, f(\boldsymbol{r}_j|\boldsymbol{x}_j)}{\sum_t^{\infty} t * f(t|\boldsymbol{x}_j)} = \frac{r_j}{E(\boldsymbol{r}_j|\boldsymbol{x}_j)} * f(r_j|x_j). \tag{3.6}$$

The first term on the right hand side is the weight that corrects an on-site observation for endogenous stratification and zero truncation. Shaw uses this result to adjust for the probability of being included in an on-site sample using a Poisson estimator:

$$\Pr(\boldsymbol{r}_j|\boldsymbol{x}_j) = \frac{e^{-\lambda_j} \boldsymbol{\lambda}_j^{(r_j-1)}}{(\boldsymbol{r}_j-1)!}, \tag{3.7}$$

where

$$E(\boldsymbol{r}_j|\boldsymbol{x}_j) = \boldsymbol{\lambda}_j + 1, \text{ and}$$

$$Var(\boldsymbol{r}_j|\boldsymbol{x}_j) = \boldsymbol{\lambda}_j\ .$$

Subtracting one from the reported number of visits ($\boldsymbol{r_j}$) for each observation allows the standard Poisson model to be run with the on-site data, and unbiased population parameter estimates will result. That is, the correction weight is $\boldsymbol{w_j} = (\boldsymbol{r_j} - 1)$ (Shaw 1988; Loomis 2003).

Englin and Shonkwiler (1995) extend this correction to the negative binomial model, resulting in the Truncated Stratified Negative Binomial (TSNB) estimator (subscripts omitted):

$$f(\boldsymbol{r}|\boldsymbol{x}) = r\frac{\Gamma(\boldsymbol{r}+\propto^{-1})\propto^{\boldsymbol{r}}\boldsymbol{\lambda}^{\boldsymbol{r}-\boldsymbol{1}}[1+\propto\boldsymbol{\lambda}]^{-(\boldsymbol{r}+\propto^{-\boldsymbol{1}})}}{\Gamma(\boldsymbol{r}+1)\Gamma(\propto^{-\boldsymbol{1}})}, \qquad (3.8)$$

where

$E(\boldsymbol{r}|\boldsymbol{x}) = \boldsymbol{\lambda} + 1 + \propto \lambda$, and

$Var(\boldsymbol{r}|\boldsymbol{x}) = \boldsymbol{\lambda}(1+ \propto +\propto \boldsymbol{\lambda} +\propto^{\boldsymbol{2}} \boldsymbol{\lambda})$.

The TSNB procedure corrects for endogenous stratification by adjusting the number of trips taken downward to make an on-site sample more representative of the population. It is a common approach in more recent recreational demand studies (Loomis 2003; Hesseln, Loomis and Gonzalez-Caban 2004; Martinez-Espineira et al. 2006). Several researchers have explored the reliability of TNSB estimates by comparing model results with at-large samples not subject to on-site data constraints. Zawacki, Marsinko and Bowker (2000) found the models tend to understate consumer surplus estimates; Yen and Adamowicz (1993) found the opposite. Martinez-Espineira et al. (2006), Loomis (2003), and Ovaskainen et al. (2001) found minimal differences between models controlling for endogenous stratification and those that did not.

Kriesel, Landry and Keeler (2005) account for endogenous stratification in their on-site sample by weighting each observation by the inverse of current site demand. That is, a sampling weight equal to the inverse of the number of reported trips taken is applied to each observation. This procedure gives less weight in the estimation to avid visitors, as the denominator in the sampling weight becomes larger as the number of reported trips taken increases. Those who only visited once are given a weight of one. This procedure addresses issues of endogenous stratification in their sample, but not zero-truncation.

The dataset used in this analysis are taken from an on-site survey and are considered zero-truncated and possibly endogenously stratified. Both adjusted Poisson and ZTNB estimators were tried for data estimation, however the ZTNB produced somewhat illogical results. Specifically, the overdispersion parameter ($\propto$) was found insignificant, indicating the data was not overdispersed and a Poisson estimator was therefore appropriate. As a second best estimation protocol, a Poisson estimator adjusted for zero truncation and endogenous stratification using the procedure developed by Shaw (1988) of subtracting one from the number of reported annual park trips was selected for model estimation.

Travel Cost Method Estimation Sample Adjustment

The TCM analysis uses visitors' reported distance traveled in the construction of the travel cost variable, which limits the estimation sample to observations from the second and third survey module. Additionally, use of the 'freeday' variable constraints the dataset to observations from the third module only. To assess possible effects of moving to a smaller sample size, results from models with and without 'freeday' are presented in the next chapter.

The treatment of multipurpose trips is a controversial issue in the travel cost literature. The TCM is premised on the idea that demand for a site may be estimated by visitors' willingness to pay for access as proxied by travel costs. This assumes that the expenses incurred during travel to the site are for the sole purpose of reaching that resource. The relationship between trip costs and willingness to pay for access weakens when trips are multipurpose, and it would be an error to attribute the entirety of trip expenses to the site under analysis under these circumstances (Phaneuf and Smith 2005).

Common practice in the TCM literature is to avoid this issue by assuming the entire sample primary purpose visitors. This is often justified by the presumption that all other trip purposes are incidental or complimentary to that under analysis (Phaneuf and Smith 2005). Other researchers have attempted to apportion the joint costs associated with multipurpose trips (Leeworthy and Bowker 1997), or to exclude nonprimary purpose visitors from the estimation sample (Rolfe and Dyack 2010). The dataset used in this analysis provides no information to differentiate multipurpose visitors. However, it is logical to assume that the likelihood of visitors taking a multipurpose trip increases with distance. Zawacki, Marsinko and Bowker (2000) considered observations in the top five percent of distance traveled non-primary purpose visitors. Betz, Bergstrom and Bowker (2003) dropped observations with distances greater than five standard deviations from the mean. This study adopts a similar protocol by eliminating observations in the top five percent of distance traveled (n=88). This leaves the TCM estimation sample truncated at 150 miles, or a three-hour drive assuming an average speed of 50 m.p.h.

Additional adjustments were made to the estimation sample based on group size and missing information for some respondents. The preferences for a group of 50 (e.g., a family reunion) cannot be assumed similar to those of a group of four (e.g., a hiking group), and behavioral model cannot simultaneously model demand for both types of groups. Following Bowker et al. (2009), groups of more than 8 individuals were eliminated from this analysis (n=309). Observations with missing values for the number of annual trips (n=26) and distance traveled (n=44) to each park were also excluded. Groups taking trips in excess of five standard deviations from the sample mean are considered outliers, and were also excluded. This truncation protocol bounds the maximum number of group trips at 42.

These adjustments leave the TCM estimation sample with 1,309 observations. The descriptive statistics for this subsample are presented in Table 3.4. In comparison to the complete sample descriptive statistics presented in Table 3.2, average age and income are higher for the TCM estimation sample. All other sample characteristics besides those directly affected by estimation sample adjustments (e.g., number of trips, group size) are largely similar. Although the observations eliminated from this analysis represent a small number of visitors relative to the entire sample, their preferences may be systematically different. The treatment of these observations is a practical limitation of this study, and the potential for error is acknowledged. Limiting the TCM estimation sample to observations from the third survey module is not expected to effect results.

Table 3.4 – Travel Cost Method Estimation Sample Descriptive Statistics Survey Modules #2 & #3 (n=1309).

Variable	Mean	Std. Dev.	Min.	Max.	Cases
trips	3.85	5.16	1	40	1309
subsite	0.28	0.45	0	1	1147
tcost	16.12	9.16	5.34	55.22	1309
tcostopp	40.81	33.92	5.63	272.27	1308
income	60,018	36,102	12,500	112,500	1,309
college	0.57	0.5	0	1	1256
age	39.7	12.94	18	83	1273
male	0.59	0.49	0	1	1282
grpsize	4.22	1.84	1	8	1303
freeday	0.16	0.37	0	1	1309

Empirical TCM Models

The TCM model results are used for two policy-relevant applications. The first involves the effect of different entrance fee structures on visitation and revenue at the parks. The variable of interest in this application is ‘tcost,’ as estimations of visitor price response are based on its coefficient. The empirical model estimated for these purposes is specified as:

$$\ln \boldsymbol{trips_j} = \beta_0 + \beta_1 \boldsymbol{tcost_{jm}} + \beta_2 \boldsymbol{subsite_j} + \beta_3 \boldsymbol{income_j} + \beta_4 \boldsymbol{age_j} + \beta_5 \boldsymbol{male_j} + \beta_6 \boldsymbol{grpsize_j} + \beta_7 \boldsymbol{freeday_j} + \beta_8 \boldsymbol{FM_j} + \beta_9 \boldsymbol{FY_j} + \beta_{10} \boldsymbol{annpass} + \boldsymbol{u_j}, \tag{3.9}$$

where

$\boldsymbol{j}$ = *group 1,2,3,…, n, and*

$\boldsymbol{m}$ = *tcost, tcostopp.*

The second application of TCM model results addresses diversity issues involved with the fee structure at the parks. Specifically, the sample is analyzed to determine if visitor ethnicities respond differently to changes in park entrance fees. For these purposes, a varying parameters TCM model is estimated that includes ethnic-travel cost interaction terms that allow for differentiation of visitor price response based on ethnicity. The GSPDP sample size restricted this analysis to Hispanic visitors. The empirical model estimated for these purposes is specified as:

$$\ln \boldsymbol{trips_j} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1 tcost_{jm}} + \boldsymbol{\beta_2 subsite_j} + \boldsymbol{\beta_3 income_j} + \boldsymbol{\beta_4 age_j} + \boldsymbol{\beta_5 male_j} + \boldsymbol{\beta_6 grpsize_j} + \boldsymbol{\beta_7 FM_j} + \boldsymbol{\beta_8 FY_j} + \boldsymbol{\beta_9 freeday_j} + \boldsymbol{\beta_{10} hisp_j} + \boldsymbol{\beta_{11} black_j} + \boldsymbol{\beta_{10} hisptcost_{jm}} + \boldsymbol{u_j}, \tag{3.10}$$

Economic Impact Analysis

In addition to the benefits that state parks confer to park users, nearby economies benefit from the local economic impacts generated by visitor expenditures. This study suggests that state park fee structures likely affect visitation. According to Equation (3.11), the drivers of economic impacts are the number of visitors to a particular site, their expenditures, and an associated expenditure multiplier (Stynes et al. 2000). As such, adjustments in admission fees are likely to affect local economic impacts through their influence on-site visitation.

$$\textbf{\textit{Economic Impact = Number of Visitors *Average Spending per Visitor * Multiplier.}} \quad (3.11)$$

As indicated by Equation (3.11), the data requirements for impact analyses include an accurate count of visitors, an estimate of their spending patterns, and a set of regional multipliers. Many impact analyses employ a common survey instrument to gather information on both site visitation and visitor expenditures (Bowker, Bergstrom and Gill 2007; Fly et al. 2010). Multipliers for impact studies are usually obtained directly from input-output (I-O) models developed for the specific economy (Bowker, Bergstrom and Gill 2007). Where these are not available, they are most often sourced from other studies with similar characteristics. This is the approach taken in this study, as the GSPDP sample does not contain this type of information. Visitor expenditure data and multipliers are obtained from secondary sources based on samples similar to the state parks in the GSPDP sample. Park visitation estimates are provided by Georgia State Parks and Historic Sited Division (GASPHSD) (Terrell, personal communication). Baseline economic impact estimates for the state parks are generated using these data. The demand models discussed previously in this chapter are used to estimate the effect of various fee structures on park visitation. These visitation estimates are substituted into the economic impact model to predict changes in local impacts conditioned on different entrance fee structures at the parks. This framework will allow park managers to quantify the likely economic effects of admission fee policies on nearby economies.

Visitation Estimates

Visitation estimates for the parks are provided by GASPHSD (Terrell, personal communication). The agency uses traffic counters to measure the number of vehicles that enter each park, which are then adjusted to estimate the number of total visitors. Sampling for the data used in this study took place between May 29 and September 6, 2010. As estimated by

GASPHSD, total visitation between May 2010 and April 2011 was 130,601 at Fort Mountain State Park, 467,728 at Fort Yargo, and 585,099 at Red Top Mountain. These are summarized in Figure 3.10 below.

Economic impacts are generated from expenditures that would not have been made if not for the site or activity under analysis. This usually excludes local spending unless those dollars would have otherwise leaked outside of the community (Stynes 1997). To account for this, visitation estimates must be segmented into local and non-local. This study develops an estimate for local visitation using GSPDP sample data. Following Bowker, Bergstrom and Gill (2007), 25 miles is considered the distance delineating locals from non-locals. In the TCM estimation sample, the proportion of visitors in the Fort Mountain sample traveling more than 25 miles each way to reach the park is 55.9%, to Fort Yargo 31.9%, and to Red Top Mountain 56.7%. For the full sample, 48.1% of park visitors traveled a distance greater than 25 miles each way. These proportions are used to adjust GASPHSD visitation estimates from total to non-local.

Table 3.5 – State Park Visitation (May 2010 – April 2011) (Terrell, personal communication).

Park	Individual Visitation	% Non-local	Non-local Park Visitation
Fort Mountain	130,601	65.24%	85,204
Fort Yargo	467,728	28.83%	134,846
Red Top Mountain	585,099	47.42%	277,454
Combined	1,183,099	47.67%	564,140

Visitation estimates are most often split into day use and overnight segments, as expenditure profiles for the two are usually dissimilar (Stynes 2000). Bowker, Bergstrom and Gill (2007), for example, estimate day use visitors to the Virginia Creeper Trail (VCT) spend an average of $12.00 in the local economy each trip. Overnight visitors, on the other hand, spend $87.00. These differences stem mostly from overnight visitors' food and lodging expenditures.

Stynes (2000) notes that even rough estimates of day and overnight visitors will yield more efficient impact estimates than assuming all the same. Unfortunately, two of the three sets of expenditure estimates and multipliers used in this analysis do not differentiate between day use and overnight visitors. Therefore, this visitation adjustment in unneeded for estimation of economic impacts using results from those studies.

Expenditure Estimates

As detailed in Chapter Two, visitor expenditures in the study region are the direct effect that generates local economic impacts. Many studies include questions in their survey instrument to gatherer the information necessary to estimate expenditure profiles (Cline and Seidl 2010; Bowker, Bergstrom and Gill 2007). Often, however, resource or time constraints prevent such measures. Researchers must then rely instead on previous estimates developed for similar samples or for comparable sites (Stynes 1997).

As noted previously, the survey instrument used in this study does not gather information on visitor expenditures. These must therefore be obtained from secondary sources. Bowker, Bergstrom and Gill (2007) estimate primary purpose day use VCT visitors spend an average of $20.29 in the study region.[39] They define the study region as within 25 miles of the trail. A 2010 study of Tennessee State Parks estimates groups spend an average of $128.64 in the state on each trip (Fly et al. 2010). Their calculations are based on vehicle counts with an estimated 3 people per car, which results in an average of $43.66 per person each trip. The impact regions for the Tennessee report cover the entire state, so all expenditures within those states are considered relevant. An impact study of selected North Carolina state parks estimated $27.16 in average visitor expenditures within the county where the park is located (Greenwood and Vick 2008).

[39] All figures from this point forward have been adjusted to 2010 dollars using the Bureau of Economic Analysis "Personal consumption expenditures: recreation services (chained-type price index)," available at http://research.stlouisfed.org/fred2/series/DRCARG3Q086SBEA?cid=21. Accessed 10/1/13.

Table 3.6 – Expenditure Estimates: VCT, NC State Parks, TN State Parks (Bowker, Bergstrom and Gill 2007; Greenwood and Vick 2008; Fly et al. 2010).[40]

	Day Use	Overnight	Average Visitor
Virginia Creeper Trail	$20.29	$97.08	-
NC State Parks	-	-	$27.16
TN State Parks	-	-	$43.66

The parks under analysis in this study are limited to a particular region in northern Georgia, so it would be an error to assume an impact region as wide as the Tennessee report for visitor expenditures. Rather, the appropriate impact area is most likely the county in which the parks are located, as is the case with the North Carolina study. A 25-mile parameter similar to that adopted in the Virginia Creeper Trail study may be appropriate as well. However, the VCT is located in a more rural area than the state parks in the GASPDP sample. As previously noted, visitor expenditures are more limited in rural regions with less developed economies. To accommodate a range of possible visitor expenditures, this study presents economic impacts using expenditure estimates from the VCT, Tennessee and North Carolina studies. Models using the VCT estimates should be considered a lower bound, and those using the Tennessee estimates an upper bound. Impacts calculated using expenditure estimates from the North Carolina study should fall in between. This will provide a range of possible economic impacts conditioned on assumptions regarding visitor expenditures and the economic complexity of the impact region.

Multipurpose Visitors

A complication in economic impact estimation arises in assessing expenditures for multipurpose visitors. Attributing the entirety of these visitors' expenditures to a single purpose or site would be an error. The impact analysis literature addresses this problem in several different ways. For example, Bowker, Bergstrom and Gill (2007) allocate only a portion of nonprimary purpose spending, equal to the ratio of time spent on the trail to total trip length, to

[40] Primary purpose visitors only. NC estimate is an average of the 14 state parks sampled.

the VCT. Other researchers adopt a more ad hoc approach. Stynes, Vander Stoep and Sun (2004) simply consider one-quarter of nonprimary purpose expenditures relevant in their impact analysis of Michigan Museums. A more conservative approach involves completely omitting nonprimary purpose visitor spending.

As noted in the TCM section of this chapter, the survey instrument used in this study provides no means to determine if each group is a single- or multi-purpose. For the TCM analysis, it is assumed that visitors traveling distances that fall outside of the 95th percentile of all reported distances are on multipurpose trips. To make this same assumption using GASPHSD visitation estimate may be an error, as the distribution of distances traveled for that population is unknown. Therefore, all visitors are assumed to be primary purpose in the impact analysis conducted in this study. The potential error involved with this assumption is acknowledged as a practical limitation.

Multipliers

Stynes et al. (2000) note that multipliers are the least important component of impact analyses, as they are subject to much less variability than visitation and expenditure estimates. As discussed in Chapter Two, multipliers are combined with the direct effects of visitor expenditures to estimate total economic impacts (Stynes, Vander Stoep and Sun 2004). Regional multipliers are usually sourced from input-output models such as IMPLAN (MIG, Inc., IMPLAN System; www.implan.com) or MGM2 (Stynes, Propst, Chang and Sun; http://mgm2impact.com). IMPLAN multipliers are specific to regional economies, and provide a richer amount of detail than MGM2 generic multipliers, which are differentiated only by the degree of urbanization in the impact region (Stynes et al. 2000). Chang (2001) estimates the error involved in using generic instead of regionally-specific multipliers, finding a range of only two to nine percent.

This study estimates economic impacts using the multipliers associated with the studies discussed in the previous section. These are reproduced in Table 3.7. Again, the use of multiple studies is expected to provide a range of impact estimates that can accommodate any number of different assumptions concerning visitor expenditures and the economic complexity of the study region. Estimates made using the Tennessee state park figures should be considered an upper bound, as the relevant impact area in that study was the entire state. Estimates calculated using VCT study results should serve as a lower bound, as the impact area surrounding the Creeper Trail is most likely more limited than that of the state parks considered in this study. North Carolina expenditure estimates and multipliers are expected to better represent northern Georgia state parks.

Table 3.7 – Output Multipliers per 1,000 visitors: VCT, NC State Parks, TN State Parks (Bowker, Bergstrom and Gill 2007; Greenwood and Vick 2008; Fly et al. 2010).[41]

	Day Use	Overnight	Average Visitor
Virginia Creeper Trail	1.35	1.33	-
NC State Parks	-	-	1.53
TN State Parks	-	-	2.11

Total Economic Impacts and Park Fee Structure

The product of park visitation, visitors' expenditures and regional multipliers provides an estimate of the each park's total economic impact. The evaluation of management alternatives under an impact analysis framework requires the expected economic impacts with each policy in place be compared to the baseline impacts without. The policy under consideration in this study is the adjustment of admission fees at several state parks in northern Georgia. Fee variation is expected to affect park visitation, and therefore the parks' local economic impacts. Baseline impact estimates under current access conditions are compared with adjusted estimates under

[41] Note: NC multiplier is an average of the 14 state parks sampled.

different admission fee structures to assess changes in economic impacts. The expected effect of park fee structures on local economies is then assessed.

CHAPTER 4

RESULTS AND POLICY APPLICATIONS

This chapter details results from the economic models estimated in this study. Practical policy applications using these results address the key research questions of this study. Specifically, the likely effects of changes in park entrance fee structure on expected revenue, user welfare, visitor diversity, and local economic impacts are considered. The result is expected to provide a holistic framework for park management in assessing the likely economic effects of pricing policy alternatives.

Travel Cost Method Models Summary

Exploratory analysis of the revealed preference TCM dataset showed a moderately positive correlation between the variables ‘college’ and ‘income’ (Pearson’s r = 0.4277). Multicollinearity between model covariates can lead to inflated variances and less precision in determining their effect on the dependent variable (Gujarati 1988). A common method to correct for multicollinearity is to drop the subset of suspect variable(s). However, exclusion of a practically or theoretically important variable may lead to omitted variable bias, where the omitted variable’s effects are picked up by the model’s error term. If this is the case, assumptions of error term normality are violated (Gujarati 1988). This study estimates Marshallian demands for park recreation, which are functions of prices and income. Therefore ‘income’ is retained in the estimated models for theoretical consistency. ‘College’ is omitted.

Several other variables were examined for inclusion in the TCM model but were rejected for various reasons. An experience variable ('visityear'), based on the number of previous years each respondent had visited the park, was found to reduce the explanatory power of the models and therefore omitted. Variables constructed to account for the likely demand differences of local visitors ('local' and 'hfvisitor') were found to reduce consistency in the travel cost variable parameter estimate, possibly due to endogeneity with the dependent variable ('trips') (Cameron and Trivedi 1989). These were also omitted. Additionally, an adjustment to the travel cost variable construction for respondents interviewed on a free admission day was found to introduce substantial collinearity in the models. A dummy variable ('freeday') was included to identify those visitors instead.[42]

The TCM estimation sample is analyzed using a Poisson estimator adjusted for zero truncation and endogenous stratification by subtracting one from each groups' reported trips, a procedure suggested by Shaw (1988).[43] As discussed in Chapter Three, the zero-truncated and endogenously stratified negative binomial (TSNB) is the preferred estimator with samples characterized by overdispersion in the dependent variable. The dependent variable ('trips') used in this analysis could be overdispersed, as the mean number of annual visits is slightly less than its standard deviation. However, preliminary estimation using the TSNB failed to reject the null hypothesis that the model's alpha parameter was equal to zero using the STATA "nbstrat" package (Hilbe 2005). The adjusted Poisson is used as a next best alternative.

Although the Poisson estimator generates consistent parameter estimates for overdispersed data, if employed under these circumstances (i.e., over-dispersion) standard errors

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[42] It should be noted that the mean number of trips taken by visitors interviewed on a free admission day (6.78) is more than double that of those interviewed on other days (3.28), indicating their visitation preferences may indeed be different from the rest of the sample.

[43] The Poisson estimator adjusted for endogenous stratification and zero truncation is referred to as an adjusted Poisson from this point forward.

are underestimated. In this case, the asymptotic *t*-statistics are larger and there is a greater chance of type-1 error (Martinez-Espineira and Amoako-Tuffour 2008). The parameter estimate of principal concern in this TCM analysis is that associated with the travel cost variable, as it is used to derive price elasticity of demand and consumer surplus estimates. The Poisson estimated models are not used for prediction, therefore the significance of other covariates is not of utmost importance. The travel cost coefficient was significant at a level greater than 0.01 (1% chance of a type-1 error) in all estimated models. Considering such high significance, it is expected that the chance of a false rejection of a true null hypothesis minimized, even considering the potential for error when using a Poisson estimator on potentially over dispersed data.

Model Statistics

Results from five different specifications of the TCM model are detailed below. As noted in Chapter Three, use of the 'annpass' variable limits the estimation sample to observations from the third module of the survey instrument. To assess the potential effects of moving to a smaller sample size, results from models with and without 'annpass' are presented. The three other models involve different specifications of opportunity costs, all of which include the 'annpass' variable. The first assumes time costs valued at the 2010 Georgia minimum wage ($5.15) scaled by the number of adults in each group. The second and third use a common specification in the travel cost literature where sample average household income ($55,377) is divided by 2000 hours to proxy the household wage rate (Rosenberger and Loomis 1999; Hynes and Greene 2013). One model uses the commonly assumed one-third of the household wage rate ($9.13) (Bowker et al. 2009; Martinez-Espineira and Amoako-Tuffour 2007), the other uses the full rate ($27.69), which typically leads to an upper bound estimate of opportunity costs and consumer surplus. All three specifications are scaled each group's travel time to reach an estimate for each groups' opportunity costs.[44] All travel costs specifications, both with and without opportunity costs, include the park admission fee and the mileage costs incurred by each group to reach the site. The different specifications are expected to provide a range of estimates for the policy-relevant applications detailed later in this chapter, and serve as a partial sensitivity analysis for model results (i.e., assess the robustness of results to different model specifications).

Tables 4.1 and 4.2 show the mean, standard deviation, minimum and maximum values for the variables included in the TCM models. The first table uses observations from the second and third survey modules, and the second from only the third module (which includes 'annpass').

Table 4.1 – Travel Cost Method Model Estimation Sample Descriptive Statistics Survey Modules #2 & #3 (n=1309).[45]

Variable	Mean	Std. Dev.	Min.	Max.	Cases
trips	3.85	5.16	1	40	1309
subsite	0.28	0.45	0	1	1147
tcost	16.12	9.16	5.34	55.22	1309
tcostopp1	33.66	26.53	5.54	209.72	1308
tcostopp2	28.26	19.16	5.7	110.04	1309
tcostopp3	52.91	39.47	6.44	221.35	1309
income	55,377	33,578	12,500	112,500	1,309
college	0.57	0.5	0	1	1256
age	39.7	12.94	18	83	1273
male	0.59	0.49	0	1	1282
grpsize	4.22	1.84	1	8	1303
freeday	0.16	0.37	0	1	1309

[44] Travel time is proxied by diving round-trip distance by an assumed speed of 50 miles per hour.
[45] Note: The wage rate used to construct tcostopp1 is equal to $5.15, the 2010 Georgia minimum wage, and it is assigned to each adult member of the travel party; tcostopp2 uses 1/3 of the sample average household wage rate ($9.14); tcostopp3 uses the full sample average household wage rate ($27.69).

Table 4.2 – Travel Cost Method Model Estimation Sample Descriptive Statistics Survey Module #3 (n=667).[46]

Variable	Mean	Std. Dev.	Min.	Max.	Cases
trips	3.95	5.31	1	40	667
subsite	0.39	0.49	0	1	620
tcost	16.64	9.85	5.34	55.22	667
tcostopp1	35.38	28.99	5.75	209.72	666
tcostopp2	29.34	20.6	5.7	110.04	667
tcostopp3	55.12	42.43	6.44	22135	667
income	54,464	33,779	12,500	112,500	666
college	0.58	0.49	0	1	650
age	39.73	12.85	18	82	652
male	0.59	0.49	0	1	658
grpsize	4.3	1.85	1	8	662
freeday	0.16	0.37	0	1	667
annpass	0.14	0.35	0	1	653

The summary statistics for both estimation samples are very similar. On average, groups take about four trips to the state park where interviewed each year. Average travel costs range from just over $16.00 to $55.12, depending on opportunity cost of travel time assumptions. Average income is around $57,000, and the average group size is between four and five. More than half of each sample graduated from college, and their average age is almost 40. The samples are 59% male, and 16% were interviewed on a free admission day in 2010. A primary difference between the samples lies in the substitute variable. The sample that contains observations from survey modules #2 and #3 indicates at least 28% of respondents feel there to be adequate substitutes for the park they visited. That number increases to 39% when considering only survey module #3. This is likely due to construction of the substitute variable, which, while in principal is the same, makes use of slightly different questions for each survey.

Table 4.3 presents the parameter estimates for the five reported TCM models. Parameter estimates vary in value and significance depending on model assumptions. For example, the

[46] ibid.

‘income’ parameter is significant in the no opportunity cost model without ‘annpass’ and in the opportunity cost models with household wage-based specifications only. Its value varies, and its sign switches when opportunity costs are considered. The ‘groupsize’ parameter estimates display opposite characteristics.

Table 4.3 – Travel Cost Method Model Parameter Estimates.[47]

	#1:No opp. Cost (no annpass)	#2: No opp. Cost (annpass)	#3: Opp. Cost (min. wage)	#4: Opp. Costs (1/3 HH wage)	#5: Opp. Costs (full HH wage)
tcost	-0.0705**	-0.0590**	-	-	-
	(0.0034)	(0.0042)	-	-	-
tcostopp	-	-	-0.0154**	-0.0282**	-0.0137**
			(0.0014)	(0.0020)	(0.0010)
subsite	-0.1118**	-0.0658	-0.1011*	-0.0658	-0.0658
	(0.0417)	(0.0491)	(0.0489)	(0.0491)	(0.0491)
income	-0.0018**	-0.0009	-0.0014	-0.0009	-0.0009
	(0.0006)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
age	0.0010	-0.0076**	-0.0083**	-0.0076**	-0.0076**
	(0.0014)	(0.0020)	(0.0020)	(0.0020)	(0.0020)
male	-0.0514	-0.2884**	-0.2941**	-0.2884**	-0.2884**
	(0.0359)	(0.0480)	(0.0480)	(0.0480)	(0.0480)
grpsize	0.0010	0.0273*	0.0577**	0.0273*	0.0273*
	(0.0096)	(0.0129)	(0.0131)	(0.0129)	(0.0129)
FM	0.2958**	0.2381**	0.1238	0.2381**	0.2381**
	(0.0475)	(0.0652)	(0.0646)	(0.0652)	(0.0652)
FY	0.3129**	0.2986**	0.2949**	0.2986**	0.2986**
	(0.0454)	(0.0585)	(0.0587)	(0.0585)	(0.0585)
freeday	0.5631**	0.6819**	0.6997**	0.6819**	0.6819**
	(0.0407)	(0.0545)	(0.0548)	(0.0545)	(0.0545)
annpass	-	0.6864**	0.6927**	0.6864**	0.6864**
		(0.0608)	(0.0610)	(0.0608)	(0.0608)
constant	1.8423**	1.9333**	1.5215**	1.7794**	1.7068**
	(0.0947)	(0.1278)	(0.1214)	(0.1246)	(0.1234)
n	1128	599	599	599	599
LL	-3935.2283	-2069.3230	-2118.0741	-2069.3230	-2069.3230
LR	1357.26	842.29	744.78	842.29	842.29
Pseudo R^2	0.1471	0.1691	0.1495	0.1691	0.1691

47 ** = significant at p ≤ 0.01; *= significant at p ≤ 0.05.

The parameter associated with the binary substitute site variable takes negative values in all of the estimated models. However, the parameter is significant in only two of the models. The negative sign indicates that groups that believe there to be available substitutes for recreation at northern Georgia state parks take fewer annual trips to the park where surveyed, all else being equal. This outcome is consistent with economic theory, which suggests that the availability of commodity substitutes reduces demand (Varian 2010). Leeworthy and Bowker (1997) find a similar result. A similar dummy variable used by Teasley, Bergstrom and Cordell (1994) was found to have an insignificant effect on trips to Cherokee and George Washington National Forests. Other recreational demand studies have used a substitute variable constructed with the travel costs each respondent would incur to reach a site offering similar activities or amenities as those available at the site under evaluation (Hynes and Greene 2013; Rosenberger and Loomis 1999; Martinez-Espineira and Amoako-Tuffour 2007). These studies usually find a positive sign associated with the substitute site parameter, meaning that travel costs to the substitute site and trip frequency to the site under analysis move in the same direction.

The income variable parameter is negative in all reported models, and is significant in only one. Contrary to economic theory, the negative sign suggests that trip frequency decreases as income increases. If recreation at the parks is a ordinary good, theory dictates that demand would increase with income. However, this outcome is not uncommon in the recreation demand literature (Hesseln, Loomis and Gonzalez-Caban 2004; Rolfe and Dyack 2010; Loomis 2006). One possible explanation is a greater quantity of available substitutes for groups with higher incomes, as increased income may open up a number of recreational opportunities unavailable at state parks. Another possibility is a reduced amount of leisure time available for higher income households. In a meta-study of park visitor preferences, Doucoluliagos and Hall (2010) find individuals with higher incomes more likely to cite the lack of available time as a limitation to park use, which supports this explanation. Loomis, Gonzalez-Caban and Englin (2001) found a negative relationship between income and trip demand for hikers, and a positive relationship with mountain-bikers in Colorado National Forests. They suggest the differences may be due to equipment costs, as hiking relies on more low-tech equipment, which may have lead to its inferior good classification (i.e., demand decreases as income rises). This may also be the case with the state parks sampled in this study. The hotspot sampling procedure targeted high use areas, such as group shelters and swimming locations, where the necessary equipment for recreation is minimal. Equipment-intensive locations, such as mountain bike and horse-riding trails, were given less attention in the GSPDP sampling protocol (Larson 2012).[48] The negative relationship between park visitation and income also suggests that fee increases may be regressive in nature, as these results indicate that trip demand is higher for individuals of lower incomes. These visitors would be expected to reduce trip frequency by a smaller proportion if park fees were to increase, causing them to bear a disproportionate share of the additional cost burden.

The parameter estimate for the age variable takes negative values in the models where significant, implying that trip frequency decreases with age. This is consistent with the findings of Siderelis and Moore (1995), but contrary to Hynes and Greene (2013). It should be noted that the value taken by the age variable belongs only to the group representative who was randomly selected within the group and over 18 years of age. Also, the GSPDP sampling protocol intentionally focused on-site interviews towards recreational hotspots at the parks, which may

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[48] Note that a concerted effort was made to sample campgrounds, where visitors may have required more equipment for recreational activities. Mean household income for groups surveyed at campgrounds was $67,641 compared to $51,344 for day use groups.

have been more frequented by younger visitors (Larson 2012). Therefore, care should be taken in the interpretation of this parameter.

Parameter estimates for the gender binary variable ('male') take negative values in all models, and are significant in all but one. This result suggests that males take fewer recreational trips to the parks, all else being equal, and that gender is an important determinant of trip demand. This result is similar to Englin and Shonkwiler (1995) and Hesseln, Loomis and Gonzalez-Caban (2004), both of which find female respondents more likely to take hiking trips. Somewhat similarly, Rockel and Kealy (1991) find females more likely to spend time in nonconsumptive wildlife recreational pursuits. Bowker et al. (2012) find mixed results for gender in their assessment of U.S. outdoor recreation participation. For certain activities, such as hunting and those associated with the backcountry, males were found more likely to participate. Females were more likely to participate in activities such as swimming, wildlife viewing and visiting developed sites. In the GSPDP sample, 61.3% of groups participated in a swimming activity, 18.7% in wildlife viewing, and 13.1% visited a historic site (developed) (Larson, Whiting and Green 2012). Therefore, the negative parameter estimates for the gender variable found in this study are not wholly unexpected.

The Fort Mountain and Fort Yargo dummy variable coefficients are positive and significant in all models, which indicates that visitors interviewed at those parks are more frequent park users than those interviewed at Red Top Mountain. Using results from the model estimated with the annual pass variable and exclusive of opportunity costs (#2), and with all variables evaluated with their estimated coefficients and at their sample means, groups interviewed at Fort Mountain were expected to take 0.61 more annual visits than groups surveyed at Red Top Mountain. Fort Yargo groups were expected to take 0.78 more trips each year under the same assumptions.

The dummy variables indicating visitors interviewed on a free admission day ('freeday') and those that have purchased an annual admission pass in the previous 12 months ('annpass') are both positive and significant in all models as well. Groups that fall into either category take a greater number of trips to the parks than those that do not, all else being equal. Free admission day visitors were expected to visit the park where interviewed 2.13 more times than groups sampled on any other day of the week (using results from model #2 and all other covariates evaluated with their estimated coefficients and at their sample means). Annual pass holders were expected to visit 2.18 more times each year than groups that did not purchase annual passes (same assumptions).

As noted previously, the use of a Poisson estimator on potentially overdispersed data is likely to result in a higher likelihood of type-1 error. The overwhelming significance of the covariates in Table 4.3 may be a symptom of this limitation. Therefore, caution should be exercised with the interpretation of coefficient significance. However, it is important to note that the travel cost ('tcost') parameter is highly significant in all models, has the appropriate sign. Although it takes different values depending on model assumption, it is relatively robust within the framework of similar assumptions about time costs. This is the parameter of interest in this study, as estimates of visitor price elasticity and consumer surplus are derived from its value.

Despite potential problems involved in determining parameter significance, Poisson estimators under dependent variable overdispersion are expected to produce consistent parameter estimates. Therefore the values of the travel cost coefficients reported in Table 4.3 are expected to be accurate, and are used in the applications that follow.[49] The sign of the travel cost coefficient is negative, which is consistent with economic theory suggesting consumption of ordinary goods declines as their price increases. This result indicates a downward sloping demand curve in price (trip cost) and quantity (visits) space. As the cost of a trip increases, the quantity consumed decreases.

Travel cost parameters estimated in models exclusive of opportunity costs are greater in absolute value than those without.[50] The pseudo-R^2 and log-likelihood scores both increase after adding 'annpass', indicating its inclusion enhances the explanatory power of the models.[51] It is therefore retained in each of the subsequent model specifications.

Within the three opportunity cost models, the 'tcostopp' parameter estimates vary by almost 130% in value.[52] The model with a minimum wage-based opportunity cost specification produces an estimate that falls between those from the household wage rate specifications. Note that mean travel costs under the minimum wage specification falls within the other two as well. This reinforces the notion discussed previously that travel cost parameter estimates and mean travel costs move in opposite directions. In other words, the cost of a trip has more of an influence over trip-taking behavior when those costs are minimal. This idea is further illustrated in the following price elasticity of demand applications.

Elasticity

As discussed in Chapter Two, price elasticity of demand measures the percentage change in quantity demanded for a given change in price. Because data do not exist for alternative fees

[49] Numerous preliminary models were estimated that are not reported in this thesis. In all cases the travel cost parameter proved highly significant and robust to different model assumptions and specifications.
[50] The greater in a coefficient's absolute value, the larger the estimated influence of its associated variable on the dependent variable.
[51] Note that the inclusion of 'annpass' also reduces the sample size by approximately 50%, which may affect measures of goodness of fit.
[52] This approach using multiple variations of opportunity cost specification is common in the TCM literature (Rosenberger and Loomis 1999; Bowker et al. 2009).

across parks analyzed in this study, elasticities are used to estimate the likely change in park visitation affected by variation in the entrance fee structure. Expected park revenue and economic impacts associated with different fee levels are calculated with these results. A similar approach was utilized by Teasley, Bergstrom and Cordell to estimate expected revenue for a range of fee increases in their study of Cherokee and George Washington National Forests (1994). Likewise, Ellingson and Seidl (2007) used elasticities estimated from stated preference data to predict visitation decline at a Bolivian national park for a range of higher fees.

In the context of prices and revenue, inelastic demands ($0 < |E_p| < 1$) imply that increases in price will increase revenue, as the expected decline in quantity demanded is not sufficient to offset the additional revenue. If demand is elastic ($|E_p| > 1$), the expected decline in quantity demanded from a price increase more than offsets the revenue increase, and total revenue will fall (Loomis and Walsh 1997, Chapter 8). In TCM analysis, necessary trip costs serve as a proxy for the price of nonmarket goods. These considerations of prices and revenue with respect to elasticity apply similarly.

The Poisson estimated TCM models are specified in the common log-linear form, where the natural log of trips is a linear function of model covariates (Hynes and Greene 2013; Rosenberger and Loomis 1999). The formula for elasticity in these specifications is the product of the travel cost (price) coefficient and a point estimate of those costs (Equation 4.1). Any point may be used, as the estimate varies with travel costs; most common is the sample mean. This study uses the TCM estimation sample mean at current access costs as a starting point, and, where appropriate, the mean for subgroups of that sample (i.e., when estimating elasticities for different ethnicities, the group mean travel costs for specific ethnicities are used).

$$\boldsymbol{\varepsilon_i = \beta_{tc} * \overline{TC_i}}, \tag{4.1}$$

where

$\boldsymbol{\varepsilon_i}$= price elasticity of demand associated with hypothetical entrance fee level $\boldsymbol{i}$,

$\boldsymbol{\beta_{tc}}$= estimated travel cost coefficient, and

$\overline{\boldsymbol{TC_i}}$ = sample average travel costs assuming fee level $\boldsymbol{i}$.

As noted in Equation 2.9 (reproduced below), price elasticity ($\boldsymbol{\varepsilon}$) is also equal to the ratio of percentage change in quantity ($\%\Delta\boldsymbol{q}$) to percentage change in price ($\%\Delta\boldsymbol{p}$). Of interest in this study is the change in quantity (trips) demanded for a given change in price (fee). Rearranging Equation 2.9 reveals the percentage change in quantity equal to the product of price elasticity and the percentage change in price (Equation 4.2). The latter is calculated by determining the change in sample average travel costs affected by different fee levels (i.e., [$\overline{TC}$ + fee]/$\overline{TC}$), and the former using Equation 4.1.[53] From these, the expected change in visitation associated with hypothetical fee levels may be estimated.

$$\boldsymbol{\varepsilon_i} = \frac{\%\Delta\boldsymbol{q_i}}{\%\Delta\boldsymbol{p_i}},$$

$$\%\Delta\boldsymbol{q_i} = \boldsymbol{\varepsilon_i} * \%\Delta\boldsymbol{p_i}, \tag{4.2}$$

The product of current park visitation and the expected change in visitation calculated by Equation (4.2) allows for estimation of park visitation under hypothetical entrance fees levels. Equation 4.3 explains this calculation.

$$\%\Delta\boldsymbol{q_i} * \boldsymbol{V} = \boldsymbol{\widehat{V}_i}. \tag{4.3}$$

where

$\boldsymbol{V}$ = current park visitation, and

[53] Note that $\overline{\boldsymbol{TC}}$ changes with the fee level as well (e.g., a \$2.00 fee increase would increase sample average travel costs to $\overline{\boldsymbol{TC}} + \$\boldsymbol{2.00}$), thus while a fee increase of \$2.00 from the current \$5.oo is a 40% increase in fee, it would cause a smaller percent increase in average travel costs.

$\widehat{\boldsymbol{V}}_{\boldsymbol{i}}$ = expected park visitation assuming fee level $\boldsymbol{i}$.

Park visitation estimates for 2010 were provided by Georgia State Parks and Historical Sites Division (GASPHSD) (Terrell, personal communication). Several adjustments to the estimates are necessary in order to ensure consistency with model estimates. First, the sampling protocol employed by the Georgia State Parks Diversity Project (GSPDP) targeted on-site interviews towards certain high-frequency "recreational hotspots" at the parks. Therefore, the results of these TCM demand estimations are most pertinent to individuals that visit these areas of the parks. According to GSPDP exit interviews, the sampling procedure accommodated 78.8% of park visitors (Larson, Whiting and Green 2012). However, that proportion varied by park. At Fort Mountain, an estimated 56.8% of groups were interviewed at recreational hotspots. The percentage was 70.3% at Fort Yargo and 84.9% at Red Top Mountain. These proportions were used to adjust GASPHSD visitation estimates to account for the hotspot sampling protocol. For example, the 139,111 Red Top Mountain group visits were scaled by 0.849, resulting in 118,105 groups expected to have visited recreational hotspots at that park in 2010.

Additionally, as detailed in Chapter Three, TCM estimation sample group size was truncated at eight people. Therefore, TCM model results are relevant only to group sizes of eight or less.[54] This procedure deleted 25.24% of the observations from the combined park sample. The proportion of visiting groups of eight people or below varied from 71.0% at Fort Yargo, to 77.3% at Red Top Mountain and 77.5% at Fort Mountain. GASPHSD visitation estimates were further adjusted by these proportions to account for the group size truncation procedure. For

[54] There may have been multiple members of the same large parties sampled, as the dataset indicates a number of observations of identical group sizes larger than 12 people that were interviewed on the same day at the same site. Whether or not these observations are from the same party is indeterminable. However, if this did occur, the group size adjustment to the GASPHSD visitation estimate (trimming 25.24%) may overestimate the number of large groups that visit the parks and result in conservative estimates of visitor price response.

example, the 118,105 groups left after hotspot adjustment at Red Top Mountain were scaled by 0.773, arriving at an estimated 91,260 group visits to which model estimates are most relevant.

Also, the individual visitation estimates provided by GASPHSD were adjusted by sample average group sizes for consistency with the TCM models' unit of consumption (group). Table 4.4 presents group visits without the group size truncation adjustment, and Tables 4.5 and 4.6 reflect the additional adjustment. All three tables reflect visitation adjusted for the hot spot sampling procedure.

Table 4.4 – Georgia State Park Visitation: May 2010 - April 2011, Unadjusted for Truncation (Terrell, personal communication).

	Individual Visits	Hot Spot Adjustment	Average Group Size	Group Visits
Fort Mountain	130,601	0.568	4.282	17,324
Fort Yargo	467,728	0.785	4.446	82,584
Red Top Mountain	585,099	0.849	4.206	118,105
Combined	1,183,428	0.788	4.298	216,971

Table 4.5 – Georgia State Park Visitation: May 2010 - April 2011, Adjusted Using Survey Modules #2 and #3 (Terrell, personal communication).[55]

	Individual Visits	Hot Spot Adjustment	Group Size Adjustment	Average Group Size	Group Visits
Fort Mountain	130,601	0.568	0.7826	4.419	13,137
Fort Yargo	467,728	0.785	0.7170	4.289	61,380
Red Top Mountain	585,099	0.849	0.7383	4.191	87,509
Combined	1,183,428	0.788	0.7457	4.219	164,825

[55] The hotspot and truncation adjustments left TCM estimation results applicable to 44.5% of the Fort Mountain sample, 56.3% of the Fort Yargo Sample, 62.7% of the Red Top Mountain sample, and 58.8% of the combined park sample.

Table 4.6 – Georgia State Park Visitation: May 2010 - April 2011, Adjusted Using Survey Module #3 (Terrell, personal communication).[56]

	Individual Visits	Hot Spot Adjustment	Group Size Adjustment	Average Group Size	Group Visits
Fort Mountain	130,601	0.568	0.7748	4.282	13,423
Fort Yargo	467,728	0.785	0.7098	4.446	58,618
Red Top Mountain	585,099	0.849	0.7727	4.206	91,260
Combined	1,183,428	0.788	0.7547	4.298	163,748

Note that the visitation adjustments reflected in these tables likely result in very conservative estimates of the 2010 park visitation proportion to which model estimates are relevant. For example, although the exit interviews suggested that a certain proportion of groups did not visit recreational hotspots while at the parks, certain members of those groups may have been while passing though the hotspots. Therefore, the adjustment for this sampling procedure is likely conservative. Additionally, multiple members of the same large groups may have been interviewed at the parks. There are a number of observations from respondents interviewed at the same park on the same day that traveled in identically sized groups ranging in size from 20 to 150 people. If some of these observations are from the same groups, as they likely are, then the group size truncation adjustment to park visitation likely results in even more conservative estimates.

Expected Fee Revenue

Total revenue is equal to the product of price and quantity; however the expected revenue associated with a change in the fee structure at state parks is not simply equal to the product of the new fee and an estimate of current visitation. As explained previously, park visitation is likely to vary with the cost of site access. Therefore, an estimate of the change in visitation

[56] The hotspot and truncation adjustments left TCM estimation results applicable to 44.0% of the Fort Mountain sample, 55.7% of the Fort Yargo Sample, 65.6% of the Red Top Mountain sample, and 59.5% of the combined park sample.

associated with different fee structures is necessary to more accurately predict expected revenue. This application takes into account the predicted decline in site visitation for a set of hypothetical fees in order to more fully assess expected revenue. Quantification of expected revenues for fee increases may provide management with useful information regarding park fiscal sustainability when determining pricing policy.

The product of predicted group visitation for each fee level and the fee itself ($\hat{\boldsymbol{V}}_{\boldsymbol{i}} * \boldsymbol{fee_i}$) provides an estimate of expected park revenue. These are calculated for each of the models presented in Table 4.3. Fee increases ranging from $5.00 (current) to $15.00 (a $10.00 increase) are included to explore expected revenues associated with pricing policies ranging from marginal to extreme. The results are shown in Tables 4.5 through 4.9.[57]

There are several important considerations to note about these tables. This application assumes that visitors will react similarly to increases in the price of park attendance as they would increases in the price of any market good related to travel costs (e.g., gasoline). It is assumed that fee revenue will be collected for each and every group. All estimates are relevant only to 2010 combined visitation to all three state parks. Each is based on mean travel costs for the estimation sample, which is listed at the top of each table. Mean travel costs include the current entrance fee ($5.00), and increase in value as the hypothetical entrance fee rises to levels above current. Also note that while these tables relate to combined park visitation, similar applications are easily replicated using park-specific visitation estimates. For an estimate of expected revenue for the average northern Georgia state park, the figures presented below should be adjusted by one-third.

[57] Note that model #1 estimates negative park attendance and expected revenue for certain fee levels. Obviously this is not possible. However, it is not unrealistic to fathom fee increases of two to three times the current level may invoke price responses where park visitation drops to levels near zero.

Visitors who report to have purchased an annual park admission pass in the previous 12 months represent 13.94% of the observations from the third survey module.[58] If the same proportion of the GASPHSD visitation estimate purchased annual passes in 2010, the division would have generated $1,134,591 in sales revenue. It is uncertain how these visitors will respond to price increases at the park, as it is unknown if they will continue to purchase annual passes in the future.[59] If the annual pass price does not increase proportionately, increases in admission fees may not affect their visitation preferences. Additionally, fee increases may affect an increase in annual pass sales if visitors find there to be cost savings involved. Ultimately, there is a great deal of uncertainty involved with visitors who purchase annual park admission passes. For the purposes of these and subsequent applications, their price response is considered identical to visitors who pay daily entrance fees.[60] The revenue from annual pass sales is not included in the expected revenue applications that follow.

Table 4.7 – Expected Revenue Model #1: No Opportunity Costs; No Annual Pass Variable (B_{tc} = -0.071; $\overline{TC}$ = $16.12).[61]

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\widehat{\boldsymbol{V}}_i$ (Group)	Expected Revenue
5	0%	-1.14	0.0%	0.0%	164,825	$824,124
6	20%	-1.21	6.2%	-7.5%	152,487	$914,924
7	40%	-1.28	12.4%	-15.8%	138,709	$970,961
8	60%	-1.35	18.6%	-25.1%	123,489	$987,909
10	100%	-1.49	31.0%	-46.2%	88,725	$887,248
15	200%	-1.84	62.0%	-	-	-

[58] The third survey module is the only one that inquires about annual passes. It is unknown what proportion of the rest of the sample purchased annual passes.

[59] Note that slightly under half (48.35%) of annual pass holders were interviewed on their first or second trip *to the park where interviewed* in the previous 12 months. They may or may not have visited other parks (annual park passes allow entry to any GA state park). If not, these visitors may find cost savings in paying daily entrance fees in the future. Alternatively, these visitors could be frequent visitors of other parks, or could have bought annual passes to support the park system. The GASPDP dataset does not allow for such determinations to be made.

[60] Note that the set of model estimates using the annual pass variable ('annpass') accounts for the likely difference in demand preference of these visitors using a dummy variable, however price response is assumed identical to visitors who purchase daily entrance passes.

[61] Entrance fees of $15.00 suggest a price response resulting in negative park visitation. As this is obviously not possible, estimated visitation and expected fee revenue for a fee level of $15.00 are omitted from Table 4.7.

Table 4.8 – Expected Revenue Model #2: No Opportunity Costs; With Annual Pass Variable (B_{tc} = -0.059; $\overline{TC}$ = $16.64).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	Expected Revenue
5	0%	-0.98	0.0%	0.0%	163,748	$818,740
6	20%	-1.04	6.0%	-6.3%	153,507	$921,039
7	40%	-1.10	12.0%	-13.2%	142,104	$994,727
8	60%	-1.16	18.0%	-20.9%	129,540	$1,036,321
10	100%	-1.28	30.0%	-38.4%	100,929	$1,009,290
15	200%	-1.57	60.1%	-94.5%	9,081	$136,214

Table 4.9 – Expected Revenue Model #3: Minimum Wage Rate Opportunity Cost Specification
(B_{tc} = -0.015; $\overline{TC}$ = $35.38).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	Expected Revenue
5	0%	-0.55	0.0%	0.0%	163,748	$818,740
6	20%	-0.56	2.8%	-1.6%	161,151	$966,903
7	40%	-0.58	5.7%	-3.3%	158,410	$1,108,872
8	60%	-0.59	8.5%	-5.0%	155,527	$1,244,217
10	100%	-0.62	14.1%	-8.8%	149,333	$1,493,327
15	200%	-0.70	28.3%	-19.8%	131,347	$1,970,211

Table 4.10 – Expected Revenue Model #4: 1/3 HH Wage Rate Opportunity Cost Specification
(B_{tc} = -0.028; $\overline{TC}$ = $28.26).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	Expected Revenue
5	0%	-0.80	0.0%	0.0%	163,748	$818,740
6	20%	-0.83	3.5%	-2.9%	158,966	$953,795
7	40%	-0.85	7.1%	-6.0%	153,857	$1,076,997
8	60%	-0.88	10.6%	-9.4%	148,421	$1,187,366
10	100%	-0.94	17.7%	-16.6%	136,568	$1,365,683
15	200%	-1.08	35.4%	-38.2%	101,217	$1,518,249

Table 4.11 – Expected Revenue Model #5: Full HH Wage Rate Opportunity Cost Specification
(B_{tc} = -0.014; $\overline{TC}$ = \$52.91).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	Expected Revenue
5	0%	-0.72	0.0%	0.0%	163,748	$818,740
6	20%	-0.74	1.9%	-1.4%	161,463	$968,779
7	40%	-0.75	3.8%	-2.8%	159,093	$1,113,654
8	60%	-0.77	5.7%	-4.3%	156,639	$1,253,112
10	100%	-0.79	9.5%	-7.5%	151,476	$1,514,758
15	200%	-0.86	18.9%	-16.3%	137,085	$2,056,268

Loomis and Walsh (1997) note that price elasticities for recreation demand usually range in value from -0.2 to -2.0. Betz, Bergstrom and Bowker (2003), for example, estimated a price elasticity of -0.68 for visitors to a hypothetical rail-trail in northern Georgia assuming no opportunity costs for time. Bowker, Bergstrom and Gill (2007) estimated price elasticities for Virginia Creeper Trail visitors between -0.567 and -0.605, depending on opportunity cost assumptions. Rosenberger and Loomis (1999) estimate a price elasticity of -1.18 for visitors to a resort area in Colorado's front range. Martinez-Espineira and Amoako-Tuffor (2008) estimated a price elasticity for visitors to Gros Morne National Park (Canada) of -1.87 using an adjusted Poisson estimated with visitor opportunity costs. The elasticity estimates presented in this section fall within the range suggested by Loomis and Walsh (1997) as well as the range reported in other more recent recreation demand studies.

In the applications that use results from models estimated without opportunity costs (Tables 4.7 and 4.8), a $1.00 fee increase is expected to generate over $900,000 in additional park revenue. Price response in Table 4.8, which uses results from the model that included the 'annpass' variable, is relatively less elastic than in Table 4.7, which uses results from the model estimated without that variable. Visitation is therefore predicted to decline less rapidly in in Table 4.8, and expected fee revenue is higher. In fact, at an $8.00 fee, expected revenue is almost

$50,000 higher when estimated using model results that included 'annpass.' Expected revenue is maximized somewhere in the $7.00 to $8.00 fee range in these applications that used model results estimated without visitor opportunity costs of time. Predicted visitation drops off to levels that offset the additional revenue when considering fees above $8.00. This result suggests that a fee revenue-maximizing park management strategy would involve about a $3.00 entrance fee increase. Of course, these estimates are based on the assumption that individuals do not incur opportunity costs when visiting these state parks.

The applications that use models results estimated with opportunity costs (Tables 4.9, 4.10 and 4.11) predict even greater expected revenues for each fee increase. For example, the same $1.00 entrance fee increase to $6.00 is expected to generate over $950,000 in each of those applications. Entrance fees of $7.00 and higher are expected to generate at least $1,000,000 in park revenue. The value by which opportunity costs are proxied affects revenue predictions, as the opportunity cost specifications that imply higher valued time costs predict a less elastic price response. The full wage rate application (Table 4.11) assumes the largest value for those costs. As such, relative to Tables 4.9 and 4.10, visitation is predicted to fall less rapidly and expected revenue is highest in that application. Average travel costs estimated using the minimum wage opportunity cost specification fall between the other two specifications. Price response and expected revenue for that application (Table 4.9) fall within the other two as well. The 1/3 household wage model has the lowest average travel costs of the opportunity cost class of applications, and its revenue predictions provide a lower bound for those applications as well. All three of these applications predict revenue will continue to rise until fees are at least $15.00, implying that increases of $10.00 would generate additional revenue for the parks.

Comparing between these two classes of applications, the range of expected revenue for a $6.00 entrance fee is within $914,000 and $921,000 in the no opportunity cost applications. That range rises to $953,00 to $969,000 in the applications using model results with opportunity costs considered. For a $2.00 increase, the no opportunity cost applications predict revenue would rise between $970,000 and $995,000. The same fee increase is expected to generate revenues between $1,108,000 and $1,114,000 for the class of opportunity cost applications. Entrance fee increases of $3.00 and higher have mixed effects depending on model assumptions. Expected revenue begins to decline in the applications when using results estimated without opportunity costs, and continues to increase moderately in the applications using results assuming those costs valued positively.

These applications imply there is potential for revenue capture at the state parks included in the GASPDP sample. Increased entrance fees are likely to reduce park visitation, however estimated demand is sufficiently inelastic that marginal fee increases would provide additional revenue. Expected revenue estimates are somewhat sensitive to model assumptions, however the assumptions explored in these applications are expected to provide a robust range of relevant estimates.

Welfare Change

As noted in Chapter Two, price increases are likely to reduce consumer welfare. As such, increases in admission fees at northern Georgia state parks are likely to result in visitor welfare reductions. Consumer surplus (CS) is a common metric for consumer welfare, equal to the price an individual would be willing to pay (WTP) less the price actually paid (Freeman 2003). Demand estimates from the TCM models allow for measurement of visitors' WTP for recreation at the state parks, and the "price" actually paid can be inferred from their per-visit travel costs.

Increases in the entrance fee will generally result in similar increases in visitors' travel costs, or price paid, in which case there will be reductions in visitor CS.

Consumer surplus is often used to measure benefits in benefit-cost analysis (BCA). Its estimation can provide park management with policy-relevant information, particularly useful when making decisions that affect visitor benefits, such as programming expansions, facility improvements, and service reductions. Additionally, CS estimates provide an indication of the economic value users gain from park visitation, which, when aggregated across all users, can proxy market values for park resources.

This application explores the changes in expected consumer surplus associated with a range of fee increases at northern Georgia state parks. The TCM model estimates (Table 4.3) are used to calculate group CS, which is then combined with GASPHSD visitation estimates to calculate aggregate park CS at current access costs. Reductions in park attendance affected by different entrance fees are estimated identically as described in the expected revenue section of this chapter. Expected aggregate consumer surplus for each entrance fee may then be estimated. From there, the likely decrease in CS per fee increase is estimated by netting expected CS estimates by initial CS at current access costs.

The formula for calculating consumer surplus from semi-log models, as are the Poisson models estimated in this study, is equal to the negative inverse of the price coefficient. As travel costs are used to proxy market prices for recreational trips in TCM analysis, the estimated travel cost coefficient is used for these purposes. The unit of consumption modeled in this study is the traveling group, so consumer surplus estimates are framed in the same terms. The product of the total number of group trips to the parks and per-trip group CS provides a measure of aggregate CS for park users (Equation 4.7). Expected CS for fee increases may be estimated by multiplying the predicted park visitation associated with each fee level by group CS. Deducting expected from current CS provides an estimate of the expected change in CS associated with each fee. These calculations are detailed in the equations below.

$$\widehat{CS}_i = \left(-1/\beta_{tc}\right) * \widehat{V}_i \tag{4.4}$$

where,

$\widehat{CS}_i$ = expected aggregate group consumer surplus associated with fee level i, and

$\widehat{V}_i$ = expected group visitation associated with fee level i.

$$\Delta\widehat{CS}_i = \widehat{CS}_i - \widehat{CS}_o \tag{4.5}$$

where,

$\Delta\widehat{CS}_i$ = the change in CS associated with fee level i, and

$\widehat{CS}_o$ = expected aggregate CS under current access conditions.

Several important considerations are relevant to this application of TCM model results. As discussed previously, the TCM estimation sample group size used to scale GASPHSD visitation estimates was truncated at eight people. Mean group size for visitors to northern Georgia state parks is likely greater, as the truncation procedure eliminated large groups from the sample (e.g., church congregations, sports teams, boy scouts). To account for this, the GASPHSD visitation estimate was adjusted as discussed in the previous section.[62] The hotspot sampling protocol adjustment to the visitation estimated discussed previously was used for this

[62] Note that individual travel costs borne by members of larger groups may be reduced if there are a greater number of paying adults responsible for the spending party. Larger groups may therefore enjoy higher benefits, as the trip costs that serve as a lower bound for individual consumer surplus estimates may be reduced. Aggregate CS for these groups is therefore likely to be higher than that of smaller groups. If this is the case, the CS estimates reported in this thesis are likely conservative.

application as well. Expected CS estimates are calculated with a constant value of group CS per trip. This assumption implies the groups that continue to visit the parks after a fee increase will derive the same benefits as under the previous fee structure. This may not be the case. For example, benefits may increase for groups that enjoy less crowded parks. Additionally, these estimates are based on *ceteris paribus* conditions. That is, there are no changes at the parks other than variation in fee structure that affect site visitation. Other assumptions and limitations associated with this application are identical to those discussed previously in this chapter.

The tables presented below examine changes in consumer surplus for park users over a range of hypothetical entrance fees identical to those explored in previous applications. The tables that report expected CS without considering opportunity costs use results taken from the second set of estimation results reported in Table 4.3 (TCM #2). The tables that report expected CS with opportunity costs use results from the fourth model in that table (TCM #4), where those costs are proxied by 1/3 of the household wage rate adjusted by round-trip travel time. Group CS is calculated at $16.95 per group without opportunity costs, and $35.45 per group with those costs.

These CS calculations are generally within the range estimated in other recreational demand studies. Hesseln, Loomis and Gonzalez-Caban (2004) estimated Montana National Forest hikers enjoy $14.48 in CS per trip using results exclusive of opportunity costs.[63] Bowker, Bergstrom and Gill (2007) estimated groups that visited the VCT gained $50.28 in CS per trip exclusive of opportunity costs, and $85.85 if those costs are considered. Hynes and Green (2013) reported individual CS estimates ranging from $14.85 to $28.95 without opportunity costs. Betz, Bergstrom and Bowker (2003) predicted visitors to a hypothetical Georgia rail-trial would gain $25.68 in CS using model estimates without opportunity costs, and $40.65 if opportunity costs

[63] Again, all figures have been adjusted to 2010 dollars.

were considered relevant. Bin et al. (2005) estimated CS for a number of North Carolina beaches. Their calculations for individual visitor CS ranged from \$14.11 to \$99.75 without opportunity costs, and from \$28.59 to \$483.25 with those costs. Kaval and Loomis (2003) estimated individual visitors to National Parks in the southeast US gained \$32.81 in CS each day.

Table 4.12 – Expected Consumer Surplus; Fort Mountain, Fort Yargo and Red Top Mountain; No Opportunity Costs

(B_{tc} = -0.071; CS = \$16.95 per group trip).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\widehat{V}_i$ (Group)	$\widehat{CS}$ (\$1000s)	$\Delta\widehat{CS}$ (\$1000s)
5	0%	-0.98	0.0%	0.0%	163,748	\$2,778	\$0
6	20%	-1.04	6.0%	-6.3%	153,507	\$2,602	-\$174
7	40%	-1.10	12.0%	-13.2%	142,104	\$2,409	-\$367
8	60%	-1.16	18.0%	-20.9%	129,540	\$2,196	-\$580
10	100%	-1.28	30.0%	-38.4%	100,929	\$1,711	-\$1,065
15	200%	-1.57	60.1%	-94.5%	9,081	\$154	-\$2,622

Table 4.13 – Expected Consumer Surplus; Fort Mountain, Fort Yargo and Red Top Mountain; With Opportunity Costs

(B_{tc} = -0.028; CS = \$35.45 per group trip).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\widehat{V}_i$ (Group)	$\widehat{CS}$ (\$1000s)	$\Delta\widehat{CS}$ (\$1000s)
5	0%	-0.80	0.0%	0.0%	163,748	\$5,805	\$0
6	20%	-0.83	3.5%	-2.9%	158,966	\$5,636	-\$170
7	40%	-0.85	7.1%	-6.0%	153,857	\$5,455	-\$351
8	60%	-0.88	10.6%	-9.4%	148,421	\$5,262	-\$543
10	100%	-0.94	17.7%	-16.6%	136,568	\$4,842	-\$964
15	200%	-1.08	35.4%	-38.2%	101,217	\$3,588	-\$2,217

These tables indicate the extent to which visitor welfare may be affected if entrance fees were to increase at the state parks in the GSPDP sample. Note that these estimates are based on the fraction of estimated park visitation left after adjustment for the hotspot sampling protocol and the group size truncation procedure.[64] The effect of higher entrance fees on welfare for the park visitors excluded by these adjustments is unknown. However, those visitors most likely would experience some degree of CS reduction if park fees were to increase. Therefore, the expected CS estimates reported in this application should be considered conservative. As expected, the tables predict that fee increases would affect reductions in visitor CS. For example, if the entrance fee were increased from $5.00 to $6.00, aggregate visitor CS is expected to decline by $173,589, or 6.25% (assuming no opportunity costs). A $2.00 increase to $7.00 is predicted to result in a $366,858 less in total CS, a 7.43% decline. These decreases continue to expand with higher fee levels. The assumption of opportunity costs dampens the rate of CS decline, but does not have a large effect on the magnitude of the losses. [65] For example, the same fee increase from $5.00 to $6.00 is expected to affect a 2.92% decline in aggregate CS using model results estimated with opportunity costs – 3.33% less than predicted using results estimated without those costs. However, the 2.92% reduction amounts to $169,542 less in total CS – a level within 3% of the loss predicted if opportunity costs are not assumed relevant ($173,589). A fee increase from $7.00 to $8.00 at the typical state park is predicted to reduce aggregate CS by 3.21% using model results estimated with opportunity costs, a much smaller rate than the 7.43% predicted if opportunity costs are not assumed. The magnitude of the two

[64] The hotspot and truncation adjustments left TCM estimation results applicable to 44.0% of the Fort Mountain sample, 55.7% of the Fort Yargo Sample, 65.6% of the Red Top Mountain sample, and 59.5% of the combined park sample.

[65] Note that the level of CS at the current fee level is more than doubled when opportunity costs are considered. This outcome is not unlike Zawacki, Marsinko and Bowker (2000) who find including these costs increases CS estimates by three times on average.

decreases, however, is still somewhat similar ($350,673 compared to $366,858 for the estimates with and without opportunity costs, respectively).

Table 4.14 – Expected Consumer Surplus; Fort Mountain; No Opportunity Costs
(B_{tc} = -0.071; CS = $16.95 per group trip).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	$\widehat{CS}$ ($1000s)	$\Delta\widehat{CS}$ ($1000s)
5	0%	-0.98	0.0%	0.0%	13,423	$228	$0
6	20%	-1.04	6.0%	-6.3%	12,583	$213	-$14
7	40%	-1.10	12.0%	-13.2%	11,648	$197	-$30
8	60%	-1.16	18.0%	-20.9%	10,619	$180	-$48
10	100%	-1.28	30.0%	-38.4%	8,273	$140	-$87
15	200%	-1.57	60.1%	-94.5%	744	$13	-$215

Table 4.15 – Expected Consumer Surplus; Fort Mountain; With Opportunity Costs
(B_{tc} = -0.028; CS = $35.45 per group trip).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	$\widehat{CS}$ ($1000s)	$\Delta\widehat{CS}$ ($1000s)
5	0%	-0.80	0.0%	0.0%	13,137	$466	$0
6	20%	-0.83	3.5%	-2.9%	12,754	$452	-$14
7	40%	-0.85	7.1%	-6.0%	12,344	$438	-$28
8	60%	-0.88	10.6%	-9.4%	11,908	$422	-$44
10	100%	-0.94	17.7%	-16.6%	10,957	$389	-$77
15	200%	-1.08	35.4%	-38.2%	8,121	$288	-$178

Expected CS estimates for the specific parks are somewhat dissimilar. The linear relationship between park visitation and CS shown in Equation (4.4) determines expected CS. Initial visitation levels are based on GASPHSD estimates and are specific to each park. However, estimates consumer surplus changes at each park are calculated using the same travel cost coefficient – that from either TCM #2 or TCM #4, depending on whether opportunity costs are considered or not. Therefore, because CS does not vary with fees, the predicted rate of CS decline for each entrance fee is common across all parks (although it varies whether opportunity costs are considered or not). The only difference between parks is the starting point, or the initial level of estimated park visitation.

Table 4.16 – Expected Consumer Surplus; Fort Yargo; No Opportunity Costs (B_{tc} = -0.071; CS = \$16.95 per group trip).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	$\widehat{CS}$ (\$1000s)	$\Delta\widehat{CS}$ (\$1000s)
5	0%	-0.98	0.0%	0.0%	58,618	$994	$0
6	20%	-1.04	6.0%	-6.3%	54,952	$931	-$62
7	40%	-1.10	12.0%	-13.2%	50,870	$862	-$131
8	60%	-1.16	18.0%	-20.9%	46,372	$786	-$208
10	100%	-1.28	30.0%	-38.4%	36,130	$612	-$381
15	200%	-1.57	60.1%	-94.5%	3,251	$55	-$939

Table 4.17 – Expected Consumer Surplus; Fort Yargo; With Opportunity Costs (B_{tc} = -0.028; CS = \$35.45 per group trip).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	$\widehat{CS}$ (\$1000s)	$\Delta\widehat{CS}$ (\$1000s)
5	0%	-0.80	0.0%	0.0%	58,618	$2,078	$0
6	20%	-0.83	3.5%	-2.9%	56,906	$2,018	-$61
7	40%	-0.85	7.1%	-6.0%	55,077	$1,953	-$126
8	60%	-0.88	10.6%	-9.4%	53,131	$1,884	-$195
10	100%	-0.94	17.7%	-16.6%	48,888	$1,733	-$345
15	200%	-1.08	35.4%	-38.2%	36,233	$1,285	-$794

For example, a fee increase from \$5.00 to \$6.00 is estimated to reduce aggregate CS by \$14,229 at Fort Mountain[66] - a decline of 6.3%. The same increase is predicted to affect \$96,744 less in total CS at Red Top Mountain (below) – also a 6.3% decrease. The magnitude of these estimates differ only because the initial level of visitation is dissimilar (13,423 group visits at Fort Mountain and 91,260 at Red Top Mountain).

Table 4.18 – Expected Consumer Surplus; Red Top Mountain; No Opportunity Costs (B_{tc} = -0.071; CS = \$16.95 per group trip).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	$\widehat{CS}$ (\$1000s)	$\Delta\widehat{CS}$ (\$1000s)
5	0%	-0.98	0.0%	0.0%	91,260	$1,547	$0
6	20%	-1.04	6.0%	-6.3%	85,552	$1,450	-$97
7	40%	-1.10	12.0%	-13.2%	79,197	$1,342	-$205
8	60%	-1.16	18.0%	-20.9%	72,195	$1,224	-$323
10	100%	-1.28	30.0%	-38.4%	56,250	$953	-$593
15	200%	-1.57	60.1%	-94.5%	5,061	$86	-$1,461

[66] Assuming no opportunity costs.

Table 4.19 – Expected Consumer Surplus; Red Top Mountain; With Opportunity Costs (B_{tc} = -0.028; CS = \$35.45 per group trip).

Entrance Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\widehat{V}_i$ (Group)	$\widehat{CS}$ (\$1000s)	$\Delta\widehat{CS}$ (\$1000s)
5	0%	-0.80	0.0%	0.0%	91,260	$3,235	$0
6	20%	-0.83	3.5%	-2.9%	88,594	$3,141	-$95
7	40%	-0.85	7.1%	-6.0%	85,747	$3,040	-$195
8	60%	-0.88	10.6%	-9.4%	82,718	$2,933	-$303
10	100%	-0.94	17.7%	-16.6%	76,112	$2,698	-$537
15	200%	-1.08	35.4%	-38.2%	56,410	$2,000	-$1,236

These applications demonstrate how visitor welfare at the parks may be affected if management implemented a policy that increased entrance fees. Visitor benefits would clearly decline, the extent of which depends on the fee level and assumptions regarding how visitors value their time. Park-specific price response estimates would provide a much finer level of detail concerning the likely changes in CS at each park, however the available data prevented estimation of the models necessary for these calculations. Regardless, information of this type may be useful for park management when conducting benefit-cost analyses, or when making decisions that involve tradeoffs between visitor welfare and other management objectives. In addition, CS is a widely recognized economic valuation metric that can be used to measure the benefits of park resources. In aggregate, these benefits may be used as proxies for the market values of those resources.

Visitor Diversity

The effect of changes in the entrance fee structure on diversity at northern Georgia state parks was explored through an estimation of the TCM data with a varying parameters empirical model as specified in Equation (3.10). This type of model structure permits testing price response across ethnic groups (Bowker and Leeworthy 1998). The particular model estimated in this study included a Hispanic-travel cost interaction term, allowing the price response for Hispanic visitors to vary from other ethnicities in the sample. This enabled testing of whether Hispanics as a group respond differently than non-Hispanics to travel costs, and thus whether they would be differentially impacted by entrance fee increases. This and similar information may allow park management to more fully assess the impact of pricing policies on goals related to equity and diversity at the state parks.

Ethnicity Model Estimation and Results

Data for the ethnicity estimations were taken from survey modules two and three of the GSPDP sample. Models were tested that included a Black-travel cost interaction term, however the proportion of Blacks in the sample was too small to yield reliable estimates. As a second best estimation protocol, an indicator variable for Black visitors was included ('black'). This strategy imposed the assumption that price response for Black visitors was identical to the remainder of the non-Hispanic sample, however inclusion of a Black dummy variable allowed that group to exhibit different trip-taking behavior than the rest of the sample (i.e., Black visitors take a different number of annual trips to the parks). Similarly to Thapa, Graefe and Absher (2002), all visitor ethnicities besides Hispanic and Black were collapsed into a common category ('nonhisp').[67] The summary statistics for this estimation sample are presented in Table 4.20. The data were estimated as described previously in this chapter. Estimation results are given in Table 4.21.

[67] The sample sizes of other ethnicities in the sample were too small for independent estimation.

Table 4.20– Ethnicity Model Sample Descriptive Statistics Survey Modules #2 & #3 (n=1309).

	Hispanic Mean (n=249)	Hispanic Min/Max	Black Mean (n=95)	Black Min/Max	White/Asian Mean (n=944)	White/Asian Min/Max
trips	3.21	1/20	2.56	1/20	4.14	1/40
subsite (yes)	30.70%	0/1	27.70%	0/1	27.50%	0/1
tcost	$15.42	$5.34/$55.22	$15.85	$6.67/$45.18	$16.39	$5.34/$55.22
tcostopp	$26.81	$5.70/$110.04	$27.69	$8.50/$89.04	$28.82	$5.70/$110.04
income (1,000s)	$35.5	12.5/112.5	$54.7	12.5/112.5	$59.90	12.5/112.5
college grad.	28%	0/1	72.5%	0/1	63.1%	0/1
age	33.8	18/74	41.3	18/77	18/83	18/77
male	52.1%	0/1	60.9%	0/1	61.0%	0/1
grpsize	4.9	1/8	4.4	1/8	4.0	1/8
freeday	14.5%	0/1	14.7%	0/1	16.7%	0/1

Table 4.21 – Ethnicity Model Parameter Estimates.[68]

	Without Opportunity Costs	1/3 HH Wage Opportunity Cost Specification
tcost(opp)	-0.0714**	-0.0341**
	(0.0037)	(0.0018)
subsite	-0.0968*	-0.0968*
	(0.0418)	(0.0418)
income	-0.0030**	-0.0030**
	(0.0006)	(0.0006)
age	-0.0003	-0.0003
	(0.0014)	(0.0014)
male	-0.0884*	-0.0884*
	(0.0362)	(0.0362)
grpsize	0.0094	0.0094
	(0.0097)	(0.0097)
FM	0.2097**	0.2097**
	(0.0487)	(0.0487)
FY	0.2826**	0.2826**
	(0.0457)	(0.0457)
freeday	0.5628**	0.5628**
	(0.0408)	(0.0408)
hisp	-0.8197**	-0.7300**
	(0.1226)	(0.1033)
black	-0.6521**	-0.6521**
	(0.0913)	(0.0913)
hisptcost(opp)	0.0344**	0.0164**
	(0.0085)	(0.0041)
constant	0.5628**	1.8852**
	(0.0408)	(0.0944)
n	1120.0000	1120.0000
LL	-3856.9521	-3856.9521
LR	1470.4500	1470.4500
Pseudo R2	0.1601	0.1601

The ethnicity model parameters are mostly similar in sign, significance and magnitude to those from the general TCM models detailed previously in this chapter (Table 4.3). However, care should be taken when making comparisons between the two sets of models, as the ethnicity estimations contain additional covariates (‘hisp,” ‘black’, and ‘hisptcost(opp)’) and omit the

[68] ** = significant at $p \leq 0.01$; *= significant at $p \leq 0.05$.

‘annpass’ variable.[69] Additionally, limitations associated with the estimation of conceivably overdispersed data with a Poisson estimator necessitate caution when interpreting parameter significance. Nevertheless, a brief comparison of parameter estimates may be useful to better understand the effects of including additional ethnic covariates in the TCM models. The most relevant model for comparison with the ethnicity model estimated exclusive of opportunity costs is the first TCM model reported previously in this chapter (TCM #1), as the two include the greatest number of like variables. The ethnicity model estimated with opportunity costs is most similar to the fourth TCM model previously reported (TCM #4). The details of TCM #1 and TCM #4 can be found in Table 4.3.

The ethnicity model parameter signs were almost entirely identical to those from the previously reported TCM models, both with and without opportunity costs.[70] This result indicates that the directional relationship between trip frequency and model covariates was maintained after including the ethnicity terms. In effect, the ethnic and general TCM models performed similarly with respect to variable correlations. However, the magnitude of variables’ effects differed somewhat between the two sets of models.

The substitute site coefficient was significant in both ethnicity model specifications and in TCM #1, whereas in TCM #4 that parameter was not significant at the $p \leq 0.05$ level. Its sign was negative across all models, indicating that groups which feel there to be available substitutes for recreation at northern Georgia state parks take fewer trips than those which do not. However, inclusion of ethnicity covariates causes slight variation in the magnitude of effect that substitute site availability has on trip demand. The parameter estimates from the ethnicity models were less

[69] The ‘annpass’ variable was excluded from the ethnicity models to ensure a sizeable estimation sample. As noted previously, adding ‘annpass’ to estimated models limits the estimation sample to observations from survey module #2. Observations from survey modules #2 and #3 are included otherwise.
[70] The parameter for the age variable is negative in the ethnicity model estimated without opportunity costs, and is positive in TCM #1. However, is insignificantly different from zero in the ethnicity model.

negative than that from TCM #1. This result indicates that the effect of substitute site availability decreases somewhat when the preferences for Hispanics and Blacks are controlled for in model estimation.

The income coefficient is significant in both ethnicity models, as is the case in only the general TCM model estimated without opportunity costs (TCM #1). The parameters from the ethnicity models estimated are also approximately 65% larger than the coefficient from TCM #1. This result suggests that the effect of income on trip demand was greater after the visitation preferences for Hispanic and Black visitors are controlled for. However, despite these seemingly large proportional differences, the size of the income parameter was relatively small across all of the estimated models. This result indicates that the magnitude of effect income has on trip demand is negligible, all else being equal.

Age was significant only in the TCM #4, as was visitor group size. Parameter estimates for 'freeday,' the indicator variable denoting visitors interviewed on a free admission day, were almost identical between TCM #1 and the ethnicity models. The parameter estimate from TCM #4 was slightly larger. Gender was significant at the $p \leq 0.05$ level in the ethnicity model estimated without opportunity costs. In TCM #1, that parameter narrowly fell short of significance at that level. Gender was significant in both TCM #3 and the ethnicity model estimated with opportunity costs, but was much smaller in value in the latter. This result suggests that the effect of gender on trip demand becomes more pronounced after controlling for Hispanic and Black visitor ethnicity in estimation of the TCM data.

The Fort Mountain and Fort Yargo dummy variable coefficients remain significant, but take smaller values in the ethnicity models. This result indicates that the inclusion of ethnic covariates lessens the magnitude of effect park selection has on visitor demand when travel costs are considered without opportunity costs. However, this result could be due to the distribution of visitor ethnicities across the parks rather than from controlling for ethnicity. That is, Fort Mountain and Fort Yargo may simply have higher proportions of Black and Hispanic visitors than Red Top Mountain, and this characteristic may picked up by the models after including the ethnic variables.

Comparing the ethnicity models themselves, the ethnic dummy variable coefficients (‘black’ and ‘hisp’) were significant and negative in both models, indicating that trip demand for visitors of those ethnicities was less than other visitors in the sample.[71] The travel cost coefficient was negative in both models, which is consistent with economic theory and indicative of a downward sloping demand curve (i.e., as travel costs increase, trip frequency decreases). The Hispanic-travel cost interaction term was positive in each of the models, which indicates that the effect of travel costs on trip demand is reduced for Hispanic visitors. Multiple preliminary models including this interaction term were estimated and not reported in this study. In all cases its parameter was found positive and significant. The robustness of the Hispanic-travel cost coefficient across different model specifications supports the proposition that Hispanics are less sensitive to travel costs than non-Hispanics. The diversity effects of this result are explored in the applications that follow.

Note that other recreation demand studies have included ethnic dummy variables in models to test for possible demand differences (Bockstael, Hanemann and King 1987; Milon 1988; Poor and Smith 2004). Several studies have used a varying parameters approach to model differential price and consumer surplus effects for site recreational characteristics (Hesseln, Loomis and Gonzalez-Caban 2003; Loomis, Gonzalez-Caban and Englin 2001) or for multiple sites estimated within a single-site framework (Bin et al. 2005; Vaughan and Russell 1982).

[71] The base group was ‘nonhisp’, which included visitors of all ethnicities other than Hispanic and Black.

However, Bowker and Leeworthy (1998) was the only other study found offering a similar varying parameters approach for ethnic price response estimation.

Hispanic Price Elasticity and Visitor Proportion

The formula for calculation of Hispanic visitor price elasticity is equal to the sum of the travel cost and the Hispanic-travel cost interaction term coefficients multiplied by Hispanic mean travel costs (Leeworthy and Bowker 1997; Loomis, Gonzalez-Caban and Englin 2001). Non-Hispanic elasticity is simply the product of mean travel costs for that group of park visitors and the estimated travel cost coefficient. These calculations are explained in equation (4.6).

$$\boldsymbol{\varepsilon_{ij}} = \boldsymbol{\beta_{tc_j}} * \overline{\boldsymbol{TC_{ij}}}, \qquad (4.6)$$

where

$\boldsymbol{\varepsilon_{ij}}$ = price elasticity of demand associated with fee level $\boldsymbol{i}$ and ethnicity $\boldsymbol{j}$,

$\boldsymbol{\beta_{tc_j}}$ = the estimated travel cost coefficient associated with ethnicity $\boldsymbol{j}$, $\boldsymbol{\beta_{tc_{ij}}} = (\boldsymbol{\beta_{tc}} + \boldsymbol{\beta_{htc}})$ for Hispanic visitors**,** where $\boldsymbol{\beta_{htc}}$ is the estimated coefficient of the Hispanic-travel cost interaction term, $\boldsymbol{\beta_{tc_{ij}}} = \boldsymbol{\beta_{tc}}$ for non-Hispanic visitors, and

$\overline{\boldsymbol{TC_{ij}}}$ = mean travel costs at fee level $\boldsymbol{i}$ for ethnicity $\boldsymbol{j}$.

