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The Price of Public Land: An Analysis of Visitor Responsiveness to National Park Entrance Fees

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Honors Thesis

THE PRICE OF PUBLIC LAND: AN ANALYSIS OF VISITOR RESPONSIVENESS TO NATIONAL PARK ENTRANCE FEES

by
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ABSTRACT

THE PRICE OF PUBLIC LAND: AN ANALYSIS OF VISITOR RESPONSIVENESS TO NATIONAL PARK ENTRANCE FEES

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This study assesses the consumer response to changes in entrance fees at 27 of the United States National Park System sites over the past 25 years. The elasticity of demand portion of this study analyzes the relationship between monthly attendance and per-vehicle entrance fees charged at each of the 27 national parks from 1993 to the present. Although this study finds no statistically significant correlation between attendance and admission price from 1993-2006, it does identify a significant negative correlation over the past twelve years. This study also identifies varying responses to changes in admission price by different socioeconomic demographic groups. This is measured by comparing the types of cars that entered Arches National Park on a free admission day to those which entered on regular paid admission days. Cars that entered the park on the free admission day were worth, on average, $1,274 less than the cars that entered on regular admission days. Evidence suggests that entrance fees may not only adversely affect visitor attendance, but that they may also disproportionally exclude lower-income individuals from attending national parks.

Keywords: Revenue management; Recreation fee; Demand; Parks visitation; Low-income.

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1. **Introduction**

1.1 Background

In recent years, attendance at National Parks has skyrocketed to all-time highs. Over the past decade, many parks have seen increases of 20-25% in visitation rates. In 2015, NPS sites welcomed a record-high of 307 million visitors. This record was soon broken with the nearly 331 million visits that occurred in 2016 and again in 2017 (National Park Service Office of Communications, 2018).

While the number of visits is quickly increasing, funding for National Parks is declining. Last year, President Trump announced plans to cut the National Park Service's budget by 12.9% (Dupuy, 2017). In response to this budget cut, the National Park Service proposed a dramatic increase in entrance fees. Their proposal to raise fees to 1$70 per vehicle at the most popular parks would more than double current rates at most parks. The motivation behind this radical increase was to raise the revenue required to fund the $11.3 billion backlog of maintenance needs (Dupuy, 2017). The NPS estimated that the proposed fee increases would increase national park revenue by $70 million per year (Gray, 2017).

However, this proposed fee increase was immediately met with backlash from the public and media. Opponents of the change claimed that such a steep price increase would "price out" lower-income families (More and Stevens, 2000). They argued that public natural spaces should be available to all Americans, regardless of socioeconomic status. By contrast, those in support of the entrance fee increase pointed out that entrance fees only represent a fraction of the total cost required to attend national parks. Attendance at national parks often requires high travel and equipment costs which far exceed the minimal cost of park entrance (More and Stevens, 2000). Proponents of the $70 fee argued that, although an entrance fee increase may limit the number of lower income families and individuals attending national parks, these people may already be constrained by other barriers that would prevent them from attending. Therefore, it is possible that a fee increase would have little to no effect on park attendance, even among the economically disadvantaged.

Given the debate and clear public controversy regarding the fee proposal, the National Parks Service deliberated for over five months before finally reaching a conclusion. In the end, they settled for a much more moderate, five-dollar fee increase that began June 1, 2018 at the majority of the parks and will continue to be implemented at additional parks over the next two years. ("Entrance Fees by Park," 2018). This modest fee-increase is comparable to dozens of similar increases that have occurred over the past few decades.

Although some research exists regarding these past fee changes, such research is minimal and, in many cases inconclusive. Thus, it is unclear how entrance fee changes impact current park attendance. Equally unclear is whether the fee change will actually generate the desired revenue required to keep the parks maintained. It is probable that the issue of park funding will be revisited in the coming months and years.

As potential solutions are considered, it is important to consider not only the impact that additional entrance fees will have on park attendance but also the impact that such fees impose on lower-class families and individuals. Economist Margaret Walls (2016) of Resources for the Future sheds light on some of the needs for further research in this area:

> Figuring out an efficient and fair fee structure will not be easy. It requires detailed data on visitation, for starters, as well as analysis to shed light on price elasticities of demand for different groups of visitors at different locations. This means going beyond simple visitor counts to collection of sociodemographic information. It may also require some experimentation.

As Walls points out, developing an effective fee structure will require detailed economic analysis of the price elasticities of demand for groups of differing socioeconomic backgrounds. To date, research in this area is extremely limited. The majority of existing literature focuses on total park attendance, rather than attendance by specific demographic groups. The small portion of literature that does address socioeconomic aspects of this issue is limited to small, isolated samples. Such literature fails to accurately reflect the attitudes and behavior of the entire American public. It is therefore critical that additional data be collected and analyzed in order to better understand the effect of fee changes of specific demographic groups within the country. Further research and experimentation in this area will provide vital information which can be used to ensure that parks continue to serve the entire American public, rather than a mere small subset of the population.

1.2 History of Entrance Fees

The National Parks Service was established on August 25, 1916. Upon its establishment, the NPS was given the charge to "conserve the scenery and the natural and historic objects and the wildlife 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" ("To Provide Enjoyment for Future Generations", 2017). The NPS mission therefore included protecting and preserving the parks as well as ensuring that public lands could be enjoyed by current and future generations. Park entrance fees represent an important component of fulfilling this mission. Not only does revenue raised through park fees facilitate park maintenance projects, but fees also provide a means of regulating park visitation and preventing over-crowding. