NATIONAL PARK VISITATION: AN ECONOMETRIC ANALYSIS OF PAST AND FUTURE RECREATION DEMAND

by

MATTHEW STOWERS

(Under the Direction of John Bergstrom)

ABSTRACT

The National Park Service was established by the Organic Act of 1916 with the purpose of managing the ‘crown jewels’ of the American landscape, the National Parks, along with other unique sites for their scenic, environmental, cultural, or historical significance. Today, there are 59 National Parks and over 400 total NPS units, which received over 330 million recreation visits in 2016. This thesis uses first difference regression models on panel data to estimate the relative effect on National Park attendance of several determinants of demand. The regression results are used to forecast future attendance, and a benefit transfer method is used to estimate the consumer surplus produced by visits. The results show that the two most important determinants of demand are gasoline prices, which act as a proxy for travel costs, and the number of U.S residents aged 65 or older. Implications of these findings are also explored below.

INDEX WORDS: National Park Service, recreation demand, congestion, forecasts, first difference regression

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CHAPTER 1

INTRODUCTION

National Parks Background

The Yellowstone Act of 1872, which was established by Congress and signed into law by President Grant, set aside over one million acres of land in what would become Wyoming, Montana, and Idaho as the world's first National Park, Yellowstone. The purpose of this designation was to preserve this scenic land, and to allow it and all of its amenities to be enjoyed by the public. Soon, more National Parks such as Yosemite, Mount Rainier, and Rocky Mountain were also established in the west for their scenic beauty. These parks were managed by the U.S. Department of the Interior until President Wilson signed the Organic Act of 1916, which established the National Park Service. The Organic Act states that the purpose of the National Park Service "is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations " (Dilsaver 1994). The two requirements of the Organic Act, to conserve the natural environments of the parks and to provide the parks for current and future generations, are often referred to as the "dual mandate" of the National Park Service.

Today, the National Park System consists of over 400 park units including 59 National Parks. Other units managed by the National Park Service (NPS) include National Monuments, National Memorials, National Historic Sites, National Seashores and several other designations. Altogether, the NPS manages over 84 million acres across all 50 states and in other U.S. territories (U.S. Department on the Interior, 2017a). The National Parks and other NPS units preserve scenic landscapes, perform ecosystem services, provide recreational opportunities to visitors, protect wildlife, promote biodiversity and preserve cultural and historic sites for their educational purposes. The National Parks and the NPS are very popular and are viewed positively by most Americans (Haefele, Loomis and Bilmes 2016). Because of this affinity, the NPS received a record-breaking 330 million recreation visits in 2016 (U.S. Department of the Interior, 2017a).

Past National Park Visitation Trends

Figure 1.1 shows total National Park System visitation from 1904 to 2016 and Figure 1.2 shows National Park visitation from the same time period.[1] Attendance to the National Parks and other National Park System units experienced slow growth at the beginning of the twentieth century, but this changed quickly in the late 1940s. Post-World War II America experienced a booming economy and the advent of the U.S. Interstate System, both of which certainly made it easier for Americans to travel long distances. In 1987, total National Park System visitation reached a then-peak of approximately 287 million visitors and declined for several years until finally re-reaching 1987 levels again in 2014. As of 2016, visitation to the National Parks, and the National Park System as a whole, is still rising. Given the recent upward trend in National Park visitation, it is important for several reasons to study the drivers of past park visitation

[1] National Park Service Visitor Use Statistics website includes a query builder which was used along with accompanying National Reports to gather attendance data used throughout this thesis. Available at https://irma.nps.gov/Stats/. Accessed November 28, 2017.

and predict potential future trends in park visitation. Two of the most important reasons for examining past and future park visitation trends relate to the economic benefits and impacts of National Park visitation, and the effects of congestion on the quality of visitor experiences.

Economic Benefits and Impacts of National Parks

Turner (2002) questioned whether or not the National Parks are justified economically. He explains that despite the popularity of the National Parks, there is little economic rationale justifying the government's provision of them. Most NPS units do not charge fees and those that do, do not cover their costs with them and rely on government-appropriated funds in order to stay open. There are over 400 units within the NPS and each one needs to be studied on a case-by-case basis to determine if the value it brings to people is greater than its costs, argues Turner. This is consistent with a benefit-cost analysis criterion which is used by many agencies when making decisions. U.S. Congress has required that agencies perform economic analyses similar to benefit-cost when making natural resource or environmental decisions (Bergstrom and Randall 2010). Similarly, Executive Order 12866 signed into law by President Clinton in 1993 requires that federal agencies assess the full benefits and costs of their actions including those that are quantifiable and non-quantifiable (U.S. Federal Register).

Some of the values that the National Parks provide are those that are not easily measured. Option demand, or option value, is a non-use value that people place on retaining the option to use an area that would be difficult or impossible to replace (Krutilla 1967). Turner asserts that the benefits provided by the non-use values of the parks must be greater than the parks' operating costs and the opportunity costs of the land in order to justify them. A 2016 study by Haefele, Loomis and Bilmes, which is discussed further below, estimates the non-use values of the NPS. However, there are no estimates of the opportunity costs of the National Park lands. Some studies have looked at the opportunity costs of some preserved federal lands (Loomis and McKean 1984; Walker 1984; Aliski 1995; Considine 2013), but large scale efforts are still needed in order to assess the total opportunity costs of the lands managed by the NPS.

When discussing the economic benefits of National Parks, it is important to understand the concept of willingness-to-pay (WTP). In this study, WTP, or sometimes referred to as consumer surplus or economic benefit, is the benefit that the consumer receives from undertaking a trip to a National Park. WTP is the difference between what a consumer would be willing to pay and what they actually paid for a good or service and is widely regarded in the literature as an indicator of utility, or pleasure gained from taking a recreation trip. WTP is a real economic benefit because it represents the money saved by the visitor because the cost of the trip was below their maximum willingness-to-pay (Loomis and Walsh 1997).

Furthermore, visits for recreational, aesthetic, cultural, and historical uses are an important component of the value derived from the National Parks and provide economic benefits (Duffield et al. 2013.) However, once again these benefits are difficult to measure. Heberling and Templeton (2008) estimate a travel cost model to Great Sand Dunes National Park and Preserve (GSD) in an effort to estimate consumer surplus (also known as net willingness-to-pay (WTP) or economic benefit) per visitor per year. The authors note that a study focused solely on visitors does not estimate a complete value of the park because it does not include the benefits of the ecological services that the park provides or the non-use values associated with the park. The authors estimate consumer surplus per visitor per year to be around $120 (in 2016 U.S. dollars).[2] This value increased to around $340 for individuals that visited GSD as part of a multi-destination trip. There is limited research on the valuation of the U.S. National Parks, but the authors claim that the data to perform similar studies on other parks exists.

Rosenberger and Loomis (2001) and Kaval and Loomis (2003) compile many studies like the one above on outdoor recreation use values. The literature that they review includes studies dating back to 1968 and covers 30 different recreation activities across several different recreation area types and regions. The many studies used several stated and revealed preference modelling techniques such as conjoint analysis, contingent valuation, individual travel cost, zonal travel costs, and random utility models. In total, there are 1,239 value estimations for different areas and activities such as camping, hiking, hunting, wildlife viewing, fishing and others. Of these 1,239 estimates, 49 of them are for National Parks. This collection of research shows that the value of visiting an NPS unit per visitor per day ranges from around $10 to $140 and has an average of about $70 (in 2016 U.S. dollars). This database of recreation values is continuously being updated by Rosenberger.[3]

Duffield et al. (2013) use results from a 1998 NPS visitor survey to estimate two models that can provide a basis for benefit transfer. This method involves inferring the

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[2] Note that all dollar values reported in this section have been adjusted from their original values to 2016 U.S dollars using the Consumer Price Index found here: U.S. Department of Labor, Bureau of Labor Statistics. CPI All Urban Consumers Series Id:CUUR0000SA0. Accessed November 29, 2017. https://data.bls.gov/pdq/SurveyOutputServlet.

[3] Rosenberger, R. S. 2016. Recreation Use Values Database – Summary. Corvallis, OR: Oregon State University, College of Forestry. [http://recvaluation.forestry.oregonstate.edu/]

non-priced benefits of a recreation site based on existing values of other sites. Because recreation values have only been estimated for a limited number of units, benefit transfer is an efficient method for estimating values for other units that have not been individually studied. The paper estimates WTP for 12 NPS units based on survey data using a bivariate logistic regression model. The resulting model was used to predict bid values for eight units not included in the original sample. WTP estimates ranged from around $80 to $350 per person per trip for these eight units (in 2016 U.S. dollars). A second model used calculated WTP estimates for the original 12 units as the dependent variable and used individual and unit-specific variables as the independent variables for their regression model. WTP estimates are calculated for the out-of-sample units using the regression coefficients. Estimates ranged from $50 to $200 per person per trip (in 2016 U.S. dollars). The authors conclude that there are a variety of benefit transfer methods that can be used to estimate the value of visits to recreation sites.

Stated preference survey data is required to estimate visitor WTP and these surveys are costly to administer and have not been done for all parks. Because of this, studies on the valuation of the economic benefits of recreation provided by the National Parks have largely been done on a small, park-by-park basis, and do not provide an estimate on the benefits to the NPS as a whole. Recently more and more studies have been attempting to get a larger picture of the benefits provided by National Parks. These are discussed below.

Neher, Duffield and Patterson (2013) commence a larger analysis, estimating average and total WTP for recreation visitation to the entire National Park System in 2011 through the use of a count data trip valuation model and a meta-regression model.

Using survey data from 58 different NPS units, a count data model explains the number of trips an individual has taken to a specific unit in a given period of time as a function of the costs associated with making the trip. After this model is executed, the per trip WTP can be estimated from the regression coefficients. The meta-regression model uses demographic and unit-characteristics to explain the variation in the WTP estimates. The estimated coefficients from the meta-regression model are then applied to every unit in the NPS system to estimate per trip WTP for every unit. Their results show that WTP estimates ranged from around $70 to $300 per person per trip, and system-wide had an average of near $110 per person per trip. The unit-specific per trip WTP estimates were then multiplied by the number of visits that that unit had received in 2011 to receive an annual WTP estimate for each individual NPS unit. Cumulatively, the annual WTP for the entire NPS was estimated to be $30.5 billion in 2011 (all values in 2016 U.S. dollars).

Another important economic impact to consider is the impact of visitor spending in the communities near the National Parks. Visitors to parks pay for lodging, food, souvenirs, etc. With the high volume of visitors to the National Parks, this can amount to a large economic impact for the communities surrounding the National Parks especially considering the multiplier effects of spending as new money is circulated through a local economy. The NPS itself estimates annual visitor spending effects. The 2016 NPS Visitor Spending Effects Report estimates that in 2016 the near 331 million NPS visitors spent $18.4 billion in local economies which supported 318,100 jobs, $12 billion in labor income, $19.9 billion in value added, and $34.9 billion in total economic output in the national economy (U.S. Department of the Interior, 2018b).

Hardner and McKenney (2006) use a collection of benefit transfer methods on 12 National Parks to estimate the economic impacts of visitor spending, the economic benefits of recreation, and the effects on economic growth in surrounding communities. They then go on to estimate these for the National Park System as a whole. The study estimates that the NPS generates over $12 billion of recreation benefits (i.e. consumer surplus), and supports $17 billion of local private sector economic activity which provides 267,000 jobs in communities near the National Parks (all values in 2016 U.S. dollars). The study also claims that economic growth in communities near national parks, which is measured by population change, number of jobs, per capita income, and earnings per job, have all outpaced statewide averages by 1% per year over the last 30 years. However, the authors warn that the current budget for the NPS is too small to maintain the parks in their current states. The analysis estimates that the budget for the NPS is $1 billion too short (at the time) and that the quality of the parks will deteriorate and continue to do so until they have the funds to properly conserve the lands and manage the many challenges that they face.

In a recent study, Haefele, Loomis and Bilmes (2016) provide the first ever comprehensive estimate of the total economic value of the NPS, including non-use values. Their estimate covers all NPS units as well as NPS programs which include preserving cultural, historic, and environmental sites, improving recreation opportunities and providing educational programs. Because non-use values cannot be detected by observable behavior, this study employed a stated preference choice experiment to capture the total economic value of the NPS.