Using calculations of Hispanic price response, the proportion of Hispanic visitors in the GSPDP sample may be estimated for each fee level. Equation 4.7 shows how the percentage change in Hispanic and non-Hispanic park visitation for each entrance fee visitors was calculated. The number of group trips this change represents was calculated by adjusting current group visitation by this proportion (Equation 4.8). From there, Equation 4.9 shows how the relative proportion of each group expected to continue visiting the parks as fees increased was calculated – essentially this is the ratio of expected visitation for each group to total expected park visitation. Examining these relative proportions for different fee levels provides a measurement of the diversity change in park visitation associated with variation in the entrance fee policy.

$$\%\Delta \boldsymbol{q}_{ij} = \boldsymbol{\varepsilon}_{ij} * \%\Delta \boldsymbol{p}_{ij} , \tag{4.7}$$

$$\%\Delta \boldsymbol{q}_{ij} * \boldsymbol{V}_j = \widehat{\boldsymbol{V}}_{ij}. \tag{4.8}$$

where,

$\%\Delta \boldsymbol{q}_{ij}$ = percentage change in visitation affected by entrance fee $\boldsymbol{i}$ for ethnicity $\boldsymbol{j}$,

$\%\Delta \boldsymbol{p}_{ij}$ = percentage change in travel costs affected by entrance fee $\boldsymbol{i}$ for ethnicity $\boldsymbol{j}$,

$\boldsymbol{V}_j$ = current park visitation for ethnicity $\boldsymbol{j}$, and

$\widehat{\boldsymbol{V}}_{ij}$ = expected park visitation for ethnicity $\boldsymbol{j}$ assuming fee level $\boldsymbol{i}$.

$$\%\widehat{\boldsymbol{V}}_{ij} = \widehat{\boldsymbol{V}}_{ij} \Big/ \sum_{j=h}^{nh} \widehat{\boldsymbol{V}}_{ij} \tag{4.9}$$

Tables 4.22 and 4.23 present the predicted proportions of Hispanic and non-Hispanic visitors at northern Georgia state parks for a range of hypothetical fees. The first table uses results from the model estimated without visitor opportunity costs, and the second from the model estimated with opportunity costs proxied by one-third/3 of the estimated sample average household wage rate ($9.14) scaled by round-trip travel time. Relative proportions of visitor ethnicities are predicted for both individual and group park attendance, as group sizes for Hispanics and non-Hispanics in the estimation sample differ.

The same considerations associated with using TCM model estimation results for visitation predictions discussed previously in this chapter apply similarly to these applications. Additionally, the empirical model specification imposed the assumption that all ethnicities other than Hispanics have identical price responses. The proportions of other visitors in the sample were relatively small, which prevented the inclusion of additional ethnic-travel cost interaction terms to estimate their independent price responses. However, even were these visitors highly price sensitive, their relative proportion in the GSPDP sample would not change dramatically with fee increases because their initial proportions are so minor.

Table 4.22 – Elasticity and Relative Visitor Proportion: Hispanics, No Opportunity Costs

(B_{tc} = -0.071; B_{htc} = 0.0344; $\overline{TC}_{nh}$ = \$16.39 ; $\overline{TC}_{nh}$ = \$15.42).

Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	Proportion (Group)	$\hat{V}_i$ (Indiv.)	Proportion (Indiv.)
5	0%	-0.57	0.0%	0.0%	249	19.3%	1220	22.7%
6	20%	-0.61	6.5%	-3.9%	239	19.9%	1172	23.4%
7	40%	-0.64	13.0%	-8.4%	228	20.7%	1118	24.3%
8	60%	-0.68	19.5%	-13.3%	216	21.8%	1058	25.4%
10	100%	-0.76	32.4%	-24.5%	188	25.3%	921	29.3%
15	-	-	-	-	-	-	-	-

Table 4.23 – Elasticity and Relative Visitor Proportion: non-Hispanics, No Opportunity Costs

(B_{tc} = -0.071; B_{htc} = 0.0344; $\overline{TC}_{nh}$ = \$16.39 ; $\overline{TC}_{nh}$ = \$15.42).

Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	Proportion (Group)	$\hat{V}_i$ (Indiv.)	Proportion (Indiv.)
5	0%	-1.17	0.0%	0.0%	1039	80.7%	4156	77.3%
6	20%	-1.24	6.1%	-7.6%	960	80.1%	3841	76.6%
7	40%	-1.31	12.2%	-16.0%	873	79.3%	3491	75.7%
8	60%	-1.38	18.3%	-25.3%	776	78.2%	3103	74.6%
10	100%	-1.53	30.5%	-46.6%	555	74.7%	2221	70.7%
15	-	-	-	-	-	-	-	-

As previously noted, Hispanic visitors are less price sensitive than non-Hispanics on average. At current fee levels using results from the model estimated without opportunity costs

(Tables 4.22 and 4.23), Hispanic price elasticity is -0.57 and non-Hispanic -1.17. Elasticities of larger magnitudes in absolute terms imply a greater price response. As such, fee increases should be expected to affect a greater decline in visitation by non-Hispanic groups. The tables above support this outcome. As the hypothetical fee level increases, the proportion of Hispanic visitors slightly increases relative to non-Hispanics. These results are contrary to Bowker and Leeworthy (1998), who found Hispanics more price sensitive than non-Hispanics in their sample of Florida Keys visitors (-1.15 versus -0.30, respectively), implying their relative proportion would decrease if travel costs increased.

When calculated on an individual, rather than group basis, the relative proportion of Hispanic visitors in the sample is greater and increases faster with the hypothetical fees. This is due to their larger average group size.[72] For example, the GSPDP sample at current access costs is 19.3% Hispanic if calculated by group, and 22.7% Hispanic. Using model results estimated without opportunity costs, a $8.00 is expected to increase the proportion of Hispanic groups in the sample to21.8%, and Hispanic individuals to 25.4%. So, the same $3.00 fee hike is expected to increase the relative proportion of Hispanic visitors by 2.5% if calculated by group, and 2.7% if calculated by individual.

Table 4.24 – Elasticity and Relative Visitor Proportion: Hispanics, With Opportunity Costs
(B_{tc} = -0.0341; B_{htc} = 0.0164; $\overline{TC}_{nh}$ = \$28.82; $\overline{TC}_{nh}$ = \$26.81).

Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	Proportion (Group)	$\hat{V}_i$ (Indiv.)	Proportion (Indiv.)
5	0%	-0.47	0.0%	0.0%	249	19.3%	1220	22.7%
6	20%	-0.49	3.7%	-1.8%	244	19.6%	1198	23.0%
7	40%	-0.51	7.5%	-3.8%	240	19.9%	1174	23.4%
8	60%	-0.53	11.2%	-5.9%	234	20.3%	1148	23.7%
10	100%	-0.56	18.6%	-10.5%	223	21.1%	1092	24.7%
15	200%	-0.65	37.3%	-24.3%	189	25.1%	924	29.1%

[72] The estimation sample average group size is 4.9 people for Hispanics and 4.0 for non-Hispanics.

Table 4.25 – Elasticity and Relative Visitor Proportion: non-Hispanics, With Opportunity Costs

(B_{tc} = -0.0341; B_{htc} = 0.0164; $\overline{TC}_{nh}$ = \$28.82; $\overline{TC}_{nh}$ = \$26.81).

Fee	% Fee Change	Elasticity	%ΔP	%ΔQ	$\hat{V}_i$ (Group)	Proportion (Group)	$\hat{V}_i$ (Indiv.)	Proportion (Indiv.)
5	0%	-0.98	0.0%	0.0%	1039	19.3%	4156	77.3%
6	20%	-1.02	3.5%	-3.5%	1002	19.6%	4009	77.0%
7	40%	-1.05	6.9%	-7.3%	963	19.9%	3853	76.6%
8	60%	-1.09	10.4%	-11.3%	922	20.3%	3686	76.3%
10	100%	-1.15	17.3%	-20.0%	831	21.1%	3324	75.3%
15	200%	-1.32	34.7%	-46.0%	562	25.1%	2246	70.9%

As noted in Chapter Three, the addition of opportunity costs usually dampens visitor price response because marginal increases in travel costs then become less meaningful with respect to total costs. Table 4.24 reflects this concept, as the relative proportion of Hispanic visitors increases at a slower rate with fee increases when these costs are considered in model estimation. At a fee level of \$10.00, the sample proportion of Hispanic groups is expected to be 27.1% in Table 4.24. The same admission charge is expected to affect a sample proportion of only 22.2% Hispanic groups if calculated using results from the model estimated with opportunity costs (Table 4.22).

It should be noted that the group size truncation procedure eliminated 41.7% of the Hispanic and 18.5% of non-Hispanic observations in the TCM sample. It is uncertain whether larger groups would respond similarly to price increases as those included in the estimation sample. However, increasing the truncation size to 10 people resulted in price elasticities calculated at -1.23 for non-Hispanic groups and -0.57 for Hispanic groups using results from a model estimated without opportunity costs. These differences between these elasticities and those reported in the tables above are minimal, especially for Hispanic groups. A model estimated without truncating group size at all resulted in elasticity calculations of -1.27 and -0.62

for non-Hispanic and Hispanic groups, respectively (at current access costs and exclusive of opportunity costs). Again, the differences between these elasticity estimates and those calculated using results from Table 4.21 are very slight. This outcome supports the conclusions reached in this application that Hispanics in the GSPDP sample are less price sensitive than non-Hispanics.

It should be reiterated that the estimates used for these calculations pertain only to groups of eight people or less that were interviewed at recreational hotspots at the parks. Extrapolation to GASPHSD visitation estimates would require adjustments for the sampling and truncation procedures that create this limitation. If examining the decline in visitation on a per capita, rather than proportional basis, that type of analysis would be useful.[73]

The application of ethnicity model results in this section reveals how park diversity could change if entrance fees were increased. The outcome reached suggests fee increases are likely to expand the relative proportion of Hispanic visitors in the GSPDP sample, but by very minimal margins. Given adequate sample sizes, similar applications could be estimated for other ethnicities. These results could provide park management with useful information concerning the likely implications of pricing policy alternatives on equity and diversity at these state parks.

Expected Economic Impacts

Visitation by non-locals is a primary driver of economic impacts. Equation (3.26) (reproduced below) reveals a linear relationship between the two. As detailed in the previous section, increases in park entrance fees are expected to decrease site visitation. Therefore, such increases are also likely to reduce local economic impacts. Estimates of economic impacts are often used in management to measure the effect of policy or structural changes on output,

[73] Note that the relative change in GASPHSD Hispanic visitor proportion would likely be similar to that estimated in the GSPDP sample, as both would be based on the same ethnic visitor proportions and model results. For reference, the proportion of Hispanic groups in sample provided by GASPHSD at current park access costs is expected to be 17.2% after these adjustments - a level fairly similar to that estimated in the GSPDP sample at the same costs.

income and jobs in a regional economy. Quantification of the degree to which different entrance fee structures may affect local economic impacts could provide park management with additional information to assess the economic implications of pricing policy alternatives on communities proximate to the parks.

This application predicts total output impacts using results from two of the estimated TCM demand models discussed previously. One model was estimated without opportunity costs (TCM #2), and the other included a measurement for those costs proxied by 1/3 of the estimated sample average household wage scaled by total travel time (TCM #4). Projected park visitation for hypothetical entrance fee increases was calculated using the procedures outlined in the expected revenue section. The likely economic impacts associated with each hypothetical fee were estimated by calculating the product of projected visitation and the expenditure estimates and output multipliers sourced from the studies discussed in Chapter Three and in more detail below. This is explained in Equation (4.10). Note GASPHSD visitation estimates were adjusted to reflect only non-local visitors as detailed in Chapter Three (Figure 3.10), as only those expenditures are relevant to economic impacts. Visitation estimates were also adjusted for the hotspot sampling protocol and the group size truncation procedures discussed previously in this chapter.

$$\boldsymbol{EI} = \boldsymbol{V}*\boldsymbol{S}*\boldsymbol{M},$$

where

$\boldsymbol{EI}$ = economic impact,

$\boldsymbol{S}$ = average visitor expenditures, and

$\boldsymbol{M}$ = multiplier.

$$\widehat{EI}_{ij} = \widehat{V}_i * S_j * M_j, \tag{4.10}$$

where

$\widehat{EI}_{ij}$ = expected economic impact assuming fee level i , with expenditure estimates and multipliers from study j.

Expenditure estimates and multipliers from multiple impact studies were used in this application in order to assess variation in impacts due to different assumptions concerning visitor expenditures and the economic complexity of local communities.[74] Larger and more complex economies generally create larger economic impacts (Stynes 1997). Impact regions ranged from a relatively rural area in the Virginia Creeper Trail (VCT) study (Bowker, Bergstrom and Gill 2007), to the entire state in the study of Tennessee State Parks (Fly et al. 2010). The impact area of the North Carolina State Park study (Greenwood and Vick 2008) consisted only of the county where the park is located, which is expected to be more consistent with that of northern Georgia state parks. The VCT study was expected to represent a lower bound for impact estimates, and the TN study an upper bound. Some additional discussion of these studies may provide a greater degree of insight into their differences.

Bowker, Bergstrom and Gill (2007) estimate economic impacts and net economic value for the VCT under an integrated framework using primary survey data on visitor preferences and expenditures. Intercept surveys were administered on the trail between November 1, 2002 and October 31, 2003 following a stratified random sampling approach. The survey instrument gathered information on users' characteristics and preferences, as well as expenditures in the local area (defined as within a 25 mile radius of the trail) for non-local visitors. There were 1,036

[74] Note that individual expenditure estimates from these studies were adjusted by GSPDP sample average group sizes to arrive at an estimate for group expenditures consistent with the unit of consumption used in the TCM estimations. Average group sizes were Average group sizes were 4.298 for the TCM estimation sample, 4.282 at Fort Mountain, 4.289 at Fort Yargo, and 4.206 at Red Top Mountain.

completed surveys in the sample (72% response rate), which translated to 112,366 annual person-trips to the VCT. The proportion of non-locals in the sample was 45%, and 85% of respondents were day use visitors. Local VCT users traveled an average of 7.8 miles to reach the trail, and non-locals 260 miles.

Analysis techniques included TCM data estimation with a zero-truncated negative binomial estimator (ZTNB) and economic impact analysis (multipliers sourced from IMPLAN). Primary purpose day use visitors spent an average of $20.29 in the local area, primary purpose overnight visitors $97.08, non-primary purpose day use visitors $14.56, and non-primary purpose overnight visitors $8.30.[75] Primary purpose day use multipliers were 1.35 for output, 1.33 for employment, and 1.44 for total value-added. Primary purpose overnight multipliers were 1.33, 1.23, and 1.37 for the same categories. These resulted in estimated total economic impacts of $1.6 million in output, 27.4 local jobs, and $0.921 million in value-added to a local economy that consisted of the two-county region surrounding the trail.

The sampling strategy for the Tennessee State Parks study (Fly et al. 2010) was a random phone survey of 1,137 state residents conducted by researchers at the University of Tennessee Human Dimensions Research Lab in 2009. Based on vehicle counts, there were an estimated 16.9 million visitors to Tennessee state parks in 2009, or 5,637,623 group visits assuming an average group size of three. Average expenditures per group while in Tennessee were $131.00 ($43.66 per person), resulting in a total direct effect of $738.5 million. Secondary effects of visitor expenditures were estimated with an input-output (I-O) model developed by the Agri-Industry Modeling and Analysis Group (AIMAG) specifically for Tennessee. The output multiplier used was 2.11, and the employment multiplier was 1.58. Accordingly, state park

[75] All figures from this point forward have been adjusted to 2010 dollars using the Bureau of Economic Analysis "Personal consumption expenditures: recreation services (chained-type price index)," available at http://research.stlouisfed.org/fred2/series/DRCARG3Q086SBEA?cid=21. Accessed 10/1/13.

visitor expenditures were estimated to have generated $1,559.95 million in total output and 11,812 full- and part-time jobs in Tennessee.

Greenwood and Vick (2008) used survey data from 2,148 North Carolina state park visitors to estimate economic impacts for a sample of 14 parks in 2004. Primary-purpose non-local visitors represented 39.3% of the sample (852 people). Non-local was defined as residing outside of the county in which the park was located. The NC Division of Parks and Recreation (NCDPR) provided visitation estimates for the study. Each visitor was estimated to spend $27.16 each day in the area nearby the parks. The average group size was 3.14 and the average length of stay was 1.73 days, resulting in per-trip group expenditures of $147.54. Secondary effects of these direct expenditures were estimated with IMPLAN. These differed by park, however the average output multiplier was 1.53. Employment multipliers were not reported. The impact area was limited to the county where the state park was located.

This study estimated total output economic impacts for each of the parks in the GASPDP sample and for the average northern Georgia state park using GASPHSD visitation estimates and expenditure estimates and output multipliers from the studies discussed above. Each estimation used park-specific average group sizes, mean travel costs, and proportions of non-local visitors. Impacts were estimated for the average northern Georgia state park using GSPDP sample averages for those values. Impacts were calculated for a range of hypothetical entrance fee increases to explore the likely reductions in total output associated with different pricing policies. Expected economic impacts calculated in terms of total output are presented in Tables 4.26 through 4.31.

These applications are subject to the same assumptions and constraints associated with the TCM estimations discussed previously in this chapter, as well as those associated with impact analyses detailed in previous chapters (e.g., no economies or diseconomies of scale, no product substitution, linearity in effects). The applications also assume visitors do not offset price increases at the parks by limiting expenditures in the local area. Considering entrance fees represent a minimal portion of total trip spending by most non-local visitors, this assumption may not be too limiting. It is also important to note that park visitation estimates have been adjusted for the GSPDP hotspot sampling protocol and the group size truncation procedure adopted for the TCM estimation sample, the details of which were explained previously.[76] Although it is not possible to determine how the proportion of visitors excluded by these adjustments will respond to increased entrance fees, their trip frequency will most likely decline. Therefore these adjustments likely result in conservative impact estimates, as the impacts reported below represent only a fraction of total park visitation.[77]

Table 4.26 – Expected Economic Impacts: VCT Expenditure Estimates and Multipliers; No Opportunity Costs ($1000s).

