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What Does the Future Hold for U.S. National Park Visitation? Estimation and Assessment of Demand Determinants and New Projections

John C. Bergstrom, Matthew Stowers, and J. Scott Shonkwiler

Using a first-difference econometric model, we estimate an aggregate demand model for assessing the determinants of the quantity of visits to 47 national parks in the continental United States. The estimated model was then used to project visitation to these parks from the 2016 base year to 2026. Total visitation could see an average increase of about 1.2 million visitors per year through 2026, suggesting that congestion problems already experienced at many parks may get worse. Congestion and overuse strain already limited operation and maintenance budgets and can lead to environmental damage to park sites and reductions in visitor satisfaction.

Key words: congestion, demand determinants, future projections, national park visitation

Introduction and Background


The Organic Act of 1916 established the National Park Service with the purpose:

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 (quoted in Dilsaver, 1994, page xiii).

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 Service manages over 400 park units, including 61 national parks, which comprehensively make up the National Park System (NPS). Altogether, the National Park Service manages over 84 million acres across all 50 states and in several U.S. territories (National Park Service, 2017b). 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 educational purposes. The national parks and other NPS units are very popular and are viewed positively by most Americans (Haefele, Loomis, and Bilmes, 2016). Because of this affinity, national parks and other NPS units received a record-breaking 330 million recreation visits in 2016 (National Park Service, 2017b).

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Review coordinated by Richard T. Woodward.

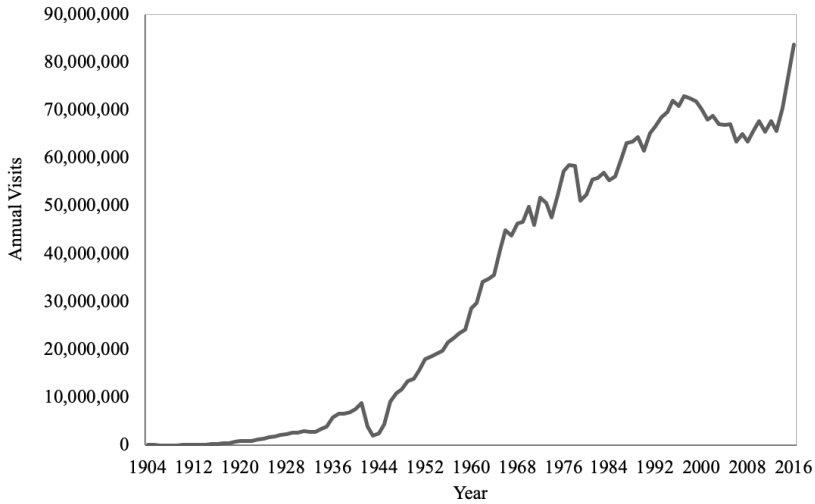


Figure 1. Annual Recreation Visits to U.S. National Parks

Source: National Park Service (2017c).

Figure 1 shows national park annual visitation from 1904 to 2016.¹ From 1904 to the end of World War II in 1945 (when national park annual visits totaled about 2.5 million), the trend in national park visitation was relatively flat. After 1945, national park visitation showed a relatively large upward trend for several decades. In 1997, total visitation to national parks reached a then-peak of about 70 million visitors and generally declined thereafter, until reaching the 1997 peak again in 2014. Total visitation then increased to about 83 million in 2016 (the year of the National Park Service Centennial).

Using national park visitation data from 1993–2010, Stevens, More, and Markowski-Lindsay (2014) predict a long-term decline in national park visitation. One of the initial catalysts for the research discussed in this paper was to examine more recent visitation data to assess whether their projections still seem to hold. Three of the most important reasons for examining past and future park visitation trends relate to the economic benefits (consumer surplus) of national parks to visitors, the economic impacts on regional economies (e.g., employment) of national park visitor spending, and the effects of congestion on the quality of visitor experiences.

In a recent study, Haefele, Loomis, and Bilmes (2016) provide the first comprehensive estimate of the total economic value of the NPS. Based on a nationwide stated preference survey, they estimate the annual total economic value of national parks, other NPS units, and NPS programs outside of NPS units at \$62 billion. This total economic value represents the benefits of NPS units and programs to visitors measured in terms of net economic value (consumer surplus), including both use and nonuse values.

In addition to net economic value (consumer surplus), it is also important to consider the economic impacts 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 National Park Service estimates that in 2016 the over 330 million visitors to national parks and other NPS units spent \$18.4 billion in local economies, which supported 318,100 jobs, \$12 billion in

¹ The National Park Service *Visitor Use Statistics* (2017c) includes a query builder that was used along with accompanying national reports to gather attendance data used for this research. 2016 represents the 100-year anniversary (centennial) of the establishment of the National Park Service in 1916. Yellowstone National Park was established as the world's first national park in 1872. The NPS does not report national park visitation data prior to 1904.

labor income, \$19.9 billion in value added, and \$34.9 billion in total economic output in the national economy (Thomas and Koontz, 2017).

The large economic benefits that national park visitors and nonvisitors receive, along with the visitor spending that they produce, surely make the national parks an economic asset. The National Park Service tracks 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 demand and projecting visitation levels into the future can help park managers better prepare for future challenges, including overcrowding and the potential negative effects of overuse on visitor experiences and park environmental quality.

Theoretical Background

The United States 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, and other factors determine demand (Gray, 1970). In this research, we used recreational visits to national parks as the measure of demand, which is the quantity measure most consistent with economic consumer theory (Loomis and Walsh, 1997). We assume that visitors to national parks are utility-maximizing individuals who allocate their time and money between national park visits and all other goods and services to maximize their utility over a certain time horizon (Nerg et al., 2012).

An individual's demand for national park visits can be stated as

$$(1) \quad v_i = d_i(c_i, Y_i, \gamma_i, FT_i),$$

where $d_i(\cdot)$ is a function that determines recreation visits, c_i is the price or costs associated with national park visits (including entrance fees, out-of-pocket travel costs, opportunity costs of time) for individual i , Y_i is individual i 's income, γ_i is the amount of time required to make a national park trip, and FT_i is the total amount of an individual's free time. Equation (1) shows the individual's demand for total national park visits in a given period. However, it is possible that the individual will visit more than one national park during this period, meaning that v_i can be broken down to account for all 61 national parks, such that

$$(2) \quad v_i = \sum_{j=1}^J v_{i,j} \quad j = 1, 2, \dots, 61,$$

where $v_{i,j}$ is the number of visits the individual makes to park j and J represents all 61 national parks.

In addition to the costs of a recreation trip, other important factors that 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. Some of the determinants of recreation demand are specific to each individual (i.e., demographic characteristics, tastes and preferences), while some are specific to each recreation site (i.e., site attributes/quality, congestion, substitutes and complements).

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

$$(3) \quad v_{i,j} = d_{i,j}(c_{i,j}, Y_i, \gamma_{i,j}, FT_{i,j}, W_i, E_i, A_i, \mathbf{Q}_j, SRO_j, CRO_j, CON_j, \mathbf{TP}_i) \quad j = 1, 2, \dots, 61,$$

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 , \mathbf{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

\mathbf{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; Stevens, More, and Markowski-Lindsay, 2014):

$$(4) \quad V_j = \sum_{i=1}^Z v_{i,j} = \sum_{i=1}^Z d_{i,j}(c_{i,j}, Y_i, \gamma_{i,j}, FT_{i,j}, W_i, E_i, A_i, \mathbf{Q}_j, SRO_j, CRO_j, CON_j, \mathbf{TP}_i) \\ j = 1, 2, \dots, 61.$$

An implicit aggregate demand (visitation) function for park j can then be stated as

$$(5) \quad V_j = D_j(c_j, Y_Z, \gamma_Z, FT_Z, W_Z, E_Z, A_Z, \mathbf{Q}_j, SRO_j, CRO_j, CON_j, \mathbf{TP}_Z, Z) \quad j = 1, 2, \dots, 61.$$

Data and Empirical Methodology

Data Sources

Attendance or visitation is measured in this research by the number of annual recreation visits to each national park retrieved online from the National Park Service *Visitor Use Statistics* (2017c). Data on national park entrance fees were obtained through personal communication with National Park Service personnel (Devenney, personal communication, September 29, 2017) and online (National Park Service, 2019). Available entrance fee data range from 1993 to 2016. Thus, our empirical analysis was limited to the 1993 to 2016 period, as the entrance fee variable is a key explanatory variable for analyzing national park demand and projecting future visitation.² All entrance fees were adjusted for inflation using the annual average U.S. City Average Consumer Price Index as reported by the U.S. Bureau of Labor Statistics (2017b). Real entrance fees are reported in 2016 U.S. dollars. U.S. population and U.S. real median personal income were both retrieved from the Federal Reserve Bank of St. Louis (2017a,b). Real median personal income was reported in 2016 U.S. dollars (Stowers, 2018).

Estimates of the number of U.S. residents aged 60 to 84 were obtained from the U.S. Census Bureau (2017a, 2019b,a). We argue that this variable also acts as a proxy for free time as people in this age group are more likely to be retired,³ thus having more free time for leisure, including visiting national parks.⁴ Also, research has 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, compared to those who did not interact with natural areas as children. Thus, people who did not grow up in the digital age and spent more time outdoors as children may be more likely to visit national parks in their senior years (Hungerford and Volk, 1990; Duda, Bissel, and Young, 1998). Estimates for U.S. residents

² Stevens, More, and Markowski-Lindsay (2014) also analyze data starting with 1993. Their dataset went to 2010.

³ Research based on the Survey of Household Economics and Decision-Making (SHED) conducted by the Board of Governors of the Federal Reserve System (2018, pp. 50–52) indicated that half of retirees in 2017 retired before age 62. Also, using the SHED data, we calculated an average reported age of retirement of 60. Although previous visitor use studies conducted by the National Park Service (<https://sesrc.wsu.edu/nps/>) indicate that for a select group of parks for which data are available, visitors well into their 80s are observed, the age 84 seems like a reasonable cut-off for more elderly people most likely to visit national parks. These same studies also show that park visitors age 76 and older comprise only 1%–2% of total visitors.

⁴ According to the American Time Use Survey conducted by the U.S. Bureau of Labor Statistics (<https://www.bls.gov/charts/american-time-use/activity-by-age.htm>), in 2017 Americans age 55 to 64 spent an average of about 5.4 hours per day engaging in leisure and sports activities, those age 65 to 74 spent an average of about 7.3 hours per day on leisure and sports, and those age 75 and over spent an average of about 7.8 hours per day on leisure and sports, compared to about 5.4 hours per day for 15–24 year olds, and 4.5 hours per day for 25–64 year olds (e.g., working age adults).

aged 5 to 18 were also gathered from the same sources as the 60-to-84 age variable; this latter age variable is explained later in this paper.