In the survey, respondents were asked to consider potential cuts to NPS lands and programs. Respondents were then asked about their WTP to maintain NPS units and programs. The vehicle of payment presented was a one-time per household tax increase. Respondents indicated a mean WTP of approximately $3,000 to maintain all NPS units and an additional $1,400 to maintain all NPS programs. The response rate to survey was 18%, so the researchers then multiplied these estimates by 18% of all US households to arrive at a national WTP of $92 billion dollars for the NPS. It is likely that more than 18% of the U.S. population has some value for the NPS, therefore the authors conclude $92 billion is a conservative estimate and should be viewed as a minimum estimate for what U.S. households are willing to pay to avoid the loss of the NPS and its programs.

Effects of Congestion on Visit Quality

Certainly the value of economic benefits to recreation and visitor spending impacts change when the number of visitors changes. A greater number of visitors means that more visitors are experiencing the benefits of recreation and creating larger spending impacts. However, a perpetual increase in the number of visitors is likely to lower the total economic benefits of the National Parks due to the potential negative effects of congestion and overcrowding.

Lawson and Manning (2001) wanted to study the tradeoffs visitors make between solitude (lack of congestion) and access to Delicate Arch within Arches National Park. Solitude was represented by the maximum number of people seen at one time at Delicate Arch and access is defined as the percentage chance of receiving a permit to hike to Delicate Arch. The researchers used indifference curve analysis, regression analysis, and computer simulation models to estimate indifference curves and budget constraints for solitude and access. Findings from studies like this can help guide management decisions concerning optimal use. For example, for 64.2% of Delicate Arch visitors, the optimal number of users was below current use. Management can take action to limit the number of users at one time to increase solitude in an effort to make the visitor experience more enjoyable.

Overcrowding and subsequent overuse of the parks can also have potential negative environmental effects due to the pressure put on fragile ecosystems and natural resources (Loomis and Walsh 1997; Lawson et al. 2003; Leon et al. 2015). Overuse of a natural recreation site may lead to disruptions to the local flora and fauna, pollution, erosion, and the exhaustion of resources (Hunter and Green 1995). Degradation of the parks will ultimately lower the economic benefits of the parks by reducing the consumer surplus of each visitor and by reducing overall visitation (Hardner and McKenney 2006).

Social carrying capacity of a recreation site refers to the number of people that can simultaneously use the site without diminishing the quality of visitor experience (Lawson et al. 2003). Studies of social carrying capacity of National Parks need to be done on a park-by-park basis (Keele 1998). It is easily conceivable that overcrowding can become an issue concerning some of the larger, more popular parks but may still be far in the future for others. Whether the parks should focus on solitude or access is a difficult dilemma for park managers to approach. Visitors certainly value solitude in the parks, but if the parks begin limiting attendance, is the gain in welfare to visitors great enough to offset the welfare loss by those who are not granted access into the park that day? Equally, this is where the dual mandate of the Organic Act becomes difficult to accomplish. When in the case of environmental damage caused by overuse, complete open-access for current enjoyment of a National Park may work against the required preservation of the land. Additionally, if the quality of the park is changed due to inadequate preservation efforts, this will further limit the enjoyment of future generations. As Kamron Keele states, “It should be clear by now that national parks simply cannot indefinitely continue accommodating every person that wants to drive his or her automobile through the parks. If the parks are to retain their distinctive character, the numbers of people and their means of access will have to be controlled” (Keele 1998 p.453).

According to economic theory, park managers should aim for long-run economically efficient levels of visitation where the marginal benefits received by additional users equals the marginal decrease in benefits due to congestion. At this level of visitation, aggregate total benefits of a recreation area will be maximized (Loomis and Walsh 1997). Figure 1.3 shows the relationship between the marginal benefits and the marginal congestion costs of visitation. However, with natural resources, such as the National Parks, the economically efficient level of visitation with respect to congestion may not be environmentally sustainable given that their fragile environments may begin to degrade at certain levels of use which most likely will not coincide with their respective social carrying capacities. Thus, the economically efficient level of visitation occurs where the marginal benefits of visits are equal to the full marginal costs of visitation including marginal congestion, environmental, and operating costs.

Thesis Purpose and Specific Objectives

The large economic benefits that NPS visitors and non-visitors receive, along with the visitor spending that they produce, surely make the National Parks an economic asset. With a 2016 budget of $2.851 billion, the benefits of the NPS likely outweigh its costs; however, we do not know the opportunity costs of the NPS lands (U.S. Department of the Interior 2017a). The NPS keeps track of visitors to each of its units, for management planning, budget allocation, and for showcasing the importance of the NPS to policy-makers and the public. Understanding factors that affect National Park attendance levels can help park managers better prepare for the future challenges they face, including overcrowding and overuse. Thus, the overall purpose of this thesis research is to determine how National Park visitation responds to certain economic and social factors. Specific objectives of this thesis include: (1) develop a theoretical demand model for aggregate National Park trips, (2) collect relevant data on National Park visitation and factors that may affect demand for park visits, (3) based on the theory developed in Objective 1 and the data collected for Objective 2, estimate an empirical National Park visitation model that shows the relative impacts of certain factors on National Park demand and visitation, and (4) using the model estimated for Objective 3, forecast future National Park visitation levels and associated economic benefits.

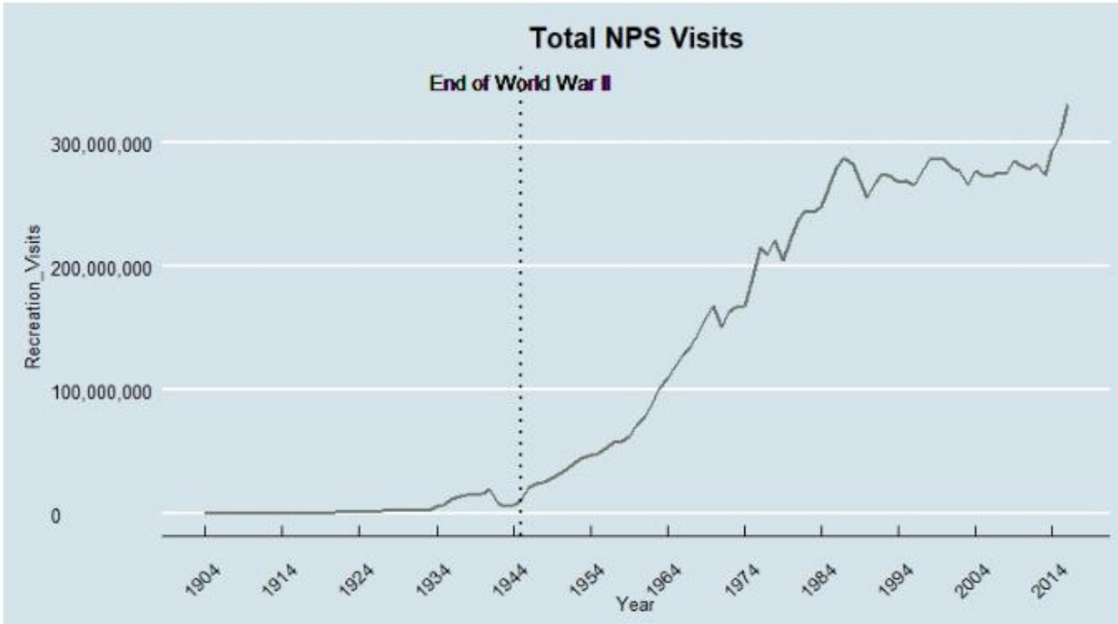

FIGURE 1.1: Total National Park System Attendance

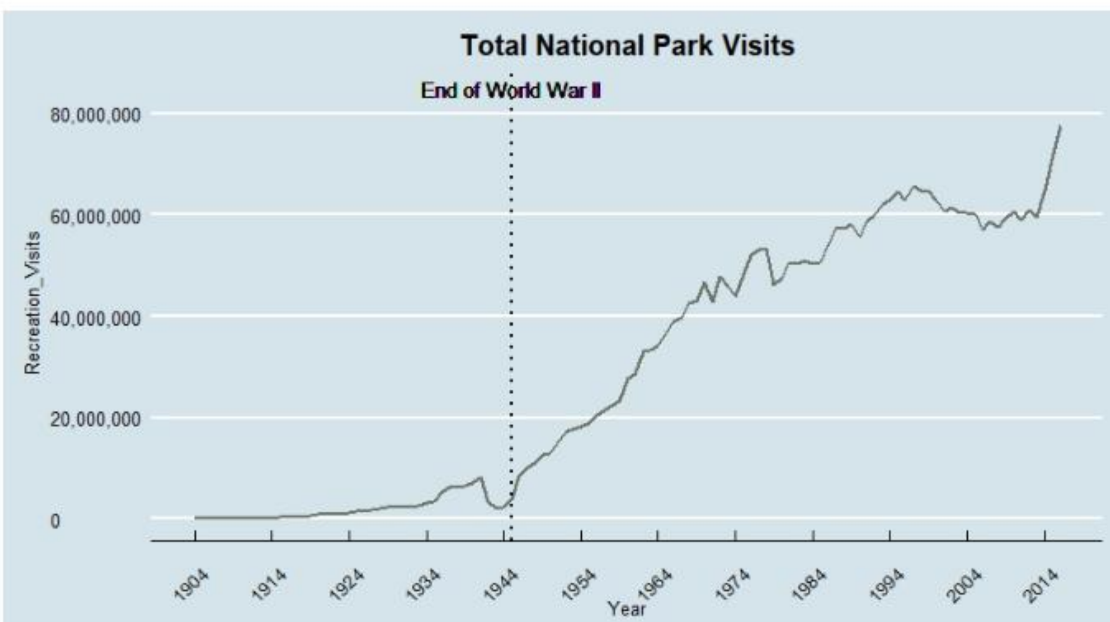

FIGURE 1.2: Total National Park Attendance

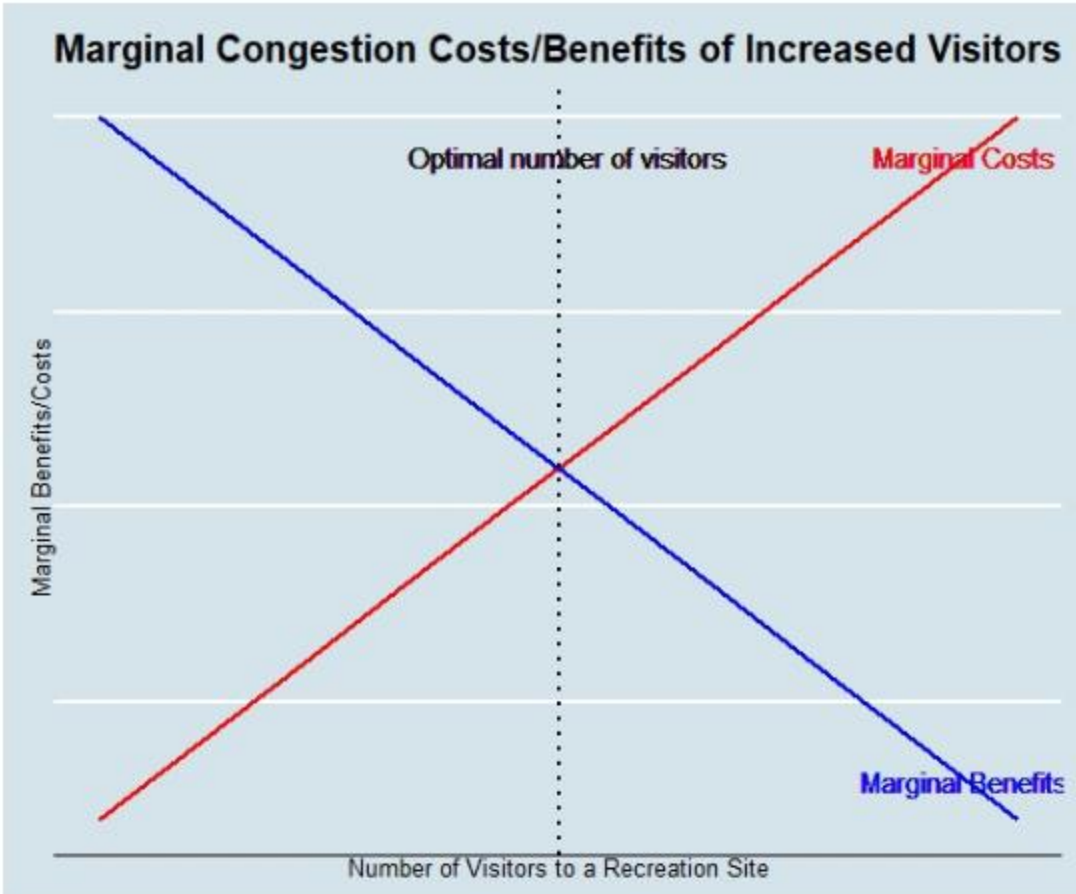

FIGURE 1.3: Marginal Costs and Benefits of Visitation

CHAPTER 2

THEORETICAL BACKGROUND

Economic Justification for National Parks

As mentioned in Chapter One, some authors have questioned why the government provides and manages the National Parks instead of private enterprise. The justifications for the government's provision of National Parks lie in the theory behind economic efficiency and market failure. It is widely accepted that a major role of government is to promote economic efficiency in the use of resources in an effort to achieve maximum benefit for society (Musgrave 1959). Government provision of the National Parks attempts to address the market failures that prevent the private market from efficiently allocating land to the National Parks.

One market failure that justifies the government's provision of National Parks is that they have characteristics of public goods. Public goods are those that are non-excludable and non-rival. A good is said to be non-excludable if it is impossible to prevent a person from using it once it is supplied. While some National Parks do charge entrance fees (making them excludable), others do not. Also, the non-use values of the parks and some of the ecosystem services they provide are impossible to prevent someone from enjoying, whether they pay to visit the park or not. Because of their physical characteristics, many natural resources, such as National Parks, do not easily do not fit the specifications of rival and exclusive property rights (Bergstrom and Randall 2010). A good is said to be non-rival if one person's use of the good does not infringe upon another person's use of that same good. Several people can enjoy certain services provided by a National Park at the same time, such as scenic viewing at the Grand Canyon National Park (assuming that congestion is not a problem). Services provided by a National Park only become rivalrous when congestion is a concern, such as RV-camping at developed campground where there are only a limited number of developed camping sites. But, the non-use services and values of the National Parks are always non-rival and non-exclusive.

Because of what is called the "free-rider effect," private markets will not provide non-excludable goods, or at least not an economically efficient quantity of them. If a good is non-excludable then there is an incentive for "free-riders" to avoid paying for it. After the good is supplied they will still be able to use it despite not financially contributing to it. The private firm, however, will only provide enough of the good supported by the payments of those who do pay, thus undersupplying the actual amount of the good that would be efficient. Through taxes, governments are capable of ensuring that all (or most) pay for the use of a non-excludable good and can therefore theoretically provide the efficient quantity of the good.

It is also near impossible for a private market to provide the efficient allocation of a non-rival good (Bergstrom and Randall 2010). In order to be economically efficient, goods should be produced at a level where the marginal cost of providing an incremental amount of the good equals the marginal revenue it would bring in. The marginal revenue is related to the marginal value it provides to the user through price. However, marginal valuations differ across users. Perfect price discrimination would be required to receive marginal revenues exactly the same as the marginal values that the good provides to users. In other words, each user of the good would be asked to pay the amount that they personally think the good is worth. Perfect price-discrimination is near impossible because users have incentives to understate their actual value for the good in an attempt to “free-ride,” (Samuelson 1954). Again this will lead to the private-firm not having all of the funds in order to allocate the non-rival good at the efficient level. Governments can provide non-rival goods with tax revenues and are capable of setting non-price-discriminatory user fees, which in the case of National Parks, are below the cost of providing the good. The use of tax dollars allows them to provide the efficient or near-optimal amount despite not receiving enough funds from visitors.

Another reason for government control over the National Parks is the presence of externalities. An externality is the cost or benefit experienced by one actor due to the actions of another actor which occur outside of, or external to, private markets. Whether the externalities come from the parks or from outside actors, private owners usually underprovide goods with positive externalities and overprovide goods with negative externalities. This is because the effect on others is not accounted for in the decision-making process by the private actor. The costs to society of a negative externality are greater than the private costs, and the benefits to society of a positive externality are greater than the private benefits. Because private actors only consider their private costs or benefits, they do not provide the socially efficient quantity of a good associated with an externality.

“A National Park usually is a large area that contains several nationally outstanding natural or cultural features. The area of land is large enough to ensure the protection of these features from influences outside of the Park’s boundaries” (Loomis

2002). This "buffer" helps to protect the park from negative externalities caused by the actions of others. For example, if a chicken farm were located directly next to a unique, natural feature, the smell of the chicken farm would decrease the overall visitor experience of that feature. It may be socially optimal, or efficient, for the farm to not operate, but the private farm owner only considers his or her own costs and benefits. The large sizes of the National Parks, most of which were created from federally-owned land (except in the eastern U.S.), prevents situations like this from happening.

The National Parks create their own positive externalities as well. National parks educate citizens about culture, history, and the environment. They also act as 'natural laboratories' for research in many different academic disciplines. These are two positive externalities that provide some value to society (Turner 2002). Governments are able to take positive externalities into account when determining how much of good to supply because governments are concerned with social measures of benefits and costs rather than just private measures. Thus when faced with externalities, economic efficiency can theoretically be reached by government provision of a good or service.

Market failures, like the public goods problem and externalities, would likely lead to the undersupplying of the National Parks if they were not provided and managed by the government. Under private control, the National Parks would likely turn into private parks like Niagara Falls in the 1800s, where tall fences were put up around the falls and exorbitant prices were charged to view them (Dilsaver 1994). As explained above, this type of exclusion of a non-rival resource (e.g. view of the falls) leads to economic inefficiency which in this case would be represented by "too few" visitors viewing the falls. In addition, there is a societal ethic/belief in the U.S. based on the ideals of democracy, that certain unique natural areas or amenities should be available to all the people rather than just private owners and select visitors able to afford high entrance fees (Bergstrom and Randall 2010).

Recreation Demand Theory

Because of the economic and social reasons discussed above, the U.S. has developed an extensive system of public parks at the local, state and national levels. Recreation visits to these parks can be analyzed just like any other good or service where prices, or costs, along with other factors determine demand (Gray 1970). In this study, we focused on recreational visits to National Parks as the measure of demand which is the quantity measure most consistent with economic consumer theory (Cordell and Bergstrom 1991). In this analysis the assumption is made that visitors to National Parks are utility-maximizing individuals that allocate their time and money between National Park visits and all other goods and services in order to maximize their utility over a certain time horizon (Nerg et al. 2012). The utility maximization problem is given as:

$$\text{(1)} \qquad \text{Max } U = u_i(v_i, x_i), \text{ subject to,}$$

$$P * xi + c_i * v_i \leq Y_i$$

$$\Gamma_i * v_i \leq FT_i$$

where $u_i(\cdot)$ is a strictly concave utility function for individual i with respect to National Park visits, v_i, and the consumption of all other goods and services, x_i. P equals the price level of all other goods and services while c_i is the price or costs associated with National

Park visits, and Y_i is individual i's income. Γ_i is the amount of time required to make a National Park trip, FT_i is the total amount of an individual's free time and U is an ordinal measure of utility.

The solution to the above utility maximization problem gives the individual's demand for National Park visits.

$$v_i = d_i(c_i, Y_i, \Gamma_i, FT_i) \tag{2}$$

Equation (2) shows the individual's demand for total National Park visits in a given time horizon. However, it is possible that the individual will visit more than one National Park during this time, meaning that v_i can be broken down to account for all 59 National Parks such that:

$$v_i = \sum_{j=1}^{J} v_{i,j} \tag{3}$$

$$j=1,2,\ldots,59$$

where $v_{i,j}$ is the number of visits the individual makes to park j, and J represents all 59 National Parks.

Because of the relatively small entrance fees at National Parks, previous studies have shown that they have little to no influence on the demand for visits (Factor 2007; Stevens et al. 2014). However, this does not mean that the cost of making a National Park trip is negligible. Visitors still incur costs in the form of travel expenses and time spent.

In recreation demand theory, travel expenses are considered part of the variable cost of the trip because visitors are required to make them in order to make additional trips. Time spent (either travelling or at the site) is also a real cost because the visitor is choosing to engage in a recreation trip instead of other opportunities that could potentially be more profitable. Therefore, c_i in *Equation (2)* represents the total cost of a National Park trip which is unique to each individual rather than just the price of an admission ticket (e.g., entrance fee).

In addition to the costs of a recreation trip, other important factors that also influence demand for National Park visits identified by standard demand theory and previous studies (e.g., Loomis and Walsh 1997; Rosenberger and Loomis 2001) are described below.

Socioeconomic, or demographic, characteristics of the user population can influence recreation demand (Loomis and Walsh 1997; Cordell and Bergstrom 1991; Rosenberger and Loomis 2001). Studies have shown that the typical participant in outdoor recreation is a caucasion, well-educated, male with an above average income (Bowker et al. 2006; Bowker et al. 2007; Cordell, Bergstrom, and Bowker 2005). The effect of higher levels of education is likely a representation of a disparity in tastes and preferences that exists between higher- and lower-educated subsets of the population. The same can be said for race and ethnicity. Johnson et al. (2004) claim that the meanings and values that people associate with wilderness are not inherent, but that they are determined by a person’s culture. It is reasonable to believe that people of different races and ethnicities will have different preferences for what activities to engage in in their spare time. (Johnson et al. 2004; Bowker et al. 2008). Similarly, demographics such as race, gender, or urban dweller status may provide different barriers, real or perceived, to outdoor recreation (More and Stevens 2000; Johnson, Bowker, and Cordell 2001; Perry, Xiao, and Manning 2015). Higher levels of disposable income give potential users more opportunities to undertake recreation trips as the costs relative to income will be lower. The age of the visitor is also likely to have an effect on the number of trips taken to a recreation site. Relatively more young people engage in recreation activities as compared to older people when the recreation activity is physically strenuous. Visitation to National Parks however, might have a positive correlation with age because strenuous activity is not required on a National Park trip; for example, many park sites and attractions can be viewed from a car or a leisurely stroll from a parking lot. Also, older people are more likely to be retired so they have more leisure time to take recreation trips. These are all demographic variables that theoretically should affect the number of recreation trips taken by a visitor.

It can also be assumed that the marginal utility received by a visit to a park is dependent on the specific **attributes, or quality, of each park**. Each of the National Parks is set in a unique location offering unique attributes that effect visitor experiences, and in turn, trip demand. Attributes of a park may include wildlife viewing opportunities, number of campsites, scenic viewing areas, hiking trails or any other factor that might provide utility to visitors. Quality of a recreation site is often measured through water quality, fish and game harvest, or congestion among other things (Loomis and Walsh 1997).

The availability of **substitute or complementary recreation opportunities** will also affect visitation. Economic theory suggests there will be a positive relationship between the demand for one good or service and the price of a substitute good. Conversely, economic theory suggests that there is a negative relationship between demand for one good or service and the price of a complementary good. It is conceivable that a person will visit multiple National Parks in a relatively close area on a single trip in order to decrease his or her average costs of producing one trip. Thus, in this case the parks would be complements for the visitor. Alternatively, the visitors may decide that they only want to spend their resources (money and time) on one National Park destination in order to maximize their benefits of visiting that park. In this situation the National Parks become substitutes. Other substitutes may exist as well, such as recreation trips taken to other countries or to state parks. The relationships between similar and related goods and services play an important part in consumer decisions, and should therefore be considered when modeling recreation demand (Loomis and Walsh 1997; McIntosh and Wilmot 2011; Henrickson and Johnson 2013).

Congestion at a recreation site may have a substantial effect on the demand for visits, especially for sites like National Parks where natural beauty and serenity are significant attractions that can be spoiled by the sights and sounds of people and cars. High levels of congestion will decrease the benefits of recreation and for some visitors benefits may fall below their WTP, so they will stop visiting. Potential visitors may have higher values for National Parks that are less crowded (Lawson and Manning 2001; Leon et al. 2015). The desire for solitude and limited human interaction might be what induces visitors to endure the high travel costs required to visit the National Parks in Alaska. From an aggregate point of view, visitation will rise until it reaches the social carrying capacity at which point it will level off. If visitation overshoots the social carrying capacity, visitors will realize that because of the high congestion costs, their benefits received from making the trip are below their costs. They will therefore reduce the number of trips they take until visitation levels off at the social carrying capacity (Loomis and Walsh 1997).

Tastes and preferences are another determinant of demand according to economic theory, but these are difficult to measure. Some variables such as location, seasonality, and park age can attempt to capture some of the effects of visitor tastes and preferences (Loomis and Walsh 1997). For example, those who prefer recreating in desert environments will likely choose to visit Death Valley National Park rather than Great Smoky Mountains National Park. General societal attitudes toward nature recreation or other activities also represent tastes and preferences and may affect visitation (Pergams and Zaradic 2006).

All of these non-price and income determinants of demand can be added to our demand function as follows:

$$(4) \qquad v_{i,j} = d_{i,j}\left(c_{i,j}\,, Y_i, FT_i, \Gamma_i, W_i, E_i, A_i, Q_j, SRO_j, CRO_j, CON_j, TP_i\right)$$

$$j=1,2,\ldots,59$$

where W_i is a race or ethnicity component for individual i, E_i is the highest education level attained by individual i, A_i is the age of individual i, Q_j is a vector of quality attributes for park j, SRO_j is the availability of substitute recreation opportunities for park j, CRO_j is the availability of complementary recreation opportunities for park j, CON_j is a measure of congestion at park j, and TP_i is vector of taste and preference attributes for consumer i. All other variables are as previously defined.

Total demand for visits to park j, represented by V_j, can be found by aggregating individual demand functions across the subject population Z (Loomis and Walsh 1997; Nerg et al. 2012):

$$(5) \quad V_j = \sum_{i=1}^{Z} v_{i,j} = \sum_{i=1}^{Z} d_{i,j}\left(c_j, Y_i, FT_i, \Gamma_i, W_i, E_i, A_i, q_j, SRO_j, CRO_j, CON_j, TP_i\right)$$

An implicit demand function for park j can be stated as:

$$(6) \quad Vj = D_j(c_j, Y_Z, FT_Z, \Gamma_Z, W_Z, E_Z, A_Z, Q_j, SRO_j, CRO_j, CON_j, TP_Z, Z)$$

Equation (6) is a theoretical model for visitation to National Parks and can be estimated using regression analysis. The equation shows that just as with other goods and services, the number of visits that consumers decide to take to National Parks depends on many factors, some that are park-specific and some that are visitor-specific. The following analysis will attempt to uncover the relationships of these factors and National Park visitation over a 24 year period. Table 2.1 shows the theoretical expectation for the estimated sign of the regression coefficient for each of the theoretical components of demand. Most previous studies have focused on the decline of National Park visitation experienced in the 1990s and the 2000s. This study will examine these declines as well as recent increases in National Park Visitation since about the mid-2000s. According to NPS data, in the last couple of years, many National Parks have recorded record visitation numbers.[4]

TABLE 2.1: Theoretical Variables

Table of Theoretical Variables	
Theoretical Variable	Expected Sign of Estimated Regression Coefficient
c_j	Negative
Y_Z	Positive
FT_Z	Positive
Γ_j	Negative
W_Z	N/A
E_Z	Positive
A_Z	N/A
Q_j	N/A
SRO_j	Negative
CRO_j	Positive
CON_j	Negative
TP_Z	N/A
Z	Positive

[4] National Park Visitor Use Statistics website includes a query builder which was used along with accompanying National Reports to gather the data used here. Accessed November 28, 2017.

CHAPTER 3

DATA AND EMPIRICAL METHODOLOGY

Data Sources

Attendance is measured in this article by the number of annual recreation visits to each National Park, and these data were retrieved online from the National Park Service Visitor Use Statistics.[5] Annual visitation data covers 47 National Parks over a time period ranging from 1979 to 2016. The NPS defines a recreation visit as “one entrance per individual per day” with the exception of non-recreation visits such as the entrance by NPS employees, volunteers, contractors, private tenants whose residence is within the park boundaries, etc. (U.S. Department of the Interior, 2018c).

Data on per vehicle and per person entrance fees were obtained through personal communication with NPS officials (Devenney, 2017). Entrance fee data ranges from 1993 to 2016. This was the limiting factor of the data and thus this entire study encompasses this same time frame. Note that not all National Parks collect entrance fees. Of those parks that do collect them, entrance fees increased several times for some of the parks and not at all for others. All entrance fee values have been adjusted for inflation using the annual average U.S. City Average Consumer Price Index as reported by the Bureau of Labor Statistics.[6] Real entrance fees are reported in 2016 U.S. dollars, and vary considerably ranging from $0 to $33.44.

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[5] National Park Service Visitor Use Statistics website includes a query builder which was used along with accompanying National Reports to gather the data used here.Accessed November 28, 2017.

[6] Bureau of Labor Statistics, U. S. Department of Labor, CPI All Urban Consumers Series Id: CUUR0000SA0.Accessed November 29, 2017. https://data.bls.gov/pdq/SurveyOutputServlet.

U.S. Population[7] and U.S. Real Median Personal Income[8] were both retrieved online from the St. Louis Federal Reserve's Economic Data. U.S. population is as estimated on January 1st of each year. Real median personal income was reported in 2016 U.S. dollars.

Estimates of the number of U.S. residents aged 65 or older were obtained from the U.S. Census Bureau.[9] [10] [11]. The inclusion of this measurement as an explanatory variable attempts to explain how variations in visitation are related to age demographics. As stated previously, the typical National Park visitor is a relatively older person. It can also be argued that this variable also acts as a proxy for free-time, because those over 65 years old are more likely to be retired, thus having more free time to visit National Parks. Estimates for U.S. residents aged 5-18 were also gathered from the same sources; this age variable will be explained later in this thesis.

Because I am modeling aggregate visitation to each of the National Parks, it is not possible for me to know the travel costs involved with producing a trip for each individual visitor. For this reason, folowing Stevens et al. (2014), I used the U.S. City

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[7] Population, Total for United States Series [POPTOTUSA647NWDB], retrieved from FRED, Federal Reserve Bank of St. Louis. Originally sourced from World Bank. Last Updated July 7, 2017. Accessed November 28, 2017. https://fred.stlouisfed.org/series/POPTOTUSA647NWDB.

[8] Real Median Personal Income in the United States Series [MEPAINUSA672N], retrieved from FRED, Federal Reserve Bank of St. Louis. Originally sourced from U.S. Census Bureau. Last Updated September 18, 2017. Accessed November 28, 2017. https://fred.stlouisfed.org/series/MEPAINUSA672N.

[9] U.S. Census Bureau, Population Division, U.S. Department of Commerce. Intercensal Estimates of the Resident Population by Single Year of Age, Sex, Race, and Hispanic Origin for the United States: April 1, 2000 to July 1, 2010. Release Date: September 2011. Accessed November 28, 2017. https://www.census.gov/data/datasets/time-series/demo/popest/intercensal-2000-2010-national.html.

[10] U.S. Census Bureau, Population Division, U.S. Department of Commerce. Intercensal Estimates of the United States Resident Population by Age and Sex, 1990-2000. Last Revised February 8, 2017. Accessed November 28, 2017. https://census.gov/data/tables/time-series/demo/popest/intercensal-national.html.

[11] U.S. Census Bureau, U.S. Department of Commerce. Annual estimates of the resident population by single year of age and sex for the United States: April 1, 2010 to July 1, 2016 (NC-EST2016-AGESEX-RES) Last Revised June 26, 2017. Accessed November 28, 2017. https://www.census.gov/data/datasets/2016/demo/popest/nation-detail.html.

Average Retail Price of Unleaded Premium Gasoline as a proxy for travel costs. Previous research claims that gasoline price is directly proportional to travel costs in an aggregate recreation demand model (Lane 2012; Poudyal, Paudel and Tarrant 2013). These values were obtained from the Energy Information Administration[12] and have been converted to 2016 U.S. dollars in the same manner used for entrance fees.

Multiple sources were used to collect data on the racial makeup of the United States. Estimates of the number of white and non-white members of the U.S. population from 1993-1999 were obtained online from the U.S. Census Bureau.[13] Similar estimates ranging from 2000-2014 were obtained online from the Centers for Disease Control and Prevention (CDC).[14] Finally, these estimates were retrieved online for the years 2015 and 2016 from the U.S. Census Bureau's annual American Fact Finder for 2015 and 2016 respectively.[15] Ideally, I would like all of these data to come from the same source to minimize the risk of measurement error, however in this case that simply was not possible. Nevertheless, I do not believe that there will be any large measurement error problems because the population estimates from the different sources are similar and do not suggest any major discrepancies in the estimation techniques used.

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[12] U.S. Energy Information Administration, U.S. Department of Energy. August 2017 Monthly Energy Review. Release Date: August 28, 2017. Accessed September 10, 2017. https://www.eia.gov/totalenergy/data/monthly/previous.php\#2017.

[13] U.S. Census Bureau, Population Division, U.S. Department of Commerce. Resident Population Estimates of the United States by Sex, Race, and Hispanic Origin: April 1, 1990 to July 1, 1999, with Short-Term Projection to November 1, 2000. Release Date: January 2, 2001. Accessed November 29, 2017. https://www.census.gov/population/estimates/nation/intfile3-1.txt.

[14] Centers for Disease Control and Prevention, National Center for Health Statistics, U.S. Department of Health and Human Services. Table 1. Resident population, by age, sex, race, and Hispanic origin: United States selected years 1950-2014. Last Updated April 27, 2016. Accessed November 29, 2017. https://www.cdc.gov/nchs/hus/contents2015.htm\#001.

[15] U.S. Census Bureau, U.S. Department of Commerce. Annual Estimates of the Resident Population by Sex, Race, and Hispanic Origin for the United States, States, and Counties: April 1, 2010 to July 1, 2016.Accessed November 28, 2017. https://www.census.gov/data/datasets/2016/demo/popest/nation-detail.html.

Blunk, Clark, and McGibany (2006) claim that the September 11th, 2001 terrorist attacks that involved the hijacking of domestic airplanes had a significant short-run impact on domestic air travel because they created a nationwide fear of air travel. Increased security measures implemented after the 9/11 attacks also decreased the efficiency of air travel by requiring travelers to spend more time in airport security, thus increasing the opportunity cost of air travel. The higher opportunity cost of air travel is important when studying visitation to National Parks because the remoteness of the National Parks often require long-distance air travel. I have included a binary variable that attempts to explain the decline in National Park visitation following the 9/11 attacks. Following similar methods used in previous studies (Schuett, Le, and Hollenhorst 2010; McIntosh and Wilmot 2011; Stevens et al. 2014), the regression variable representing the 9/11 attacks was set equal to 1 for the years 2002 through 2016 and 0 otherwise.

As discussed briefly in Chapter One, total NPS visitation over time reached a then-peak in 1987 and declined for several years until finally re-reaching 1987 levels again in 2014. Much of the previous research related to NPS visitation in this field was conducted during the years in which visitation numbers were falling, in an attempt to explain the declining visitation numbers. The rise in entrance fees and the fluctuation of gas prices were common suspects to the investigations (Stevens et al. 2014), but Pergams and Zaradic (2006) had a different hypothesis.

Pergams and Zaradic (2006) proposed that the rise in electronic media in the Unites States has been responsible for decreased NPS visitation on a national level. Watching television and movies, playing video games, and browsing the internet all use up our limited time. If our time is increasingly spent on those activities then it cannot be spent visiting National Parks or engaging in other outdoor recreation opportunities. In an effort to assess the general changes in the tastes and preferences of society, I first gathered U.S. video game industry revenues over time. Next, I divided this value by the population of U.S. residents aged 5-18 years old and included this variable as an explanatory variable in the regression analysis presented later in this thesis. This variable will hereby be referred to as “video game revenues per player.”

In a book entitled, *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*, author Richard Louv makes the case that because so many children are raised in urban areas these days, and spend a lot of time indoors interacting with electronic devices (e.g. “screen time”), children and young people are losing interest in nature recreation and spending time outdoors (Louv 2006). Thus, the “video game revenues per player” variable should act as a proxy for how young Americans’ tastes are shifting towards indoor “screen time” and away from outdoor, nature-based recreation.