Fee	$\widehat{EI}$ Avg. SP	$\Delta\,\widehat{EI}$ Avg. SP	$\widehat{EI}$ FM	$\Delta\,\widehat{EI}$ FM	$\widehat{EI}$ FY	$\Delta\,\widehat{EI}$ FY	$\widehat{EI}$ RTM	$\Delta\,\widehat{EI}$ RTM
5	$3,216	$0	$1,104	$0	$2,259	$0	$5,631	$0
6	$3,015	-$201	$1,036	-$68	$2,115	-$144	$5,278	-$354
7	$2,791	-$425	$962	-$142	$1,950	-$309	$4,882	-$750
8	$2,544	-$672	$882	-$223	$1,763	-$496	$4,443	-$1,188
10	$1,982	-$1,234	$703	-$401	$1,326	-$933	$3,438	-$2,194
15	$178	-$3,038	$152	-$953	-$139	-$2,398	$179	-$5,452

76 The hotspot and truncation adjustments left TCM estimation results applicable to 44.5% of the Fort Mountain sample, 56.3% of the Fort Yargo Sample, 62.7% of the Red Top Mountain sample, and 58.8% of the combined park sample.

77 Moreover, as noted previously, multiple members of the same large groups may have been sampled, resulting in an overestimation of the proportion of the number of those groups in the sample. Thus, the proportion of the total visitation estimated to be outside of the range of these models' predictions may be overestimated as well. This could lead to even more conservative impact estimates.

Table 4.27 – Expected Economic Impacts: VCT Expenditure Estimates and Multipliers; With Opportunity Costs ($1000s).

Fee	$\widehat{EI}$ Avg. SP	Δ $\widehat{EI}$ Avg. SP	$\widehat{EI}$ FM	Δ $\widehat{EI}$ FM	$\widehat{EI}$ FY	Δ $\widehat{EI}$ FY	$\widehat{EI}$ RTM	Δ $\widehat{EI}$ RTM
5	$3,216	$0	$1,104	$0	$2,259	$0	$5,631	$0
6	$3,165	-$51	$1,087	-$17	$2,223	-$36	$5,542	-$89
7	$3,111	-$105	$1,069	-$36	$2,183	-$76	$5,447	-$184
8	$3,055	-$162	$1,050	-$54	$2,141	-$118	$5,348	-$284
10	$2,933	-$283	$1,010	-$94	$2,048	-$211	$5,133	-$499
15	$2,580	-$636	$898	-$206	$1,765	-$494	$4,506	-$1,126

The impact area in the NC study consisted of the county in which the park is located. Expected impacts calculated using those expenditures and multipliers fall within those made using figures from the other two studies.

Table 4.28 – Expected Economic Impacts: NC Expenditure Estimates and Multipliers; No Opportunity Costs ($1000s).

Fee	$\widehat{EI}$ Avg. SP	Δ $\widehat{EI}$ Avg. SP	$\widehat{EI}$ FM	Δ $\widehat{EI}$ FM	$\widehat{EI}$ FY	Δ $\widehat{EI}$ FY	$\widehat{EI}$ RTM	Δ $\widehat{EI}$ RTM
5	$4,879	$0	$1,675	$0	$3,427	$0	$8,543	$0
6	$4,574	-$305	$1,572	-$103	$3,208	-$218	$8,007	-$536
7	$4,234	-$645	$1,459	-$216	$2,958	-$469	$7,406	-$1,137
8	$3,860	-$1,019	$1,338	-$338	$2,675	-$752	$6,740	-$1,803
10	$3,007	-$1,872	$1,067	-$608	$2,012	-$1,415	$5,215	-$3,328
15	$271	-$4,69	$230	-$1,445	-	-	$272	-$8,271

Table 4.29 – Expected Economic Impacts: NC Expenditure Estimates and Multipliers; With Opportunity Costs ($1000s).

Fee	$\widehat{EI}$ Avg. SP	Δ $\widehat{EI}$ Avg. SP	$\widehat{EI}$ FM	Δ $\widehat{EI}$ FM	$\widehat{EI}$ FY	Δ $\widehat{EI}$ FY	$\widehat{EI}$ RTM	Δ $\widehat{EI}$ RTM
5	$4,879	$0	$1,675	$0	$3,427	$0	$8,543	$0
6	$4,802	-$77	$1,649	-$26	$3,372	-$55	$8,407	-$136
7	$4,720	-$159	$1,621	-$54	$3,312	-$115	$8,264	-$279
8	$4,634	-$245	$1,593	-$82	$3,248	-$179	$8,113	-$431
10	$4,450	-$430	$1,532	-$143	$3,107	-$320	$7,787	-$757
15	$3,914	-$965	$1,363	-$313	$2,678	-$749	$6,835	-$1,708

The TN impact area encompassed the entire state – a considerably more complex impact region. Impacts estimated using numbers from that study provide an upper bound.

Table 4.30 – Expected Economic Impacts: TN Expenditure Estimates and Multipliers; No Opportunity Costs ($1000s).

Fee	$\widehat{EI}$ Avg. SP	Δ $\widehat{EI}$ Avg. SP	$\widehat{EI}$ FM	Δ $\widehat{EI}$ FM	$\widehat{EI}$ FY	Δ $\widehat{EI}$ FY	$\widehat{EI}$ RTM	Δ $\widehat{EI}$ RTM
5	$10,817	$0	$3,714	$0	$7,597	$0	$18,939	$0
6	$10,140	-$677	$3,485	-$229	$7,113	-$484	$17,750	-$1,189
7	$9,387	-$1,430	$3,235	-$479	$6,557	-$1,040	$16,418	-$2,521
8	$8,557	-$2,260	$2,965	-$749	$5,930	-$1,667	$14,942	-$3,997
10	$6,667	-$4,150	$2,365	-$1,349	$4,460	-$3,137	$11,561	-$7,378
15	$600	-$10,217	$510	-$3,204	-$468	-$8,065	$603	-$18,336

Table 4.31 – Expected Economic Impacts: TN Expenditure Estimates and Multipliers; With Opportunity Costs ($1000s).

Fee	$\widehat{EI}$ Avg. SP	Δ $\widehat{EI}$ Avg. SP	$\widehat{EI}$ FM	Δ $\widehat{EI}$ FM	$\widehat{EI}$ FY	Δ $\widehat{EI}$ FY	$\widehat{EI}$ RTM	Δ $\widehat{EI}$ RTM
5	$10,817	$0	$3,714	$0	$7,597	$0	$18,939	$0
6	$10,645	-$172	$3,655	-$59	$7,475	-$122	$18,638	-$301
7	$10,464	-$353	$3,594	-$119	$7,343	-$254	$18,320	-$619
8	$10,274	-$543	$3,531	-$183	$7,201	-$396	$17,985	-$954
10	$9,864	-$952	$3,397	-$317	$6,889	-$708	$17,262	-$1,677
15	$8,676	-$2,140	$3,020	-$693	$5,936	-$1,661	$15,152	-$3,787

The level of reduced economic impact associated with each fee depends on the expected reduction in park visitation that fee is likely to affect. As detailed in Equation (4.3), expected visitation is dependent on visitor price elasticity and the proportional change in price affected by each hypothetical fee. Price elasticity is conditioned, in part, on how prices, or travel costs, are defined. Travel cost constructions that include opportunity costs take greater values than those without, which causes a less elastic visitation response to price changes. Thus, as fees increase, economic impacts estimated using model results that assume a positive value for opportunity costs generally decrease at a slower rate than those estimated without. This feature is evident in the tables above.

The number of non-local visitors at each park also affects estimated economic impacts, as impacts are relevant only to non-local expenditures. The proportion of non-local visitors was highest in the Fort Mountain sample (60.8%), followed by Red Top Mountain (47.6%) then Fort

Yargo (30.8%). The number of non-local visitors at each park also affects average necessary travel costs, as non-local visitors generally travel further distances and thus incur greater costs. Average travel costs without opportunity costs of time ranged from a high of $21.64 at Fort Mountain, to $15.60 at Red Top Mountain and $12.51 at Fort Yargo. Red Top Mountain also had the highest overall number visitors of the three parks sampled, thus estimated economic impacts are larger there for a number of reasons.[78]

Assuming the expenditure estimates and multipliers from the NC study are most suitable, and opportunity costs of time are not relevant to visitors' travel costs, an increase in the park entrance fee to $8.00 is expected to decrease local economic impacts by $1.019 million (20.9%) for the average northern Georgia state park, $0.338 million (20.2%) for Fort Mountain, $0.752 million (22.0%) for Fort Yargo, and $1.803 (21.1%) for Red Top Mountain. If opportunity costs are assumed valued positively, it would take entrance fees in excess of $15.00 to affect decreases of a similar magnitude.

If the entrance fee were increased to $10.00 under the same assumptions as before (NC study figures, no opportunity costs), economic impacts for the average northern Georgia state park are expected to fall by $1.872 million (38.4%), Fort Mountain by $0.608 million (36.3%), Fort Yargo by $1.415 million (41.3%), and Red Top Mountain by $3.328 million (39.0%). The decrease in expected local economic impacts continues to intensify as the hypothetical fee price increases, however the decline is considerably less precipitous if opportunity costs are assumed to be relevant to visitors' travel expenses.

Expected economic impacts estimated with expenditure and output multipliers from the TN and VCT studies decrease by identical proportions, but by different magnitudes, than those

[78] The expected economic impacts decline much faster for fee increases at Red Top Mountain for these same reasons.

detailed above. For example, the same $8.00 entrance fee at the average northern Georgia state park is expected to affect a $0.672 million dollar decrease in local economic impacts if using the VCT estimates, and a $2.260 million dollar decrease if using figures from the TN study. Both represent a 20.9% decrease, identical to that predicted using the NC state park expenditures and multipliers. However, these proportional decreases, while identical for each park, are not identical between parks. For example, if the entrance fee were $8.00 at Fort Mountain, economic impacts are expected to decrease by 13.9%, regardless of which set of expenditures and multipliers are used (assuming no opportunity costs are relevant). At Fort Yargo, impacts are expected to decrease by 24.0% for that same fee; and at Red Top Mountain, 19.2%.

This application of TCM model results provides an indication of the extent to which local economic impacts could change if management altered the entrance fee policy at northern Georgia state parks. It should be reiterated that these estimations are based on expenditure estimates and multipliers sourced from secondary data. The studies from which expenditures and multipliers were taken are capable of accommodating a range of assumptions regarding visitor expenditures and the economic complexity of the impact region. However, their consistency with the parks and visitors included in the GSPDP sample is ultimately unknown.

The applications show that fee increases are likely to affect reductions in total output economic impacts of non-local park visitor expenditures, regardless of the complexity of the regional economy and whether opportunity costs are assumed or not. These considerations do, however, have a substantial effect on the magnitude of those reductions. Analysis of this type may provide management with useful information concerning the likely ways in which park pricing policy decisions may affect the economies of communities nearby the parks.

CHAPTER 5

SUMMARY AND CONCLUSIONS

This chapter presents summaries and conclusions regarding the research findings of this study. Results from estimations of revealed preference Travel Cost Method (TCM) data are discussed, and the applications of those results to policy-relevant domains at northern Georgia state parks are detailed. Research limitations and suggested areas for future inquiry conclude this chapter.

Summary

State parks face fiscal constraints, and one of the many policy options available to resolve this problem involves increasing the fees levied on park users. The purpose of this study was to explore the likely economic effects of changes in the entrance fee structure at northern Georgia state parks on park revenue, user welfare, visitor diversity and nearby economies.

The data used in this study were collected as part of the Georgia State Parks Diversity Project (GSPDP), and included the necessary information for travel cost method (TCM) analysis. The state parks sampled included Fort Mountain, Fort Yargo and Red Top Mountain. Variable construction and empirical model specification were based on economic theory and previous recreation demand research using similar modeling techniques. Following common convention in the TCM literature, models were estimated under a single-site framework with a count data Poisson estimator adjusted for zero-truncation and endogenous stratification. The number of annual group trips to the state park where each group was interviewed served as the dependent variable. Independent variables included travel costs, income, age, gender, ethnicity, group size, and indicator variables for groups interviewed on free admission days, for groups that purchased annual park entrance passes, and to denote the park where the interview occurred. Model variations included different specifications of the travel cost variable to accommodate different assumptions regarding visitors' opportunity costs of time, and a varying parameters approach to estimate Hispanic price response.

Estimated coefficients were largely significant and retained mostly the same signs across all models, but took different magnitudes depending on model assumptions. The parameters associated with the travel cost variable were used to derive group elasticity and consumer surplus estimates for visitors, from which the policy-relevant applications were calculated. Estimated group price elasticity ranged from -0.55 to -1.14 and consumer surplus from $35.45 to $16.95 per group, depending on model assumptions.

Policy Implications: Expected Revenue

Information concerning the level of revenue that different entrance fee structures could be expected to generate may be useful for park management should they decide to adopt a policy of higher entrance fees to relieve budget pressures. Economic theory suggests increased fees would lead to lower visitation rates. The first application of model results explored expected park revenues for a range of hypothetical fee increases conditioned on the likely decline in expected visitation for such increases. Application results indicated a considerable volume of revenue capture potential at the parks, the size of which depended on the fee level and model assumptions concerning visitors' opportunity costs of time. Using park visitation estimates provided by Georgia State Parks and Historic Sites Division (GASPHSD), a $1.00 fee increase was expected to generate between $100,000 and $135,000 in additional park revenue. A $2.00 increase was expected to generate between $175,000 and $260,000. Lower bound estimates were calculated using model results estimated exclusive of visitor opportunity costs of travel time; upper bound estimates were from models that assumed a positive value for those costs.

Applications calculated using results estimated exclusive of opportunity costs suggest revenues will continue to increase until entrance fees are doubled to $10.00, after which the decline in expected visitation offsets additional fee receipts. This result suggests fee increases up to $5.00 would result in additional park revenue. Teasley, Bergstrom and Cordell (1994) find similar results, estimating revenue capture at George Washington National Forest maximized with a $5.00 fee increase. However, fee collection in their study was per person rather than per group, as is the case at the state parks under analysis in this study.

Expected revenue applications that use results estimated assuming positively valued opportunity costs of travel time indicate revenues will continue to increase until fees are at least $15.00, implying increases of $10.00 or higher would generate additional revenue. This outcome appears somewhat tenuous, as it is difficult to conceive a large majority of individuals would continue visiting the parks if entrance fees were tripled in price. Perhaps including opportunity costs, particularly those specified at higher values, may not be appropriate for the predominantly day use visitors to northern Georgia state parks. The next best use of these individuals' time may be some other form of recreation or household labor that is not appropriately valued by the wage rate. Bowker and Leeworthy (1998), for example, find only 15% of their Florida Keys visitor sample capable of working rather than vacationing in south Florida. Over two-thirds of the sample analyzed by Ovaskainen, Neuvonen and Pouta (2012) were unable to make such exchanges, most noting the next best use of their time to be another leisure activity or some type of unpaid household labor. These studies cast doubt on the use of wage-based proxies for visitor opportunity costs of time in recreation demand estimation. Accordingly, the price response calculated in this study using model results estimated without opportunity costs may better represent visitor behavior in the GSPDP sample.

Also, as noted previously, expected revenues were calculated using visitation estimates adjusted for the hotspot sampling protocol and group size truncation procedure, likely resulting in conservative estimates. For reference, $1.00 fee increase using an unadjusted park visitation estimate is expected to increase revenue by $172,017 without opportunity costs and by $227,096 with those costs. A $2.00 fee increase under the same assumptions is expected to increase revenue by $295,924 and $434,262, respectively. These estimates are considerably higher than those calculated using the adjusted visitation sample, however the total level of expected fee revenue is higher for each fee under this assumption as well.

Policy Implications: Consumer Surplus

Economic values for public goods, such as the parks under analysis in this study, are difficult to measure directly due to characteristics of nonrivalry and nonexclusiveness that generally lead to externalities if traded in private markets. Nonmarket valuation techniques exist for these purposes. Consumer surplus (CS) is a common technique of this type used in policy analysis and program evaluation to measure economic efficiency, resource value, and individuals' use benefits. Estimates of the likely changes in CS associated with different fees could assist park management and government decision-makers in determining the effects of different fee structures on park visitors.

Calculated per-trip group CS ranged in value from $35.45 to $16.95 with and without opportunity costs of time (respectively) at current access costs and sample mean travel costs. This is equivalent to about $8.40 to $4.02 per individual. Aggregate park CS estimated at sample mean travel costs and current access costs was $5,805,328 if opportunity costs of time are assumed relevant, and $2,775,460 if not. Elasticities were used to predict park visitation associated with a range of hypothetical fee increases. This allowed for calculations of CS conditioned on changes in park fee structure, from which the expected decrease in CS associated with each fee could be calculated. A $1.00 fee hike was expected to decrease aggregate CS between $169,542 and $173,589 at the parks. A $2.00 fee increase was expected to more than double the loss to a level between $350,673 and $366,858.[79] CS losses continue to mount as the hypothetical entrance fee increased.