Because we modeled aggregate visitation to national parks, it is not possible to know the travel costs of a trip for each individual visitor. For this reason, following Stevens, More, and Markowski-Lindsay (2014), we used the U.S. city average retail price of unleaded premium gasoline as a proxy for out-of-pocket fuel 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 U.S. Energy Information Administration (2017b) and have been converted to 2016 U.S. dollars in the same manner used for entrance fees. Unfortunately, we were unable to find data to serve as a proxy for travel time in the aggregate demand (visitation) function.

Multiple sources were used to collect data on the racial makeup of the United States. Estimates of the number of white and nonwhite members of the U.S. population from 1993 to 1999 were obtained from the U.S. Census Bureau (2001). Similar estimates were obtained from the Centers for Disease Control and Prevention (2016) for 2000–2014 and from the U.S. Census Bureau (2016) for 2015 and 2016. Ideally, it would have been better for all of these data to have come from the same source to minimize the risk of measurement error, but in this case that simply was not possible. Nevertheless, we do not believe there are any large measurement error problems because the population estimates are from federal government sources that employ similar data collection and compilation techniques (Stowers, 2018).

We also included a binary variable for the 9/11 New York World Trade Center terrorist attacks that occurred on September 11, 2001. Following similar methods used in previous studies (Schuett, Le, and Hollenhorst, 2010; McIntosh and Wilmot, 2011; Stevens, More, and Markowski-Lindsay, 2014), the regression variable representing the 9/11 attacks was set equal to 1 for the years 2002–2016 and 0 otherwise. The 9/11 attacks may have caused a short-term fear of traveling within and to the United States as well as a long-run increase in the opportunity costs of air travel due to increased time spent in airport security (Blunk, Clark, and McGibany, 2006).

Much of the previous research related to national park visitation 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, More, and Markowski-Lindsay, 2014). Pergams and Zaradic (2006) offer a different hypothesis, proposing that the rise in electronic media in the United States has been responsible for decreased national park visitation on a national level. Watching television and movies, playing video games, and browsing the Internet all take up part of our limited time. If our time is increasingly spent on those activities, then it cannot be spent engaging in outdoor recreation opportunities, including visiting national parks. Increased engagement with electronic media indoors may also reduce interest in nature and outdoor recreation, especially among young people, as argued by Louv (2006) in his thought-provoking book, *Last Child in the Woods*.

In an effort to assess the general changes in the tastes and preferences of society, we first gathered U.S. video game industry revenues over time. Revenue data for 1993–2013 were retrieved from the Fandom Video Game Sales Wiki (“Video Games in the United States,” 2017), which aggregated data from an independent research firm called the NPD Group. Data for 2014–2016 were obtained directly from NPD Group press releases in conjunction with the Entertainment Software Association, NPD Group (2016, 2017). Next, we divided video game revenue by the population of U.S. residents aged 5–18 years old. We propose that this “video game revenues per player” variable

Table 1. Empirical National Park Visitation Explanatory Variables

Variable	Description	Theoretical Counterpart from Equations 3–5	Expected Sign of Regression Coefficient
<i>RealEntranceFee</i>	Real entrance fee	<i>c</i>	Negative
<i>RMPI</i>	Real median personal income	<i>Y</i>	Positive
<i>60to84</i>	Number of U.S. residents age 60–84	<i>A, FT</i>	Positive
<i>RealFuelPrice</i>	Real gasoline price	<i>c</i>	Negative
<i>Nonwhite</i>	Percentage of U.S. population that is nonwhite	<i>W</i>	Negative
<i>Post-9/11</i>	Post-9/11 years, 2002–2016	<i>TP, c</i>	Negative
<i>VGRpP</i>	U.S. video game industry revenues per player	<i>TP, SRO</i>	Negative
<i>EKIP</i>	Every Kid in a Park years, 2015–2016	<i>c</i>	Positive

acts as a proxy for how young Americans’ tastes are shifting toward indoor screen time and away from outdoor, nature-based recreation.⁵

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 (National Park Service, 2017a). This program is essentially a price reduction for some visitors. In the regression analysis presented later, we include a binary variable that accounts for this effect.

Following Stevens, More, and Markowski-Lindsay (2014), our empirical analysis only considered visits to national parks in the continental United States. Unlike Stevens, More, and Markowski-Lindsay (2014), who only included 30 of the national parks in the continental United States, we included all 47 that existed in 2016. The 12 national parks located outside of the continental United States were excluded due to the exceptionally long distances separating these parks from most of the U.S. population. Because of these long distances, trips to these parks almost always involve long commercial airline flights, leading to relatively high travel costs for nonlocal visitors. By acting as influential observations and outliers, these relatively high travel costs would likely skew the empirical visitation modeling results.

Empirical Analysis

Table 1 lists all of the explanatory variables used in our empirical analysis, along with a label, their theoretical counterparts, and the hypothesized sign of their respective regression coefficients. Table 2 provides summary statistics. Altogether, we used 1,128 observations in the empirical analysis. This encompasses 47 national parks ($j = 1, 2, \dots, 47$) over a 24-year period from 1993 to 2016. Because of the combined cross-sectional and time-series nature of our data, we employed a panel data modeling approach. As part of this approach we tested the visitation data to see if it follows a stationary or nonstationary process using an augmented Dickey–Fuller Test (ADF) and a Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test.