In order to construct the “video game revenues per player” variable, data for 1993 to 2013 were retrieved from fandom.com,[16] which aggregated data from an independent research firm called the NPD Group. Data for 2014, 2015, and 2016 were obtained directly from NPD Group press releases in conjunction with the Entertainment Software Association.[17] [18] Data on internet usage and television watching was scarce and incomplete for the time period of this study, however the Bureau of Labor Statistics’ American Time Use Survey suggests that the amount of time that Americans spend

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[16] Data for this study was compiled from information presented online by Fandom. Video Games in the United States. Accessed November 29, 2017. http://vgsales.wikia.com/wiki/United_States\#cite_note-1.
[17] Entertainment Software Association, NPD Group. Press Release U.S. Video Game Industry Generates \$23.5 Billion in Revenue for 2015. Accessed November 29, 2017. http://www.theesa.com/article/u-s-video-game-industry-generates-23-5-billion-in-revenue-for-2015/.
[18] Entertainment Software Association, NPD Group. Press Release U.S. Video Game Industry Generates \$30.4 Billion in Revenue for 2016.Accessed November 29, 2017. http://www.theesa.com/article/u-s-video-game-industry-generates-30-4-billion-revenue-2016/.

watching television has been relatively stable over the past decade when compared to video game industry revenues that have been rising substantially.[19] Unfortunately, I was not able to identify data sources for the actual time children and young people spend playing video games or watching their electronic device screens for other purposes (e.g. social media).

In late 2015, the Obama Administration started a program called "Every Kid in a Park," which allows free entry into National Parks and other NPS locations for 10 year-old children and their families (U.S. Department of the Interior, 2017d). This program reduces entrance fees or prices for some visitors as children and their families who qualify that might normally be charged $30 per vehicle to enter a park can now enter for free. In the regression analysis presented later in this thesis, I included a binary variable that accounts for this effect for every National Park included in the analysis for the years 2015 and 2016.

Altogether, there are 59 National Parks. However, only the 47 parks located in the continental United States were included in the analysis for this thesis. Of the 12 parks excluded from the analysis, 8 are located in Alaska, 2 are located in Hawaii, one is located in American Samoa, and one is located in the U.S. Virgin Islands. A unique, and common feature of the 12 National Parks located outside of the continental U.S. are the exceptionally long distances separating these parks from the most of the U.S population. Because of these long distances, trips to these parks almost always involve travel on commercial airlines leading to relatively high travel costs for non-local visitors. By acting as influential observations and "outliers", these relatively high travel costs would likely

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[19] Bureau of Labor Statistics, U.S. Department of Labor. American Time Use Series Id: TUU20101AA01014236. Accessed November 29, 2017. https://data.bls.gov/pdq/SurveyOutputServlet.

skew my empirical visitation modeling results, which is why I dropped these observations from the analysis. Previous studies that have estimated recreation participation and visitation models also typically only model trips to parks and other natural areas in the continental U.S. for the same reason (Bergstrom and Cordell 1991; Bowker et al. 2007; Stevens et al. 2014).

Figure 3.1 shows the total number of recreation visits to the subset of 47 parks included in the analysis received from 1993 to 2016. Figure 3.2, which shows the total number of visitors to all 59 of the National Parks, is below as well. Notice that the two graphs generally follow the same trends. Nonetheless, this thesis only focuses on the parks within the contiguous United States.

Table 3.1 lists all of the variables used in the empirical analysis for this thesis, along with a label, their theoretical counterparts and the hypothesized sign of their respective regression coefficients. Summary statistics are provided in Table 3.2. Note that other data were collected to represent park characteristics such as park size, the availability of substitutes and complements, congestion and other characteristics, but ultimately did not fit with the model specification selected for this analysis and were therefore omitted.

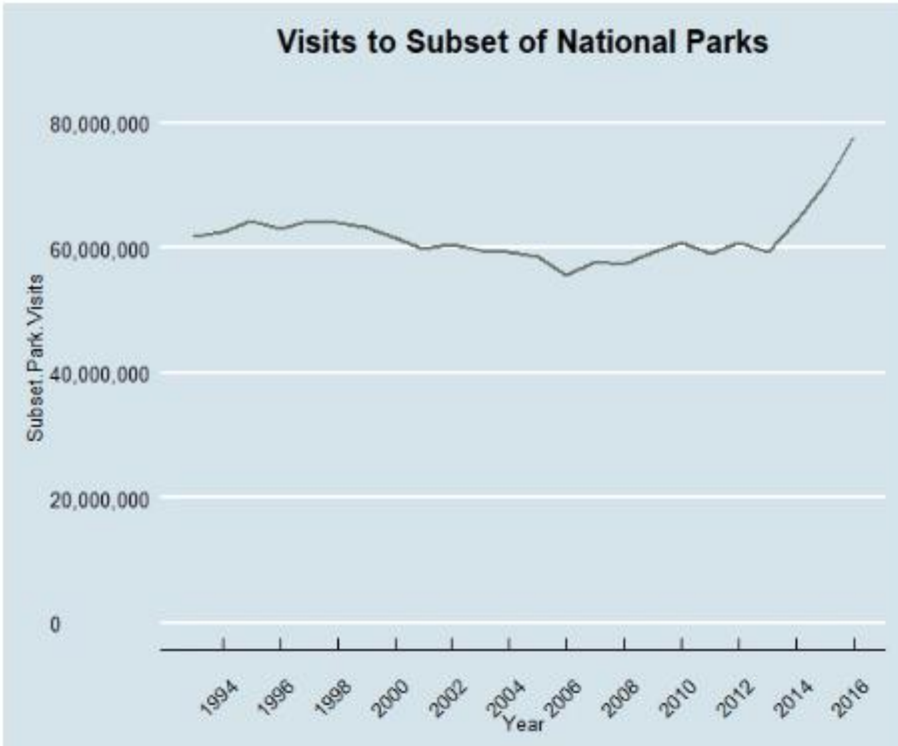

FIGURE 3.1: Total Attendance to the Subset of 47 Parks

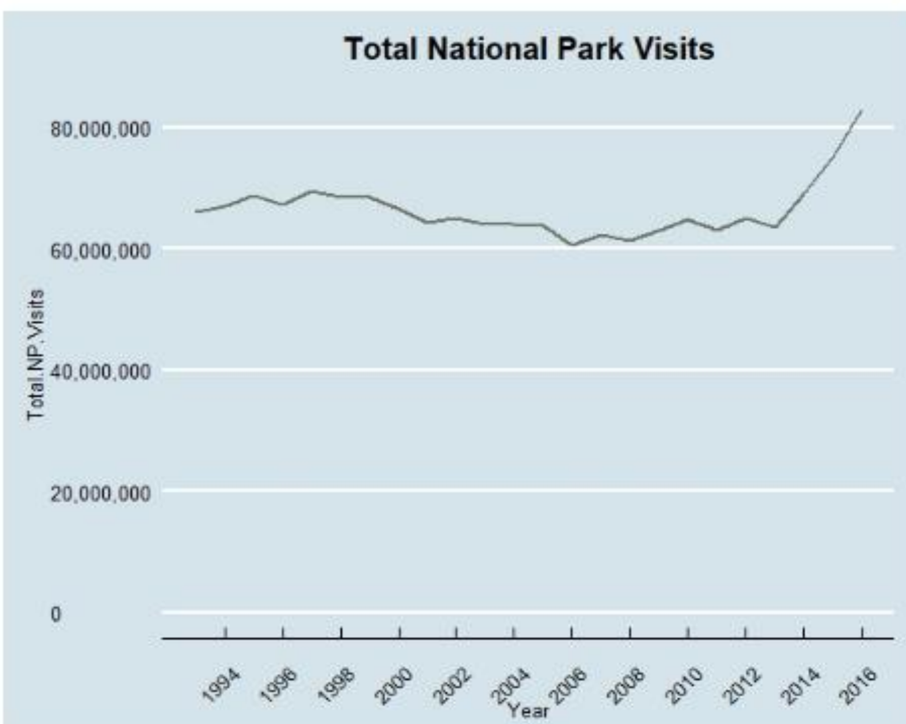

FIGURE 3.2: Figure 1.2 Reproduced, Total National Park Attendance

Table 3.1: Empirical Variables

Table of Empirical Variables

Empirical Variable	Label	Theoretical Counterpart	Expected Sign of Regression Coefficient
Real Entrance Fee	RealEntranceFee	c	Negative
Real Median Personal Income	RMPI	Y_Z	Positive
Number of Residents 65 or older	65Older	A_Z, FT_Z	Positive
Real Gasoline Price	RealFuelPrice	c	Negative
Percentage of the U.S. Population that is non-white	Nonwhite	W_Z	Negative
Post-9/11 years, 2002-2016	Post-9/11	TP_Z, c	Negative
U.S. Video game industry revenues per player	VGRpP	TP_Z, SRO_Z	Negative
Every Kid in a Park years, 2015-2016	EKIP	c	Positive

Table 3.2: Summary Statistics

Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.
RealEntranceFee	$9.50	9.04	0	33.44
RMPI	$28,926	1554	25242	31099
65Older	38238813	4727314	32674186	49244195
RealFuelPrice	$2.81	0.74	1.84	4.09
Nonwhite	19.32%	1.80	16.70	23.09
Post-9/11	0.626	0.483	0	1
VGRpP	$293.66	83.43	142.46	524.73
EKIP	0.08	0.28	0	1

Empirical Model

Altogether there are 1,128 observations used in this study. This encompasses 47 National Parks (j = 1,2,...,47) over a 24 year period from 1993 to 2016. Because I am working with both cross-sectional and time-series data, a panel model specification is required.

Attendance and per-capita attendance were both tested to see if they follow stationary or non-stationary processes with an Augmented Dickey-Fuller Test (ADF) and a Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. Attendance at 43 National Parks failed to reject the null hypothesis of unit root (non-stationarity) for the ADF test and rejected the null hypothesis of stationarity for the KPSS test at the $\alpha = 0.10$ level of significance. Per capita attendance was found non-stationary at 35 National Parks in the same manner. When a series is non-stationary its data-generating process is not constant over time, and therefore cannot be used for accurate modeling when using data from more than one time period (Gujarati and Porter 2009.) Because attendance at the majority of parks in the sample follows non-stationary processes, first difference models were used.

First difference models stabilize non-stationary processes by using the first-differenced values of the dependent and independent variables of interest when performing Ordinary Least Squares (OLS). That is, the value of the first difference of variable x, in time period t is equal to the value of x in period t minus the value of x in period t-1. Specifically:

$$FDx_t = x_t \text{-} x_{t-1} \quad (7)$$

where FDx_t represents the first difference of the variable that is being transformed. In other words, first difference models measure how the changes in the independent variables affect the change in the dependent variable, which is much more likely to be a stationary process (Gujarati and Porter 2009; Woolridge 2009).

One drawback of first difference models is that they remove variables for which the value does not change over time. For example, the size of a specific park does not change from year to year, so its first-differenced value is always equal to zero and therefore has no impact on the regression. For this reason, some data collected on variables of interest have been omitted from my regression models, as stated previously. These include the number of recreation activities that each park offers, the number of other nearby parks, regional dummy variables, and park size.

Also worth noting, is that first-differenced values cannot be computed for the first time period. This is because there is no previous time period available to difference from. For this reason the number of observations available for a first difference regression is less than the total number of observations gathered. In this case, 1,128 observations were gathered; however, only 1,081 first-differenced observations are calculated and used when performing OLS.

Model Specifics

Two model specifications were chosen. Both models were pooled OLS where every park and every time period were used. *Model 1* is a simple linear regression where OLS was performed on the first difference of each variable. *Model 2* is of a semi-log form where the logarithm was taken from select variables, including the dependent variable. OLS was then performed on the first-difference of these logged variables and others. Recall that some of the National Parks do not have entrance fees; every instance in which a park's entrance fee was equal to $0, I changed the value to $1. This was done because the logarithm of zero is undefined and therefore, regression software would remove this observation entirely had the value remained $0. This is only a minor change in the data and should have an inconsequential effect on estimation when compared to the benefits it provides by allowing me to keep the observation. *Equation (8)* and *Equation (9)* show the specifications of *Model 1* and *Model 2* respectively.

$$(8) \qquad FDAttendance_j = \beta_0 + \beta_1 * FDReal\text{Entrance Fee}_j$$

$$+ \beta_2 * FDRMPI + \beta_3 * FD65Older + \beta_4 * FDRealFuelPrice +$$

$$\beta_5 * FDNonwhite + 6 * FDpost - 9/11 + \beta_7 * FDVGRpP + \beta_8 * FDEKIP$$

$$(9) \qquad FDlog(Attendance_j) = \beta_0 + \beta_1 * FDlog(RealEntranceFee_j)$$

$$+ \beta_2 * FDlog(RMPI) + \beta_3 * FDlog(65Older) + \beta_4 * FDlog(RealFuelPrice)$$

$$+ \beta_5 * FDNonwhite + \beta_6 * FDpost - 9/11 + \beta_7 * FDlog(VGRpP) + \beta_8 * FDEKIP$$

Preliminary regression results were tested for the presence of heteroscedasticity with a Breusch-Pagan (BP) test. Both the linear and semi-log model specifications rejected the null hypothesis of homoscedasticity. The presence of heteroscedasticity is a violation of OLS assumptions and can lead to incorrect test statistics and confidence intervals (Woolridge 2009.) After I was able to reject the null hypothesis of homoskedasticity, the models were re-estimated with standard errors clustered around each individual park. This is done in situations where some external factor or phenomenon may not affect individual observations but may affect groups of observations uniformly in each group. Clustered standard errors account for correlation between observations of the same group. In a panel data setting, such as this one, each individual park (or group) is likely affected by the same unobservable factors each year (or observation), yet not each park is affected by these factors in the same fashion. Not clustering standard errors on park would produce misleadingly small confidence intervals because of incorrect t-statistics (Cameron and Miller 2015).

Next the models were tested for multicollinearity by identifying the variance inflation factors (VIFs) for each variable. Calculated VIFs are shown in Table 3.3. The VIFs are reasonable and do not suggest the presence of multicollinearity. The largest VIF in my sample was approximately 2, while multicollinearity is only present if the largest VIF in a set is greater than 10 (Becketti 1995).

The next chapter presents the results of the OLS regressions, which show the relative impact that each determinant of demand has on National Park visitation to the subset of parks chosen here. Recall that because *Model 1* and *Model 2* are first difference models, the regression coefficients show the effect that a change in an explanatory variable will have on the change in National Park attendance. Additionally, the regression results are used to forecast future attendance to the parks, and to estimate the economic benefits that will be provided by these visits. Chapter Five further discusses the results of the regression models by exploring the implications of their findings.

Table 3.3: Variance Inflation Factors

Variance Inflation Factors

	Model 1	Model 2
Variable	**VIF**	
RealEntranceFee	1.18	1.14
RMPI	1.58	1.66
65Older	1.48	1.45
RealFuelPrice	1.60	1.70
Nonwhite	2.06	2.10
Post-9/11	1.20	1.26
VGRpP	1.28	1.23
EKIP	2.69	2.73
Mean VIF	1.63	1.66

CHAPTER 4

EMPIRICAL MODEL ESTIMATION RESULTS

Results of OLS Estimation

This chapter presents and discussed the results of the National Park demand/visitation models specified in Chapter Three. Table 4.1 and Table 4.2 show the results of the OLS regressions performed on *Model 1* and *Model 2*, respectively. Both models had an intercept and at least three explanatory variables significant at the $\alpha = 0.10$ level. Also both models had an F-statistic significant at the $\alpha = 0.01$ level indicating that collectively, the explanatory variables do explain some of the variation in the first-differenced values of National Park visitation.

The estimated regression coefficient for park entrance fee was negative for *Model 1*, suggesting that higher entrance fees are associated with lower levels of visitation, as was hypothesized. However, the regression coefficient was positive for *Model 2* and not statistically significant in either of the two models. Therefore we cannot say with confidence that the entrance fee to a National Park has a meaningful relationship with its level of visitation. These findings are consistent with previous studies that claim that entrance fees have little to no impact on recreation visitation levels (Becker et al. 1985; Factor 2007; Stevens et al. 2014). This is likely due to the fact that entrance fees are only a small part of the total costs associated with visiting a National Park. Visitors must incur direct costs for travel, lodging, and food along with the opportunity costs of their time when visiting the National Parks. For most visitors, the fee to enter the park will be a small fraction of their total costs incurred.

The regression coefficients for real median personal income were also not statistically significant in either of the models. These dispute the claims that National Park visits are inferior goods made by Johnson and Suits (1983), McIntosh and Wilmot (2011), and Nerg et al. (2012) as these would require a significant negative estimated coefficient to be present for this variable. At the same time, this does not confirm my hypothesis that the estimated coefficients would be positive, signifying that National Park trips would be a normal good.[20] My results are consistent with Henrickson and Johnson (2013) which also found no significant relationship between income and National Park visits.

Consistent with other studies (Schuett et al. 2010; Nerg et al. 2014), and my hypothesis, is the fact that both of my models presented statistically significant, positive regression coefficients for the explanatory variable that counts the number of American residents aged 65 years or older. Those aged 65 or older are more likely to be retired and have more free time than the average American. This group is also are more likely to have disposable income that allows them to make the trips and recreation preferences that encourage them to do so.

As expected, real gasoline prices have a statistically significant, negative coefficient in both models. Travel costs are a large fraction of the total costs required to take a trip to a National Park and gasoline expenditures are a large part of such travel

[20] Stevens et al. (2014) find that income relative to entrance fees and gasoline prices have a negative and statistically significant relationship with National Park visits. Poudyal, et al. (2013) find that several different indicators of recessions have negative and statistically significant relationship with National Park visitation. The results of both of these studies indirectly suggest that National Park visits are normal goods.

costs. Figure 4.1 shows National Park visitation to the subset of parks and (adjusted) real fuel price over the time period used in this study.[21] Notice the inverse relationship between the two series. The large magnitude of the regression coefficient, in *Model 1* suggests that gasoline prices are one of the most important factors that shape annual National Park attendance. The negative relationship between gasoline prices and National Park visitation is also found in several other studies[22] (Pergams and Zaradic 2006; Henrickson and Johnson 2013; Poudyal et al. 2013; Stevens et al. 2014).

Model 2 resulted in statistically significant, positive estimated regression coefficients for the variable that counted the percentage of the population that is non-white. This contradicts my hypothesis based on previous studies related to race and outdoor recreation preferences (Johnson et al. 2004; Bowker et al. 2006) that suggest that the typical National Park visitor is white and that changing demographics may lead to decreasing levels of visitation. The results of this model may represent either a cultural change in the recreation preferences of non-white populations or they may simply be a case of spurious correlation. *Model 1,* however, does not show a positive relationship between the non-white population and National Park attendance. The fact that *Model 1* and *Model 2* do not produce the same result would suggest that the results of *Model 2* may be a consequence of spurious correlation.

Model 1 produced a positive coefficient estimate for the “post-9/11” variable suggesting that the 9/11 terrorist attacks had actually increased National Park visitation.

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[21] Adjusted fuel price was calculated as real fuel price multiplied by 10,000,000. This was done purely for the aesthetics of Figure 4.1. These values were not used in estimation or any other part of this thesis.

[22] Significant negative coefficients on the real gasoline price variable and significant positive coefficients on the 65 or older variable were also found in other model specifications that are not reported in this thesis. These other specifications were the same as \textit{Model 1} and \textit{Model 2} but with robust standard errors as opposed to clustered standard errors. The results found using clustered standard errors were reported because I believe that using clustered standard errors was more appropriate for this analysis.

Model 2, produced a negative estimate for this coefficient, as was hypothesized. The reason for the inconsistent results between the two models lies within the interpretation of the models. Recall that the dependent variable for *Model 1* is the first difference (i.e. growth or decline) of park visitation in absolute terms, or visits. The dependent variable in *Model 2* is first difference of the logarithm of park visitation. This means that the coefficient of the post-9/11 variable for *Model 2* is interpreted as the percentage change in growth of park visitation. Because the different parks experience varying levels of popularity, it is possible that an event like 9/11 may affect the growth of the different parks in the same manner in relative (i.e percentage) terms but not in absolute terms. Thus, *Model 2* may be better at estimating such an effect than *Model 1*. This is one possible reason for why the coefficient on the post-9/11 variable differs between the two models. Nonetheless, neither of these coefficients were statistically significant, indicating that 9/11 has not had a long-term impact on National Park visitation.

In contrast to Richard Louv's worries about a "nature deficit disorder" in children and young people (Louv 2006) and Pergams and Zaradic (2006) who, claim increased use of video games and other electronic media (e.g. increased "screen time") causes young people to lose interest in visiting the National Parks, my results for *Model 1* show a positive relationship between video game revenues per player and National Park attendance. Once again, this may be the result of spurious correlation as *Model 2* shows an insignificant effect. As mentioned in Chapter Three, a variable that better measures the amount of time a person uses electronic media would be a better way of estimating the relationship between a person's "screen time" and interest and participation in outdoor recreation activities, including visiting National Parks.

Finally, the dummy variable for the “Every Kid in a Park” program presents a negative estimated coefficient for both models indicating that the presence of the program has actually decreased visitation. This is the opposite of what was hypothesized. This program is still new and was established toward the tail end of the time period being assessed in this study. Its effect should continue to be monitored the see if it has any long term impacts.

In the regression results tables below, * indicates statistical significance at the $\alpha = 0.1$ significance level. ** indicates statistical significance at the $\alpha = 0.05$ significance level. *** indicates statistical significance at the $\alpha = 0.01$ significance level.

TABLE 4.1: *Model 1* Estimation Results

Model 1

# of Observations	=	1,081
F(8,46)	=	5.07
Prob >F	=	0.0002
R-squared	=	0.0745
Root MSE	=	1.5e+05

Variable	Estimate	Robust Std. Error	t	P >|t|
RealEntranceFee	-209.2825	3298.22	-0.06	0.950
RMPI	16.13666	10.0894	1.60	0.117
65Older	0.0507634	0.00946	4.96	0.000***
RealFuelPrice	-44889.87	11036.93	-4.07	0.000***
Nonwhite	13930.3	10095.29	1.38	0.174
Post-9/11	22922.72	17958.27	1.30	0.199
VGRpP	119.938	72.49194	1.65	0.105
EKIP	-3648.454	31786.49	-0.11	0.909
Intercept	-30580.62	8000.06	-3.82	0.000***

TABLE 4.2: *Model 2* Estimation Results

Model 2

# of Observations	=	1,081
F(8,46)	=	8.93
Prob >F	=	0.0000
R-squared	=	0.0371
Root MSE	=	0.1604

Variable	Estimate	Robust Std. Error	t	P >|t|
RealEntranceFee	0.0033594	0.018616	0.18	0.858
RMPI	0.3350112	0.2790911	1.20	0.236
65Older	1.112971	0.3234625	3.44	0.001***
RealFuelPrice	-0.1943286	0.0461694	-4.21	0.000***
Nonwhite	0.0504627	0.0293786	1.72	0.093*
Post-9/11	-0.0272755	0.0179693	-1.52	0.136
VGRpP	0.0067727	0.0127459	0.53	0.598
EKIP	-0.0921878	0.0641478	-1.44	0.157
Intercept	-0.0179037	0.0080152	-2.23	0.030**

FIGURE 4.1: Total Subset National Park Attendance and Real Fuel Prices

Forecasts

Now that acceptable demand models have been specified, I can use these models to forecast future values of visitation to each of the 47 National Parks included in this analysis. In this section, I will use the *Model 1* and *Model 2* equations along with projected values of each of the independent variables to estimate the first difference of National Park attendance for the years 2017 to 2026 for each park. I will then take the calculated first difference estimate and add it on to the previous year's value of attendance to provide an estimate of total visitation for that park. Finally, I will sum the forecasted value of attendance for all 47 parks to arrive at the total forecasted value of National Park attendance for that year. Though *Model 1* produced a higher R-squared value, *Model 2* may be more appropriate for forecasting. Changes in the explanatory variables of *Model 1* provide us with a change in the first difference of visitation in absolute number terms. Whereas, changes in the explanatory variables in *Model 2* provide us with a change in the first difference of visitation in percentage terms. A percentage growth in the first difference of visitation is likely more accurate because it allows for the heterogeneity in park popularity to affect projected growth. *Model 1* suggests that all parks are growing by the same amount (except in the case that there are differences in entrance fee changes). Thus, *Model 1* may overstate the first difference of visitation for small parks and understate such for large parks.[23] Nevertheless, forecasts for total National Park visitation were produced with both models. Information on the projected values of the independent variables is below.

[23] Note that \enquote{small} and \enquote{large} are referring to parks with relatively low and high visitation, respectively.