An interesting outcome of this application is despite the relatively large difference in group CS estimated with and without opportunity costs ($35.45 versus $16.95, respectively), the loss in aggregate CS predicted for each fee level is relatively similar under both specifications. For example, the estimates of expected loss in visitor CS for a $1.00 fee increase vary by less than three. The estimates for a $2.00 increase vary by less than 5%. Even with a $10.00 fee increase, the difference in expected CS decline calculated with and without opportunity costs is less than 19%. So, despite the relatively large difference in per group CS estimated with and without opportunity cost of travel time, the reductions in aggregate park CS for each fee increase were somewhat similar. The greater price response calculated using model results estimated without opportunity costs is associated with a group per-trip consumer surplus estimate roughly half the size of that estimated with opportunity costs of time ($16.95 versus $35.45, respectively). However, the relatively reduced price response calculated using model results estimated with opportunity costs of time is associated with a larger per-trip group CS estimate. These two per-trip conditions largely offset each other when exploring losses in aggregate CS

[79] The lower bound of each corresponds to the application using model results estimated with opportunity costs.

associated with fee increases at the parks, resulting in estimates calculated under both assumptions that are largely similar.

The same limitations associated with GASPHSD visitation estimate adjustments discussed in the previous section apply similarly to expected CS estimates. If those adjustments indeed overcorrect for sample constraints, the expected CS estimates reported in this study are likely conservative. That is, baseline CS under current access costs and the rate of decline associated with each hypothetical fee increase are likely higher than reported.

Policy Implications: Park User Diversity

Changes in the entrance fee structure may also have implications for management goals concerning diversity at the park. The likely effect of higher entrance fees on park ethnic composition was explored using results from a separate TCM estimation. A varying parameters model specification was utilized which allowed a specific price response for Hispanic visitors to be calculated.[80] Similarly to previous applications, elasticities were used to predict the decline in park attendance associated with entrance fee increases. However, the ethnicity model results allowed the decline in expected visitation between Hispanics and non-Hispanics to differ. Hispanic visitors were found to demonstrate more inelastic demand for these parks.

There could be any number of reasons Hispanic visitors were found less price sensitive than non-Hispanics in the GSPDP sample. No simple explanation is likely sufficient, and the cause is ultimately unknown. Hispanic visitors may have a fewer number of available substitutes for recreation at the state parks sampled. Economic theory suggests demand is reduced in the

[80] Models were tested that included a Black-travel cost interaction term, however the sample size for Black visitors proved too small for reliable estimation. As a second best estimation protocol, an indicator variable for Black visitors was included (‘black’). This strategy imposed the assumption that price response for Black visitors was identical to the remainder of the non-Hispanic sample. However the inclusion of a Black dummy variable allowed that group to exhibit different trip-taking behavior than the rest of the sample (i.e., Black visitors take a different number of annual trips to the parks).

presence of available substitutes, in which case price response becomes more inelastic (Varian 2010). However, 3.5% more of the Hispanic sample responded affirmatively to the survey question from which the substitute site variable was constructed. Another possible explanation involves place attachment, or the affinitive emotional connection visitors may have to certain places. Responses from a qualitative question included in the survey instrument indicated Hispanic visitors more strongly agreed that "state parks are special" than visitors of other ethnicities (Larson, Whiting, Green 2012). Therefore, if Hispanic visitors are more attached to recreation at the state parks, their visitation preferences may be less responsive to changes in the fee structure.

Relative proportions of Hispanic and non-Hispanic visitors in the GSPDP sample at different fee levels were calculated using results from the ethnicity models. These varied depending on assumptions regarding visitors' opportunity costs, however in all cases the proportion of Hispanic visitors increased with higher fees. At current access costs, Hispanic groups represented 19.3% of the GSPDP sample. Using model results estimated without opportunity costs, a $1.00 fee increase was expected to increase their sample share to 19.9%, and a $2.00 fee increase was predicted to increase their proportion to 20.7%. Using model results where visitors' opportunity costs for travel time were valued positively, Hispanics groups were found somewhat more price sensitive. The rate at which their relative proportion was expected to increase slowed somewhat. For example, the $1.00 and $2.00 fee increase were expected to increase the Hispanic proportion by 19.3% and 19.5%, respectively.

Hispanic and non-Hispanic group sizes differed in the GSPDP sample. Results derived on an individual rather than group basis indicated the initial proportion of Hispanic visitors was somewhat higher (22.7%). Their relative proportion also increased at slightly faster clip with fees when calculated on an individual basis, but the differences were still very minimal. For example, using results estimated without opportunity costs, for a $1.00 fee increase was expected to increase the proportion of individual Hispanic visitors by 0.68%. On a group basis, the increase was expected to be 0.61%. The relevant ratios for at $2.00 fee increase were 0.88% and 0.61%.

If a priority of park management is to maintain or increase visitor diversity, the results of this application suggest fee increases are not likely to conflict with that goal. However, although the relative proportion of Hispanic visitors is not expected to change substantially, the fees *are* expected to affect the total number of park visitors, both Hispanic and non-Hispanic. So would likely be a decrease in total Hispanic visitation at the parks if fees were to increase, but it is not expected to be disproportionate to the decrease in non-Hispanic visitation. Additionally, the price response of other visitor ethnicities in this sample is unknown, as the data requirements for estimation of unique price responses for other ethnicities were not met by the sample. Larger sample sizes for other visitor ethnicities could relieve this data constraint.

Policy Implications: Economic Impacts

Economic impacts measure the effect of non-local expenditures on total output, income and/or jobs in regional economies. As changes in the fee structure at the parks are expected to reduce visitation, park visitor expenditures in nearby communities are likely decrease along with their associated economic impacts. The expected economic impact application estimated these reductions for a range of different entrance fees. Several different studies were selected for proxy multiplier and expenditure data, as this information was unavailable in the GSPDP dataset. Each related to an impact area that varied in size and economic complexity, allowing for a range estimates that could accommodate a number of different assumptions about northern Georgia state park visitor expenditures and economies nearby the parks.

Economic impacts for the three parks, as measured by total output, ranged from $9,648,556 (low) to $14,673,526 (medium) to $32,449,849 (high). These were calculated at current access costs using model results estimated exclusive of opportunity costs of travel time. Calculations for the specific parks varied depending on initial visitation estimates.[81] The lower bound of the above range was calculated using expenditures and multipliers from the Virginia Creeper Trial (VCT) Study (Bowker, Bergstrom and Gill 2007), where the impact area was limited to a largely rural region in southwestern Virginia. The upper bound estimate was calculated using figures from the Tennessee State Park study (Fly et al. 2010), where the impact area encompassed the entire state. The intermediate impact estimate was calculated using results from a study of North Carolina state parks where the impact region consisted of the county in which the park was located – a region expected similar to the state parks included in the GSPDP sample.

A $1.00 fee increase was predicted to decrease the parks' aggregate output impacts by a level between $603,460 and $2,029,546 using model results estimated without opportunity costs. For a $2.00 increase, aggregate output impacts were expected to fall by a level between $1,275,340 and $4,289,199. The *rate* at which impacts were expected to decrease was the same regardless of which set of multipliers and expenditures were used, as it was based on a price elasticity calculated from common model results.

Assumptions concerning visitors' opportunity costs for travel time were found to be an important determinant of expected output impacts, as estimated price response became less elastic when these costs were considered. The magnitude of impact reductions became less

[81] The visitation adjustments for the survey protocol and truncation procedure were identical for each park and for the average northern Georgia state park. However, the proportion of visitors non-local varied. The proportion of non-local visitors was highest in the Fort Mountain sample (60.8%), followed by Red Top Mountain (47.6%) then Fort Yargo (30.8%). In the combined sample this proportion was 49.9%.

severe. For example, a $1.00 fee increase was expected to decrease aggregate output impacts at the parks by a level between $153,051 and $514,740 using model results estimated with positively valued visitor time costs. Impacts were expected to fall by a level between $314,517 and $1,057,778 for a $2.00 fee increase under the same assumptions. These reductions are considerably smaller than those calculated using model results estimated without opportunity costs.

Several considerations should be noted concerning the expected economic impact application. First, it assumes visitors would not adjust their spending in the local economy if park entrance fees were to increase. When considering the total costs involved with each visit, including expenditures on food and lodging, marginal fee increases are likely minor, especially for non-locals. Therefore, this assumption may not be too limiting. Fee revenue is also assumed to flow into the Georgia general fund. If those revenues were in some way invested back in economies local to the parks, expected output impacts would be higher. Also, in addition to adjustments discussed in previous sections, the GSPDP visitation estimate was further calibrated to reflect only non-local visitation for use in impact estimations. This proportion was proxied using GSPDP sample statistics. However, the distance each group travelled to reach the park was truncated at a distance five standard deviations from the sample mean in the TCM estimation sample (150 miles). Therefore the proportion used for calibration most likely underestimated the number of non-local visitors, resulting in an even more conservative estimate of total park visitation to which model results are applicable. So, the reported economic impacts in this application are likely very conservative.

For reference, using a GASPHSD visitation estimate without group size and hotspot adjustments, baseline output impacts for the parks were estimated at $16,224,142 (low) to

$24,613,145 (medium) to $54,564,742 (high). Of course, this still assumes that over 50% of the sample was local. Adjusting that proportion to 35% results in impacts estimated at $24,311,901 (low) to $36,882,835 (medium) to $81,765,348 (high). Impacts would fall by the same rate with additional fees as previously estimated, however the magnitude of the reductions would obviously be much greater for these estimates.

The availability of expenditure data and relevant multipliers for the state parks in the GSPDP sample would provide a much finer level of precision in the estimation of expected economic impacts. Additionally, the calculation of park-specific impacts would be benefit from estimations of visitor price response unique to each park. Unfortunately, the data requirements for such estimations were larger than available in the GSPDP sample.

Integrated Framework for Policy Analysis

The applications presented in this study provide and integrated framework available for park management to assess the likely economic effects of pricing policies. Expected revenue calculations allow managers to gauge how different fees may affect park budgets. Predicted consumer surplus estimates and visitor ethnicity proportions allow for the effect of such policies on park users to be measured. Economic impact estimations provide a measure of how nearby economies may be affected by fee policies. Each application reported a range of possible estimates to accommodate a number of different assumptions regarding visitor behavior. Given adequate knowledge of the rationale behind these assumptions, management can use their best judgment as to which most closely relate to the conditions under which they determine policy.

Limitations

Several important limitations regarding the data and methods used in this study should be detailed, as these may affect models estimates and the applications that make use of their results.

First, the data used in this study were not collected randomly. Rather, on-site interviews were targeted at recreational hotspots to ensure the highest response rate. According to exit interviews at the parks, sizeable proportions of visitors avoided the recreational areas that were targeted for sampling. These proportion ranged from 43.2% at Fort Mountain, 21.5% at Fort Yargo, 15.1% at Red Top Mountain, and 21.2% in the combined park sample. Adjustments were made in this study to accommodate the sampling protocol, however the characteristics of visitors excluded by such an approach is ultimately unknown. If these visitors were significantly different than those included in the GSPDP sample, the reported model estimates and application results may be different than real-world scenarios.

Another caveat to note concerns the group size truncation procedure used in this study, as it further limited the share of visitors to which model estimates were applicable. The proportion of groups eight people or larger varied by park, ranging from 29.0% at Fort Mountain, 22.7% at Red Top Mountain, 22.5% at Fort Yargo, and 25.2% in the combined park sample. It was assumed that results from the models estimated in this study were not applicable to these visitors, and the GASPHSD estimate was calibrated to reflect this procedure. However this adjustment likely overcompensates for the number of large groups in the GSPDP sample, as it is likely that multiple members of the same large groups were interviewed at the parks.[82] In combination with the sampling protocol adjustment, the share of estimated visitation to which model results were considered applicable fell to 44.0% at Fort Mountain, 55.7% at Fort Yargo, 65.6% at Red Top Mountain, and 59.5% of the combined park sample. These adjustments likely result in very conservative estimates of the proportion of park visitation to which model estimates are relevant.

[82]Multiple members of the same large groups may have been interviewed, as there are a number of observations in the sample interviewed at the same park on the same day that traveled in identically sized groups ranging in size from 20 to 150 people. Perhaps some of those observations belong to the same groups.

If the visitation estimate is indeed conservative, the applications reported in this study that make use of the estimate are likely conservative as well.

Data collection took place between Memorial Day and Labor Day in 2010. Although the majority of park visitation (63.6%) occurred between May and September of that year, groups who only visited the parks during other parts of the year were not sampled. To account for seasonal sampling, interview questions were framed in terms of annual visitation. However, if there exist groups with different preferences who visited the parks only during alternative months (e.g., anglers or hunters), the demand estimates reported in this study may not be representative of all park visitors.

Additionally, the parks selected for sampling are distributed in a somewhat narrow corridor in northern Georgia. A greater number of state parks are located in the northeastern part of the state. Model results using the pooled sample were expected to be representative of all northern Georgia state parks, however if these parks are not truly representative of all parks in that part of the state, the broader applicability assumed in this study may be more limited than expected, although the framework and approach would still be applicable.

Several practical compromises were made regarding the treatment of certain categories of visitors within the sample that have the potential to further limit the applicability of model results. One group of such visitors were those who purchased annual park entrance passes. Their inclusion in the TCM estimation sample assumed their visitation response to price increases identical to those who paid daily entrance fees. This may not be the case, as it is unknown if the cost of annual passes would increase with the daily fee, or how those visitors would respond if so. Several different options were considered regarding their treatment. The annual pass cost ($50.00) could have been prorated based on their number of reported trips, however that procedure would assume those groups only visited he park where interviewed.[83] Another treatment option involved deleting these groups from the estimation sample. However, their identification was possible only in the third survey module. None of the other modules included a question concerning annual entrance passes. It was finally decided to identify these groups with a dummy variable for model estimation. Although the assumption of an identical price response with other groups held, this method allowed groups with annual passes to exhibit different trip-taking behavior than others in the sample.

The treatment groups interviewed on free admission days (Wednesdays) was also subject to several different possibilities. Although these visitors entered the park for free on the day when interviewed, assigning a zero value for the fee portion of their travel costs would assume each of their visits in 2010 occurred on a Wednesday. It is possible these groups visited the parks only on Wednesdays, however it is also possible they visited on other days of the week as well. Regardless, these visitors may respond differently to fee increases. Unfortunately, their representation in the sample was too small for independent price response estimation. It was ultimately decided to identify these visitors with a dummy variable for the same reasons this treatment was selected for groups that purchased annual passes.

Another possible study limitation involves the model estimations. Data were estimated with a Poisson estimator adjusted for zero-truncation and endogenous stratification. Use of this type of estimator on overdispersed data, as is potentially the case with the GSPDP dataset, is likely to result in reduced standard errors and a higher likelihood of type-1 error. Interpretation of parameter significance in this study should therefore be exercised with caution. However, the applications of model results use only the travel cost parameters for prediction. These particular

[83] Slightly under half (48.35%) of the groups with annual passes reported only one or two annual trips to the park where interviewed, which, unless economically irrational, suggests they either use the pass at other parks or intend to increase future visitation frequency.

parameters were highly significant across all model specifications, and remained relatively robust across a number of alternative assumptions regarding visitor behavior. Furthermore, Poisson estimators under overdispersion are expected to produce consistent parameter estimates. Therefore the values of the travel cost coefficients estimated in this study are expected to be reliable.

Lastly, the applications of model results assume visitors' response to increased entrance fees would consist only of a reduction in the number of annual trips taken to the parks. Their response could take any number of additional manifestations. For example, higher per-vehicle entrance fees could encourage groups to travel to the parks in larger carloads in order to smooth the price increase. Groups could also attempt to visit the park without payment of the entrance fee, especially if enforcement is lacking. Additionally, it is unknown how many (if any) groups would purchase annual passes if the entrance fee were increased while keeping the annual pass price constant. Incorporation of these and other types of alternative visitor behavioral responses into model estimates would be difficult and likely error-prone.

Future Research

Larger sample sizes for the models estimated in this study could provide a much finer level of detail into the applications using their results. Increasing the sample size could result in a greater number of observations for visitor ethnicities other than White and Hispanic, allowing for estimation of their unique price responses. However, the lack of a sufficient number of these observations may be due to ethnic distribution in the communities close to the parks. That is, the restricted number of observations for ethnicities other than White and Hispanic may be a result of their limited representation in the communities proximate to the parks. If this is the case, a larger sample size may not rectify the problem. Oversampling these ethnicities for use in model estimation is another possibility.

The GSPDP dataset contains the information necessary for analysis using stated preference methods. There are several questions included in the third survey module that could be interpreted in a contingent behavior or willingness to pay framework. Additionally, one of those questions specifically asks respondents to indicate by how many annual trips park visitation would decrease if fees were to rise. Responses from this question could be stacked with the revealed preference data for a mixed revealed/stated preference dataset analyzed using a contingent trips or trip response method approach. These have been shown to provide reliable *ex ante* demand estimates for management policies in the recreation demand literature (Hynes and Greene 2013; Rosenberger and Loomis 1999; Hesseln, Loomis and Gonzalez-Caban 2004). Analysis of the GSPDP dataset using these or similar techniques could be used to validate or refute the results presented in this study.

Another interesting avenue for future research involves the estimation of likely changes in net benefit distribution for park users given increases in entrance fees. This could apply to park users of different ethnicities, incomes, or even ages. For example, the ethnicity application in this study predicts a slightly larger proportion of Hispanic park visitors if management adopted a policy that increased park entrance fees. This implies a greater share of financing park resources could be shifted to that group of visitors. Whether or not this amounts to a loss of net benefits depends on the distribution of benefits after policy implementation. Research of this type could provide useful information concerning equity issues involved with pricing policies at the parks, as the cost burden of park financing may be shifted disproportionately to one group or another under different fee structures.

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