⁵ Unfortunately, for the period of our data analysis, we were not able to obtain data 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). The American Time Use Survey (U.S. Bureau of Labor Statistics, 2017a), which surveys people age 15 and older, collects data on “time spent playing games.” However, data for this variable only go back to 2003, while the dataset used for our empirical analysis goes back to 1993.

Table 2. Summary Statistics for Empirical National Park Visitation Explanatory Variables

Variable	Mean	Std. Dev.	Min.	Max.
<i>RealEntranceFee</i> (\$)	9.50	9.04	0	33.44
<i>RMPI</i> (\$)	28,926	1,554	25,242	31,009
<i>60to84</i>	47,300,000	7,039,327	39,700,000	62,400,000
<i>RealFuelPrice</i> (\$)	2.81	0.74	1.84	4.09
<i>Nonwhite</i> (%)	19.32	1.8	16.7	23.09
<i>Post-9/11</i>	0.626	0.483	0	1
<i>VGRpP</i> (\$)	293.66	83.43	142.46	524.73
<i>EKIP</i>	0.08	0.28	0	1

For 43 of the 47 national parks we studied, we failed to reject the null hypothesis of unit root (nonstationarity) for the ADF test and rejected the null hypothesis of stationarity for the KPSS test at the $\alpha = 0.10$ level of significance. When a series is nonstationary, its data-generating process is not constant over time and therefore cannot be used for accurate modeling when using data from more than a single period (Gujarati and Porter, 2009). Because attendance at the majority of parks in our sample follows nonstationary processes, we used first-difference models, which stabilize nonstationary processes by using the first-differenced values of the dependent and independent variables of interest when performing ordinary least squares (OLS). 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; Wooldridge, 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 in our dataset did not change from year to year, so its first-differenced value is always equal to 0 and therefore has no impact on the regression. For this reason, some data collected on site-specific variables of interest have been omitted from the regression models.

Equation (6) shows the specification of the empirical model, which is a pooled OLS model of a combined double- and semi-log form where the logarithm was taken for select variables, including the dependent variable:

$$\begin{aligned}
 (6) \quad FD\log(Attendance_j) = & \beta_0 + \beta_1 \times FD\log(RealEntranceFee_j) \\
 & + \beta_2 \times FD\log(RMPI) + \beta_3 \times FD\log(60to84) \\
 & + \beta_4 \times FD\log(RealFuelPrice) + \beta_5 \times FDNonwhite \\
 & + \beta_6 \times FDPost-9/11 + \beta_7 \times FD\log(VGRpP) \\
 & + \beta_8 \times FDEKIP,
 \end{aligned}$$

where *FD* indicates the first difference of the variable in parentheses. In cases where a national park does not have entrance fees, the value of the entrance fee *FD* variable was set to \$1. This was done because the logarithm of 0 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 us to keep the observation.

Table 3. National Park Visitation Model (equation 6) Estimation Results ($N = 1,081$)

Variable	Estimate	Robust Std. Error	<i>t</i>	<i>P</i> > <i>t</i>
Intercept	-0.026	0.010	-2.58	0.013***
<i>FDlog(RealEntranceFee)</i>	0.000	0.019	-0.02	0.986
<i>FDlog(RMPI)</i>	0.554	0.245	2.26	0.029**
<i>FDlog(60to84)</i>	1.403	0.497	2.82	0.007***
<i>FDlog(RealFuelPrice)</i>	-0.201	0.049	-4.11	0.000***
<i>FDNonwhite</i>	0.049	0.030	1.64	0.108
<i>FDPost-9/11</i>	-0.029	0.017	-1.69	0.099*
<i>FDlog(VGRpP)</i>	0.001	0.013	0.10	0.917
<i>FDEKIP</i>	-0.101	0.061	-1.66	0.105

Notes: Single, double, and triple asterisks (*, **, ***) indicate [statistical] significance at the 10%, 5%, and 1% level. $F(8,46) = 8.96$; $\text{Prob} > F = 0.0000$; $R^2 = 0.0385$; Root mean squared error (MSE) = 0.1603.

Equation (6) was estimated using OLS with standard errors clustered around each individual park. Such clustering 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 parks would produce misleadingly small confidence intervals because of incorrect *t*-statistics (Cameron and Miller, 2015).

Model Estimation Results

Table 3 shows the results of the OLS regression performed on equation (6). The regression results show an *F*-statistic significant at the $\alpha = 0.01$ level. Thus, collectively, there is statistical evidence that the explanatory variables do explain some of the variation in the first-differenced values of national park visitation. Estimated variable inflation factors also did not indicate collinearity problems which would complicate interpretation of our regression results.

The regression coefficient on the entrance fee variable was negative but not statistically significant.⁶ Therefore, we cannot say with confidence that the entrance fee to a national park has a meaningful relationship with 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, Berrier, and Barker, 1985; Factor, 2007; Stevens, More, and Markowski-Lindsay, 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 a national park. For most visitors, the fee to enter the park will be a small fraction of their total costs incurred.

The regression coefficient for real median personal income was positive and statistically significant. Thus, our hypothesis that national park visits are normal goods was supported.⁷

The regression coefficient for the 60-to-84 age variable was statistically significant with a positive sign, as expected. Schuett, Le, and Hollenhorst (2010) and Nerg et al. (2012) found similar results.

As expected, real gasoline prices have a statistically significant, negative coefficient. Out-of-pocket 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 costs. The negative relationship between gasoline prices and national park visitation is also found in several other studies (Pergams and Zaradic, 2006; Henrickson and Johnson, 2013; Poudyal, Paudel, and Tarrant, 2013; Stevens, More, and Markowski-Lindsay, 2014).⁸

In addition, since in equation (6) there is a double-log specification between the attendance dependent variable and the gasoline price explanatory variable, we can interpret the coefficient on the gasoline price variable as a measure of price demand elasticity. The estimated coefficient on this variable is greater than -1.0 indicating an inelastic price demand elasticity, the implication

⁶ One of the reviewers questioned whether endogeneity issues could affect regression results for the entrance fee variable. In particular, the concern is the extent to which entrance fees are endogenously determined based on demand/visitation. Legislative authority for the National Park Service to charge recreation fees including entrance fees is granted by the Federal Lands Recreation Enhancement Act (FLREA; 16 U.S.C. §§6801–6814). Section 6802.b (“Basis for Recreation Fees”) of this act states that recreation fees “shall be commensurate with benefits and services provided to the visitor” and shall also consider “the aggregate effect of recreation fees on recreation users and recreation service providers,” “comparable fees charged elsewhere and by other public agencies and by nearby private sector operators,” “the public policy or management objectives served by the recreation fee,” and “other factors or criteria as determined appropriate” by the Secretary of the Interior (<https://www.law.cornell.edu/uscode/text/16/6802>). Thus, the FLREA does not explicitly include the level of demand/visitation as a criterion for setting fees (e.g., setting high or low fees based on the law of demand). One perhaps could argue that (i) “the amount of the recreation fee shall be commensurate with the benefits and services provided to the visitor” could encompass the level of demand/visitation (e.g., more demand or visitation leads to more benefits and services provided, which leads to higher entrance fees). However, it may not always be the case that more visitation leads to more services in the form of facilities and programs (e.g., developed campgrounds, cabins and lodges, picnic areas, developed hiking trails, horseback riding, Ranger-led interpretive programs). For example, according to the Joshua Tree National Park website (<https://www.nps.gov/jotr/playyourvisit/basicinfo.htm>), the park receives almost 3 million visitors per year but has “few facilities within the park’s approximately 800,000 acres.” At any rate, the FLREA requires the National Park Service to consider factors other than the benefits and services provided, including equity considerations such as the effect of fees on low-income visitors, which may be brought up under criteria 2–6 above (e.g., critics of national park entrance fees cite the inability of low-income visitors to afford entrance fees as a major concern/problem).

⁷ Poudyal, Paudel, and Tarrant (2013) find that several indicators of recessions (when incomes generally go down) have negative and statistically significant relationship with national park visitation, which indirectly suggests that national park visits are normal goods. In contrast to Poudyal, Paudel, and Tarrant, Weiler (2006) shows evidence of an inverse relationship between measures of national income and national park visits, which suggests that such visits are inferior goods. Johnson and Suits (1983), McIntosh and Wilmot (2011), and Nerg et al. (2012) also provide some empirical evidence that visits to public parks are inferior goods. However, a comparison of these results to our results is problematic due to sampling differences. For example, as pointed out by an anonymous reviewer, the McIntosh and Wilmot study is based on 353 sites, not just U.S. national parks, and the Nerg et al. study is based on national parks in Finland. Henrickson and Johnson (2013) find no statistically significant relationship between income and national park visits.

⁸ Significant negative coefficients on the real gasoline price variable were also found in other model specifications not reported in this paper. These other specifications used robust standard errors as opposed to clustered standard errors. The results using clustered standard errors were reported because clustered standard errors appeared more appropriate for our analysis.

of which is that consumer demand for recreation trips to national parks is relatively insensitive to changes in gasoline price, at the margin. However, this does not mean national park trip demand will be insensitive to relatively large, nonmarginal, and perhaps rapid increases in gasoline prices as have been observed in several different periods in the United States (e.g., the mid-to-late 1970s and the mid-to-late 2000s before the Great Recession) since such changes may move consumers into the elastic portions of their demand curves.

The coefficient on the variable measuring the percentage of the population that is nonwhite was positive but just barely statistically insignificant at the 0.10 level. The positive coefficient estimate contradicts our hypothesis based on a study by Johnson et al. (2004) related to race and recreation preferences. Their results indicate that outdoor recreation participants in the United States are typically white, and thus changing demographics leading to a greater percentage of nonwhites in the U.S. population may lead to decreasing levels of visitation. The coefficient on the post-9/11 variable was negative and statistically significant, suggesting that the 9/11 attacks had a negative effect on national park visitation, as we hypothesized.

The video game revenue per player variable (*VGRpP*) was highly statistically insignificant. Thus, our hypothesis that increased screen time has a negative effect on national park visitation was not supported. As mentioned above, the amount of time a person uses electronic media may 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.⁹ Unfortunately, such data were not available for this study (see footnote 5).

Finally, the indicator variable for the "Every Kid in a Park" program was not statistically significant, suggesting that this program has no discernable effect on total national park visitation. However, this program is still new and was established toward the end of the period assessed in this study. Thus, the potential long-term effects of this program should continue to be monitored and assessed.