Some accommodations were needed when the availability of data on projections was limited. Firstly, since the 9/11 terrorist attacks have already occurred in the past, the "post-9/11" dummy variable was set to equal 0 for the forecasts. Recall that this variable equals 1 for the years 2002 - 2016 and equals 0 otherwise. The negative coefficient on this variable suggest that if some similar disaster were to occur in the future, it may have the potential to adversely affect National Park attendance, however, I am not predicting any such occurrence. I also set the value of the "Every Kid in a Park" dummy variable to 1 since I have no reason to believe that this program will end any time within my forecasts. Lastly, since I could not find existing projections of U.S. video game revenues per player, I projected these values myself using OLS regression. The projections were then used to find the first difference of this variable in the same manner as the other independent variables used in this section. *Equation (10)* shows how OLS was used to project per player U.S. video game revenues (VGRpP):

$$(10) \qquad VGRpP_t = \gamma_0 + \gamma_1 * t + \gamma_2 * t^2 + \gamma_3 * VGRpP_{t-1}$$

In *Equation (10)*, t represents time where t=1 corresponds to 1993 and so on until t=24 which corresponds to 2016. Video game revenues per player were tested for unit root with a KPSS test. The results of the test indicated that we cannot reject the null hypothesis of stationarity, thereby enabling me to use *Equation (10)*. The R-squared of this regression was 0.64 which indicates satisfactory goodness of fit. The regression results of *Equation (10)* are shown in Table 4.3. This model was then used to predict VGRpP for future years up until t = 34, which represents the year 2026. Figure 4.2 shows the observed values and their corresponding predicted values using this equation for 1993 to 2016. Other model specifications were tested as well; this one was chosen because it had the highest R-squared value of those tested. Other than the three variables listed above, projections for future values of the independent variables came from other sources as described below.

According to the U.S. Bureau of Labor Statistics, personal income is projected to grow by 4.3% annually from 2016 to 2026.[24] The lack of availability of further projections of personal income growth limits the range of my forecasts to the year 2026. I created the projected values of real median personal income by taking the value of this variable for 2016 and increasing it by 4.3% each year until 2026.

The U.S. Energy Information Administration projects what the real cost of gasoline will be in the future. Their estimates for the average prices of motor gasoline for all sectors were used as the projected values for real fuel price.[25] Like before, these values are in 2016 dollars.

Similarly, the U.S. Census Bureau estimates what the demographic makeup of the United States will be in future years. Their estimates were used to calculate the projected values of my 65 or older and non-white population percentage variables.[26]

Lastly, projections for the entrance fees of the National Parks came from proposed fee increases from the NPS.[27] In late 2017, the NPS released a set of proposed

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[24] Calculations were made manually based on information presented by the Bureau of Labor Statistics, U.S. Department of Labor. Table 4.10 Personal income, 1996, 2006, 2016, and projected 2026. Last modified October 24, 2017. Accessed January 8, 2018. https://www.bls.gov/emp/ep_table_410.htm.
[25] Estimates of future per gallon prices of motor gasoline were gathered from U.S. Energy Information Administration, U.S. Department of Energy. Annual Energy Outlook 2017 Table: Petroleum and Other Liquids Prices. Accessed January 8, 2018. https://www.eia.gov/outlooks/aeo/data/browser/\#/?id=12-AEO2017&cases=ref2017~ref_no_cpp&sourcekey=0.
[26] Calculations were made manually for the non-white and 65 or older variables. Data used in these calculations were gathered from U.S. Census Bureau, U.S. Department of Commerce. Table 1. Projected Population By Single Year of Age, Sex, Race, and Hispanic Origin for the United States: 2014 to 2060. Accessed January 8, 2018. https://www.census.gov/data/datasets/2014/demo/popproj/2014-popproj.html.

price increases for 17 parks. The proposal did not include any entrance fee decreases. As of the writing of this thesis, the NPS has not made a decision on whether or not it will actually implement these increases. However, to err on the conservative side, I will assume that the fee increases will occur for the purpose of these forecasts. The suggested increases are all scheduled to occur in 2018, and I will assume that there will be no other fee increases before the end of 2026. Each of the planned increases at the 17 parks would result in either $40.00 or $45.00 increases per vehicle. Nonetheless, entrance fees are not planned to change at 30 of the parks in my data set.

Table 4.4 and Table 4.5 show the forecasted total values of attendance and annual change in attendance for the total set of 47 parks with forecasts made by *Model 1* and *Model 2*, respectively. Figure 4.3 and Figure 4.4 show the observed and forecasted values of attendance, graphically. The disparity of the forecasts from the different models is as a result of the interpretation of the econometric models as explained above. Overall, the projection results predict increases in attendance of approximately 1,000,000 - 7,000,000 visits per year for the coming years. Annual growth of 7 million recreation visits is large but not unheard of. The last three years (2014, 2015, and 2016) have seen annual increases in 5 million, 6 million and 7 million recreation visits per year, respectively.

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[27] National Park Service, U.S. Department of the Interior. Fact Sheet and Current and Proposed Fee Rates Spreadsheet. Accessed December 14, 2017. https://parkplanning.nps.gov/document.cfm?documentID=83652.

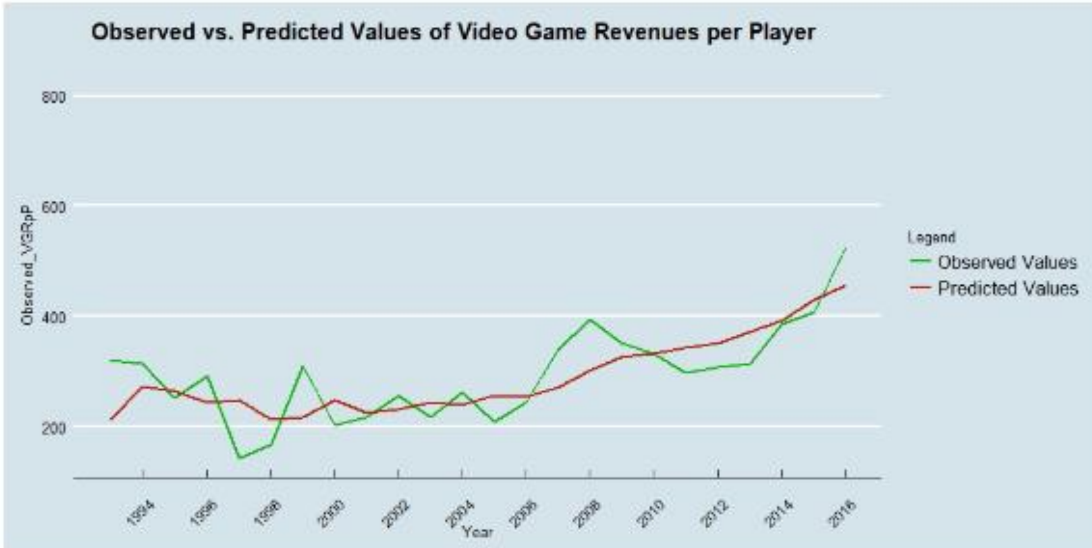

FIGURE 4.2: Observed vs. Predicted Values of Video Game Revenues per Player

TABLE 4.3: Regression Results Used for Predicting VGRpP

Estimation Results				
		# of Observations	=	23
		F(3,19)	=	11.63
		Prob >F	=	0.0001
		R-squared	=	0.6475
		Adjusted R-squared	=	0.5918
		Root MSE	=	55.539

Variable	Estimate	Std. Error	t	Prob $>\|t\|$
t	-10.99	8.582	-1.28	0.215
t^2	0.7123	0.3473	2.05	0.054*
$VGRpP_{t-1}$	0.2154	0.2337	0.92	0.368
Intercept	222.70	84.76	2.63	0.016**

Table 4.4: *Model 1* Forecasts and Valuation

***Model 1* Forecasts and Valuation**

Year	Forecasted Change in Attendance	Forecasted Attendance	Economic Benefits of Recreation
2017	7,318,391	85,004,796	$9,251,071,916
2018	6,756,998	91,761,794	$9,986,436,035
2019	6,649,185	98,410,979	$10,710,066,882
2020	7,151,714	105,562,694	$11,488,387,945
2021	7,156,210	112,718,903	$12,267,198,236
2022	7,384,265	120,103,168	$13,070,827,796
2023	7,582,020	127,685,189	$13,895,979,067
2024	7,563,067	135,248,255	$14,719,067,596
2025	7,758,552	143,006,807	$15,563,430,853
2026	7,582,911	150,590,719	$19,388,787,924

Table 4.5: *Model 2* Forecasts and Valuation

***Model 2* Forecasts and Valuation**

Year	Forecasted Change in Attendance	Forecasted Attendance	Economic Benefits of Recreation
2017	2,930,779	80,617,184	$8,773,568,180
2018	3,051,266	83,668,451	$9,105,637,483
2019	1,214,528	84,882,979	$9,237,814,612
2020	2,063,621	86,946,600	$9,462,398,482
2021	2,053,468	89,000,068	$9,685,877,380
2022	2,101,660	91,101,727	$9,914,600,988
2023	2,604,216	93,705,943	$10,198,017,801
2024	2,570,348	96,276,292	$10,477,748,805
2025	2,535,491	98,811,782	$10,753,686,281
2026	2,338,860	101,150,643	$11,008,224,455

- 2016 attendance was 77,686,405

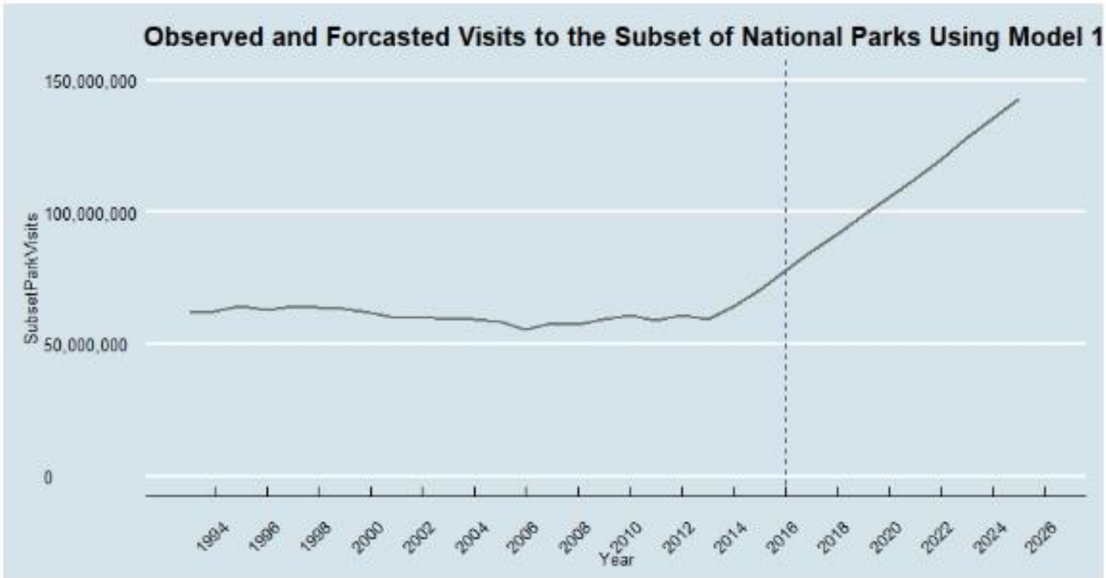

FIGURE 4.3: Observed and Forecasted Visits to the Subset of National Parks Using *Model 1*

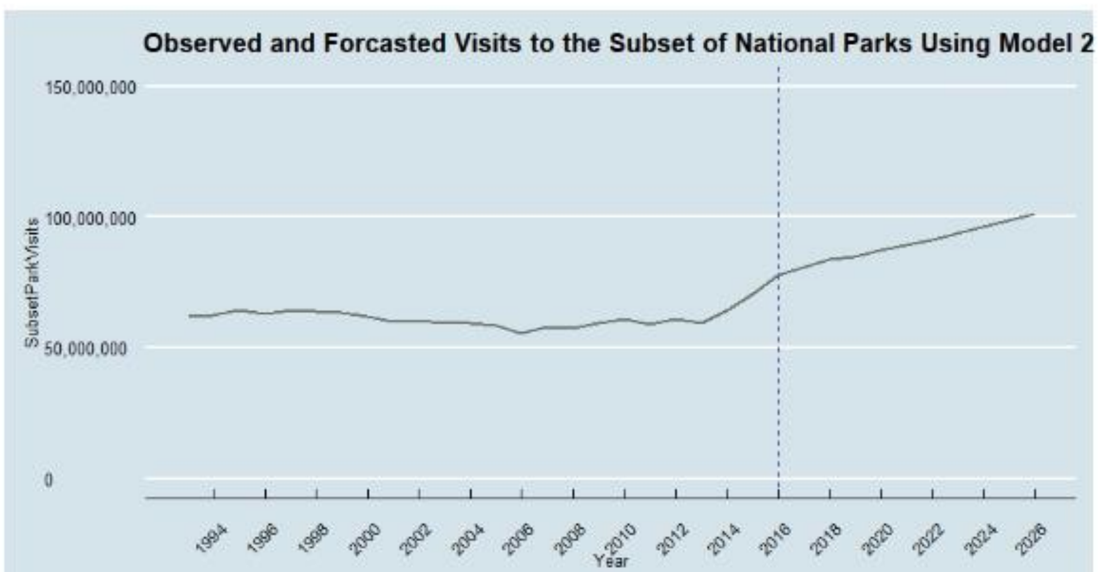

FIGURE 4.4: Observed and Forecasted Visits to the Subset of National Parks Using *Model 2*

Valuation

Finally, I will use a benefit transfer methodology to estimate the economic benefits of recreation, that these 47 National Parks will provide to visitors throughout the duration of my forecasts. Recall from Chapter One that benefit transfer involves inferring the non-priced benefits of a recreation site based on pre-existing values. Neher et al. (2013) estimate that the average system-wide consumer surplus per person per visit to the National Parks is $102. Note that this value is in 2011 dollars; once adjusted for inflation, this is equivalent to $108.83 in 2016. To estimate the total economic benefits that the 47 National Parks will provide visitors in the coming years, I multiply the forecasted number of visitors by $108.83. The ensuing results are also shown in Table 4.4 and Table 4.5.