Forecasts of Future National Park Visitation

The coefficient estimates for equation (6) reported in Table 3 were used to project future total visitation to the 47 continental national parks using the following general protocol. As a first step, for each of the 47 national parks, projections for the right-side explanatory variables for the period 2017–2026 were multiplied by the corresponding coefficient estimate; the products were summed to generate projections of the *change* in future visits each year from 2017 to 2026 for each park.¹⁰ Projected total visitation in 2017 for each park was calculated by adding the projected change in visits to actual 2016 visits (the base year for projections) for each park.

For the years 2018 and beyond, on a park-by-park basis, the projected change in visitation for a given projection year (e.g., 2018) was added to the projection of total visits for the previous year (e.g., 2017) to project individual park visits for that given projection year (e.g., 2018). This park-by-park projection process allowed for the heterogeneity in park popularity, reflected by their actual base year (2016) total visitation, to affect projected growth.¹¹ The projections for each park were then summed up for each projection year to estimate total national park visitation for 2017–2026,

⁹ A recent segment on National Public Radio's *Morning Edition* (Hegy, 2019) suggests that increasing social media posts featuring photos of and "selfies" with national park landmarks via Instagram, Facebook, Twitter, etc. may be attracting more visitors to national parks, with greater demographic diversity. If supported by academic research, this social media "influencer" effect could help to offset the potential negative effect of increased "screen time" associated with more time spent indoors and less interest in nature and the outdoors.

¹⁰ We included all equation (6) variables in the forecasting equation—regardless of statistical significance—following a structural theoretical modeling approach in which even statistically insignificant explanatory variables are retained because of their theoretical relevance and importance. Also, other model specifications were tested as well but had lower goodness-of-fit values (e.g., R^2) so were not selected for projection purposes.

¹¹ It should be noted, however, that the only right-side explanatory variable values in equation (6) that varied across parks throughout the projection years were the park-specific entrance fee values.

which we refer to as our middle forecast. In the Appendix, details of the projection protocol are illustrated using an example of projecting 2018 visitation for Zion National Park.

Some accommodations were needed when the availability of data on projections was limited. First, since the 9/11 terrorist attacks already occurred in the past, the first difference of the post-9/11 dummy variable was set to equal 0 for the forecasts. Recall that this variable equals 1 for 2002 and after and 0 otherwise. We also continued to set the value of the “Every Kid in a Park” dummy variable to 1 since we have no reason to believe that this program will end any time within our forecasts.

Since we could not find existing projections of U.S. video game revenues per player, we projected these values using OLS regression. The projections were then used to find the first difference of this variable in the same manner as the other explanatory variables used in this section. Equation (7) shows the model for projecting per player U.S. video game revenues:

$$(7) \quad VGRpP_t = \alpha_0 + \alpha_1 \times t + \alpha_2 \times t^2 + \alpha_3 \times VGRpP_{t-1}, \quad t = 1, 2, \dots, 24,$$

where t represents time (i.e., $t = 1$ 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 us to use the estimated equation (7) for projection purposes. The R^2 of the OLS regression estimates for equation (7) was 0.65, which indicates satisfactory goodness-of-fit.

The coefficient estimates for t^2 and the intercept variables were positive and statistically significant at the 0.05 level. The coefficient estimate for the t variable was negative but statistically insignificant. The coefficient estimate for the $VGRpP_{t-1}$ variable was positive but statistically insignificant. Following a structural modeling approach (see footnote 10), we included all of the variables in equation (7) to predict VGRpP for future years up to $t = 34$, which represents the year 2026. Other than the three variables listed above, projections for future values of the independent variables came from other sources as described below.

According to manual calculations based on data from the U.S. Bureau of Labor Statistics (2017c), personal income is projected to grow by 4.3% annually from 2016 to 2026. We 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 (2017a) projects the real future cost of gasoline. Their estimates for the average prices of motor gasoline for all sectors were used as the projected values for real fuel price. These values are in 2016 dollars.

The U.S. Census Bureau (2014, 2017c) estimates the future demographic makeup of the United States. Their estimates were used to manually calculate the projected values for the 60-to-84 age and nonwhite population percentage variables. Last, entrance fees per vehicle in 2017 and recently administratively approved increases by the National Park Service for 2018–2020 were obtained online from the National Park Service website.¹² We assumed these new fees will remain unchanged through 2026.

Table 4 shows forecasted total visitation and annual change in visitation for the 47 parks included in our analysis, including the 95% confidence interval. For validation purposes, we compared our 2017 and 2018 projections to actual visitation numbers reported by the National Park Service (<https://irma.nps.gov/Stats/>) for the 47 parks in our study: 78,901,636 and 78,133,907 total visits in 2017 and 2018, respectively. Our middle forecast for 2017 total visits (column 2, Table 4)

¹² The National Park Service website (<https://www.nps.gov/aboutus/entrance-fee-prices.htm>) lists entrance fees. Approved entrance fees per vehicle for low-fee national parks—including Capitol Reef, Saguaro, Great Sand Dunes, and Petrified Forest—are, on average, \$13.75 (2017), \$17.50 (2018), \$20 (2019), and \$23.75 (2020). Approved entrance fees per vehicle for medium-fee national parks—including Acadia, Arches, Badlands, Big Bend, Black Canyon of the Gunnison, Canyonlands, Crater Lake, Death Valley, Everglades, Lassen Volcanic, Pinnacles, Joshua Tree, Mesa Verde, Mount Rainier, Olympic, Shenandoah, and Theodore Roosevelt—are, on average, \$19.71 (2017), \$27.06 (2018), \$28.53 (2019), and \$30 (2020). Approved entrance fees per vehicle for high-fee national parks—including Bryce Canyon, Glacier, Grand Canyon, Grand Teton, Rocky Mountain, Sequoia, Yellowstone, Yosemite, and Zion—are on average: \$26.67 (2017), \$35 (2018), \$35 (2019), \$35 (2020).

Table 4. National Park Annual Visitation Forecasts

Year	Total Visits	Change in Visits from Previous Year	Percentage Change in Visits from Previous Year	Visits per Capita	95% Confidence Interval on Total Visits	
					Lower Bound	Upper Bound
2017	80,209,884	2,524,172	3.25	0.246	73,582,348	87,434,361
2018	82,687,469	2,477,585	3.09	0.252	66,473,872	102,889,985
2019	83,242,198	554,729	0.67	0.252	58,442,451	118,606,315
2020	84,525,978	1,283,780	1.54	0.254	52,070,930	137,258,858
2021	85,678,180	1,152,202	1.36	0.256	46,461,219	158,053,884
2022	86,536,804	858,624	1.00	0.257	41,394,282	180,974,199
2023	87,751,449	1,214,645	1.40	0.258	37,216,141	206,981,993
2024	88,881,403	1,129,954	1.29	0.260	33,478,335	236,055,034
2025	89,581,576	700,173	0.79	0.260	30,024,120	267,376,001
2026	89,751,382	169,806	0.19	0.259	26,882,063	299,760,915
Average	85,884,632	1,206,567	1.46	0.255	49,428,316	170,279,751

of 80,209,884 overestimates actual 2017 visits by 1,308,248 (1.7% of actual visits). Our middle forecast for 2018 total visits of 82,687,469 overestimates actual 2018 visits by 4,553,562 (5.8% of actual visits). Actual 2017 and 2018 visits are both within the 95% confidence interval for our projections.

From 2017 to 2018, actual visits to the 47 national parks included in our analysis decreased by 767,729 visits. Interestingly, 2018 is the same year new, higher national park entrance fees went into effect. The reduction in visits provides some corroborating evidence supporting the negative sign on the entrance fee variable in our visitation and projection models. One year does not make a trend, so it will be interesting to see if the reduction in visits from 2017 to 2018 will continue into the future. If so, future visitation to the 47 parks included in our analysis may trend more toward the lower-bound projections shown in Table 4, which indicate decreasing visitation over time.

The fifth column in Table 4 projects national park visits per capita, calculated by dividing the national park visit projections reported in Table 4 (second column) by U.S. Census Bureau (2017b) national population projections. Stevens, More, and Markowski-Lindsay (2014) show a general downward trend in annual visits per capita from 1993 to 2010. This general downward trend continued to about 2015, when visits per capita were about 0.235. In 2016 (the last year in our dataset), we observe visits per capita increasing slightly to 0.256, which is nearly identical to the estimate of visits per capita in 1993 of 0.254. According to our projections in Table 4, from 2017 to 2026, estimated visits per capita will remain relatively steady, in the 0.25 to 0.26 range.

Discussion

Using a first-difference econometric model combined with secondary data, this study estimated an aggregate visitation function for determining total recreation trips to national parks within the contiguous United States. The functions were then applied to forecast future national park visitation. Our middle forecast estimates suggest that visitation to the 47 continental national parks could see an average of about 1.2 million more visitors per year through 2026.

Our estimated aggregate visitation function and their corresponding forecasts can be used to assess economic benefits to consumers (visitors) and the economic impact that future visitation will have on the communities that surround the national parks using input-output modeling. 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.

Our middle forecast estimates suggest that congestion problems already being experienced at many national parks may worsen in the future. If actual visitation trends more toward our upper-

bound projections, congestion could become a crisis facing at least some national parks that are approaching physical and social carrying capacities. When a national park reaches its physical and/or social carrying capacities, steps may need to be taken to limit visitation (e.g., caps on daily visits). Thus, congestion and physical and/or social carrying capacities may prevent the very large increases in visitation indicated by our upper-bound estimates. These carrying capacities may also mitigate the increases in visitation indicated by our middle forecast estimates, although these projections—which amount to an average increase of about 1.4% per year—seem fairly moderate, especially as compared to average 9% increase in visitation in 2014 and 2015 and the 5-year average increase of 4.3% from 2012 to 2016.

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). Physical carrying capacity of recreation site refers to the absolute, maximum number of people a site can accommodate (e.g., campground site capacity) and/or the maximum number of people a site can accommodate without unacceptable damage to the site (e.g., major erosion on hiking trails from too many hikers). Problems related to congestion and social and physical carrying capacities can result in a decline in the quality of visitor experiences (León et al., 2015) and long-term environmental damages (Keele, 1998; Hardner and McKenney, 2006).

In addition to concerns about the effects of increasing congestion at national parks on the quality of visits, other factors can negatively impact the quality of national park visits and, in turn, visitation. For example, Keiser, Lade, and Rudik (2018) find that increasing air pollution at national parks has a negative impact on visitation. Water pollution (e.g., acid rain contamination of streams and lakes) and noise pollution (e.g., automobile, bus, and plane noise) may also have a negative impact on the quality of national park visits and visitation.