The forecasted National Park benefits over time show that the large increase in visitors over the years will certainly increase the benefits of recreation provided by visits, thus making the parks more valuable. The estimated economic benefits provided in 2016 were approximately $8.4 billion. My estimates are similar to those of Hardner and McKenney (2006) who estimate the consumer surplus of National Park visits to be $12 billion for all National Parks rather than just a subset of 47. Additionally, my results are smaller than estimates made by Neher et al. (2013) ($30.5 billion) and Haefele et al. (2016) ($92 billion), but again those studies had much larger scopes. As mentioned in Chapter One, consumer surplus may actually decrease with increased attendance if visitation surpasses the social carrying capacity and congestion becomes a concern. Given the large increases in forecasted attendance, the likelihood of a decrease in per trip consumer surplus rises.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Using first difference econometric models combined with secondary data, this thesis estimates two different aggregate demand functions for determining total recreation trips to the National Parks within the contiguous United States. The functions were then applied to forecast future National Park visitation, and a benefit transfer method along with these forecasts was used to estimate the total consumer surplus, or benefits, that National Park recreation trips will provide to visitors in the future. The results of these applications estimate that these 47 National Parks could see up to approximately 1,000,000 to 7,000,000 more visitors per year until 2026 and total visits to the parks will produce over $8 billion in consumer surplus per year. One caveat to these visitation and benefit forecasts is that the reliability of these estimates diminishes the further into the future a forecast reaches due to the potential for unforeseen changes in the determinants of demand. The aggregate demand functions specified here and their corresponding forecasts can further be used to estimate the economic impact that future visitation will have on the communities that surround the National Parks using input-output modelling, which is how the National Park Service estimates the regional economic impacts of National Park visits. Likewise, these forecasts can help National Park Service officials, park managers and the executive branch to anticipate future demand and better prepare for the budgeting processes for the upcoming years and begin efforts to mitigate the adverse effects of congestion where needed. Unlike previous studies (e.g Stevens et al.

2014), the results of this analysis suggest increasing visitation to the National Parks in the future, which is likely to aggravate congestion problems seen at some National Parks.

The two most significant indicators of National Park visitation, according to both the linear regression model (*Model 1*) and the nonlinear regression model (*Model 2*), are gasoline prices and the number of U.S. citizens that are aged 65 or older. Entrance fees, personal income, U.S video game industry revenues and the percent of the population that is non-white failed to be statistically significant on a consistent basis.

Americans aged 65 or older grew up in a time when electronic media was less pervasive in society and therefore had more time to spend outdoors and in nature. It has been shown that those who spend time in natural areas at a young age are more likely to continue caring about them as they grow older as compared to those who did not interact with natural areas as children (Duda, Bissel and Young 1998; Hunderfold and Volk 1990). In addition to having learned to appreciate nature and the outdoors when they were younger, older Americans may also be attracted to National Parks because they offer outdoor recreation opportunities that are not excessively physically strenuous. For example, National Parks offer sightseeing that can be done from within your vehicle or only a short walk away from parking areas.

The number of U.S. citizens aged 65 or older is projected to grow by 78% between 2016 and 2050, which according to my regression models will drastically increase the number of visits that the National Parks receive. However, projections made with my regression models assume that the strength of preferences of older people will remain relatively constant over time. Possible long-term effects of “nature deficit disorder" present a reason to believe that the strength of preferences of older people for visiting National Parks may change in the future.

Author Richard Louv (2006) explains in his book, *Last Child in The Woods*, that children in the twenty-first century are suffering from what he calls "nature-deficit disorder" caused by the lack of interaction that modern-day children have with the natural environment. When those children who grew up with "nature deficit disorder" join the 65 or older age group, they may not have the same preferences for outdoor recreation as people in this age group in previous generations. This possible change in tastes and preferences may result in older Americans taking fewer trips to National Parks in the future. Perhaps age will not be a strong determinant of how many trips someone will take to National Parks in the future.

Due to the strong influence of gasoline prices on National Park visitation shown in both of my regression models, it will be interesting to see how the emergence of popular and affordable electric vehicles combined with the increasing scarcity of fossil fuels will play a role in how people travel to and from the National Parks in the future. Ultimately, the cost per mile to travel by any mode will heavily influence how far and how often people are willing to travel. The Energy Information Administration predicts that the average price of motor gasoline will increase from $2.55 to $3.36 between 2016 and 2050, which is approximately a 32% increase. Those who travel long distances to visit the National Parks will be most affected by this increase in per-mile travel costs, while those who live near the parks are less likely to change their visitation patterns to their nearby park when gasoline prices increase.

Central to the economic theory of consumer demand is the idea that there is a negative relationship between price and quantity demanded of a good or service. Considering this, it may seem strange that neither of my regression models indicated such a relationship between the first differences of entrance fees and National Park attendance. The average willingness-to-pay for one recreation visit to a National Park reported in the valuation section of this paper was $108. This is almost 3 times the size of the current largest entrance fee, and is still higher than what the highest entrance fee will be if the National Park Service increases entrance fees following the agency's proposal for future fee increases discussed in Chapter Four. When entrance fees are raised, Americans who want to visit a National Park are still likely to visit considering that, if they travel a long distance to reach a park, the entrance fee is a relatively small proportion of the total costs required to make a trip. The fact that many National Park visits involve long distance traveling may explain why both *Model 1* and *Model 2* reported insignificant regression coefficients on the real entrance fee variable.

In the case of local visitors, the costs of lodging, food and travel are small, and the entrance fee now becomes a larger percentage of the total cost of making the trip. Thus, local visitors are likely to become more sensitive to entrance fee changes and reduce the number of trips they take to their nearby park when entrance fees are raised. If available, the purchase of an annual pass by local visitors to their nearby park can help to mitigate the effects of increasing entrances fees. For example, an annual pass that allows unlimited daily visits may cost about the same as what two single-daily trip entrances fees would cost.

Stevens et al. (2014) suggest that because National Park demand is relatively price-inelastic, the National Park Service could increase its entrance fees in an attempt to raise additional funds without losing too many visitors. Factor (2007) warns that the relationship between National Park entrance fees and attendance levels is only weak because entrance fees have always been relatively low. If Factor's argument is true, increasing park entrance fees too ambitiously could drive away more visitors than the expected or desired amount. Future research could potentially investigate how visitors from varying distances respond to changes in entrance fees. Some interesting research questions may include, “At what prices do we see more annual passes being purchased and what groups of people (locals or long-distance travelers) are purchasing them?”, and “At what prices do visitors simply become disinterested (e.g. what is the ‘choke price’ for an entrance fee)?”

The regression results for the “Every Kid in A Park” variable which indicated a negative relationship between this program and National Park visitation did not conform to my hypothesis. One possible explanation for this result may be that this program, which allows free entry to all National Park System units for 10-year old children and their families, has only recently been introduced, so its effects may not have been fully realized. Perhaps another explanation is that families are using this program to visit more local National Park System sites that are not National Parks (e.g. National Monument, and National historic sites). As stated above, the entrance fee is only a small portion of the total costs involved in visiting a National Park when long distance travel is required. The resulting savings that a long distance traveler will receive by taking advantage of this program will be small relative to costs. However, other National Park System units may be close enough to home for some visitors to see a higher portion of their total costs to be reduced when using this program.

Because this research only included 47 National Parks (out of 417 total National Park System units), further research could examine the effects that the “Every Kid in a Park” program has on the other types of National Park System units, such as National Battlefields, National Monuments, National Historic Sites, National Memorials and others. The “Every Kid in A Park” program could be the National Park Service’s attempt at getting young children interested in the National Parks and other recreation sites, with the hopes that new generations continue to visit them in the future. The effects of this program should continue to be monitored and examined in future research.

One limitation of this study is the fact that visitation was only examined at 47 National Parks. To obtain a complete understanding of how economic and social factors influence the demand for National Parks, all 59 of the parks should be examined at once; a cross-sectional study of all parks would allow for a better investigation of how park characteristics and entrance fees affect demand for recreation visits. The focus of this research was on all National Parks in the continental U.S. as a whole, rather than the individual National Parks. For park managers to obtain more relevant information about their specific park, individual studies should be performed. Similarly, a more in depth study would attempt to include some measurement to account for every theoretical determinant of demand in order to determine the relative effects of all potential influences. For example, future research could include state parks and all of the other units within the National Park System in an effort to address the effects of substitutes and/or complements on visitation. State parks and other National Park System units may be imperfect substitutes to National Parks; nonetheless, they still satisfy their visitors demand for recreation. Furthermore, state parks or other National Park System units may be complementary to National Parks and encourage visitation. Due to the heterogeneity of state policies, future research could shed some light on how federal and individual state policies affect the demand for both state and federal parks.

Another limitation of this study is the possibility of measurement error in the data used in the regression analysis and projections sections of this thesis because of the use of multiple, heterogeneous data sources. In order to reduce measurement error, it would be ideal to obtain all of the data used in this research from one common source collected in a consistent manner. However, for the most part credible sources (i.e. agencies of the U.S. federal government) were employed to gather the data used in this analysis. Therefore, I believe the accuracy and reliability of the reported results do not unreasonably suffer from measurement error problems.

In addition to possible measurement error, my forecasts are limited by the lack of data on future projections of U.S. video game industry revenues per player. Hence, I had to project future values myself in order to forecast future National Park attendance. Given the ubiquitous nature of electronic devices in today's society, future research should attempt to collect data on and construct a measurement that more directly captures the amount of time individuals spend indoors playing video games or looking at their electronic screens for other reasons (e.g. watching television, social media, etc.)

Furthermore, my estimates of the economics benefits of recreation of National Park visits rely on the accuracy of the benefit transfer method. Because the economic benefits of recreation are typically estimated using stated preference or benefit transfer methods, future research could investigate ways to estimate economic benefits using external data, such as the data used for this thesis.

The National Park Service and its 400+ units are great assets for historic, cultural, and economic reasons. They also perform many non-marketed ecosystem services such as sequestering carbon, providing habitat for fish and wildlife, protecting biodiversity and many other services. Because of the benefits that they provide, not only to visitors but also to their surrounding communities and to the nation as a whole, it is in the best interest of the U.S. government to ensure that the character and quality of these units are held to a reasonable standard. Changing economic and social trends will likely affect the National Parks in the coming years by way of increased attendance and subsequent decline in quality and visitor experience due to congestion.

Just a few years ago, relatively high gasoline prices and the “Great Recession” left many predicting a long-term decline in National Park visits. The results of this research contradict this convention by predicting increased visitation to National Parks in the future, at least in the continental United States. If increased visitation to National Parks goes beyond the social carrying capacity, the resulting overcrowding may cause an eventual fall in park attendance as visitors will find the congestion unattractive enough to prevent their visit. Visitors may attempt to avoid overcrowding by shifting visits to non-peak seasons when the National Parks are less congested. The potential negative environmental effects of increased use at our National Parks will need to be monitored and effectively managed on a park by park basis to ensure that these assets are not lost or severely diminished.

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