Future studies of congestion, social carrying capacity, physical carrying capacity, and environmental quality affecting the quantity and quality of national park visits need to be done on a park-by-park basis. For example, overcrowding at peak-season times is already a problem at some of the larger, more popular parks but may still be far in the future for others. Whether parks should focus on solitude or access is a dilemma for park managers. Visitors certainly value solitude in the parks, but if the parks begin limiting daily attendance, would the gain in welfare to visitors be great enough to offset the welfare loss by those who are not granted access to the park that day? Also, the potential negative environmental effects of increased congestion 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.

Our lower-bound projections suggest that decreasing visitation in the future to the 47 continental national parks is a possibility, perhaps due in part to higher entrance fees and gasoline prices. As already discussed, entrance fees to national parks increased in 2018 and additional increases sometime in the future could occur. With respect to gasoline, the U.S. Energy Information Administration (2017a) 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. This relatively large increase in prices could move national park travelers into the elastic portion of their demand curves, where increases in prices have a more pronounced downward effect on demand. 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.

The fact that many national park visits involve long-distance travel may explain why our empirical results showed an insignificant effect of entrance fees on visitation. However, 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 be more sensitive to entrance fee changes and perhaps reduce the number of visits they take to their nearby park when entrance fees are raised.

Since entrance fees may become a more important source of revenue going back to national parks for much needed maintenance work and other management costs, more research into the sensitivity of the demand for trips to national parks and entrance fees changes is needed to determine whether increasing entrance fees will lead to increased revenue (in the case of inelastic demand) or decreased revenue (in the case of elastic demand). Future research should also focus on the equity effects of entrance fees (e.g., distributional effects across income groups). To be most useful to park managers and other decision makers, such studies should be conducted both in aggregate and on a park-by-park basis.

Conclusions

The National Park Service and its 400+ units are valuable assets for historic, cultural, and economic reasons. They also support many nonmarketed ecosystem services such as sequestering carbon, providing habitat for fish and wildlife, protecting biodiversity, and many others. 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 general public for the National Park Service to ensure that the character and quality of these units be held to a reasonable standard.

Our projections of increased future visitation to national parks highlights the dilemma or paradox posed by the dual mandate of the Organic Act to provide public access to national parks *and* protect the natural resources and environment in these parks. 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 economists, we propose that park managers should aim for the economically efficient level of visitation, which occurs where the marginal benefits of visits are equal to the full marginal costs of visitation including marginal congestion, environmental, and operating costs.

[First submitted July 2018; accepted for publication June 2019.]

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Appendix A: Example of 2018 Visitation Projection for Zion National Park

Projection Steps for Zion National Park Visitation in 2018:

1. Calculate the first difference of the log of real entrance fees in 2018 (see footnote 1 above).
2. Using equation (6) in the paper, specified as

$$\begin{aligned}
 (A1) \quad FDlog(Attendance_j) = & \beta_0 + \beta_1 \times FDlog(RealEntranceFee_j) \\
 & + \beta_2 \times FDlog(RMPI) + \beta_3 \times FDlog(60to84) \\
 & + \beta_4 \times FDlog(RealFuelPrice) + \beta_5 \times FDNNonwhite \\
 & + \beta_6 \times FDPPost-9/11 + \beta_7 \times FDlog(VGRpP) \\
 & + \beta_8 \times FDEKIP,
 \end{aligned}$$

Multiply the coefficient estimates for equation (6) (column 2 in Table A1) by the projected values for the right-side variables in equation (6) (column 3 in Table A1) generating values in column 4 in Table A1. Note: Projections for all right-side variables in equation (6) are the same across all national parks with the exception of the entrance fee variable.

1. Sum up the values in column 4 in Table A1 which generates the predicted log of change in visits to Zion National Park from 2017 to 2018 = 0.013221417.
2. Add 0.013221417 to log of visits to Zion National Park in 2017 to generate 2018 predicted visits:
 - (a) 2017 visits to Zion National Park = 4,434,685
 - (b) log of 2017 visits to Zion National Park = log10(4,434,685) = 6.646862749
 - (c) 6.646862749 (log of 2017 visits) + 0.013221417 (change in visits) = 6.660084166 (log of 2018 predicted visits)
3. Take anti-log of 2018 predicted visits to generate 2018 predicted visits: anti-log (6.660084166) = 4,571,768 visits.

Table A1. Empirical National Park Visitation Explanatory Variables

Right-Side Explanatory Variables	Coefficient Estimate	2018 Projection of Right-Side Variable Value	Product of Columns 2 and 3
1	2	3	4
(2) Intercept	-0.0264	1.0000	-0.0264
(3) <i>FDlog(RealEntranceFee)</i>	-0.0003	0.0543[1]	0.0000
(4) <i>FDlog(RMPI)</i>	0.5544	0.0183[2]	0.0101
(5) <i>FDlog(60to84)</i>	1.4027	0.0133[3]	0.0187
(6) <i>FDlog(RealFuelPrice)</i>	-0.2014	-0.0076[4]	0.0015
(7) <i>FDNonwhite</i>	0.0492	0.1892[5]	0.0093
(8) <i>FDPPost-9/11</i>	-0.0291	0.0000[6]	0.0000
(9) <i>FDlog(VGRpP)</i>	0.0014	0.0179[7]	0.0000
(10) <i>FDEKIP</i>	-0.1014	0.0000[8]	0.0000
(11) 2018 projection of change in visits (sum of rows 2–10 in column 3)			0.0132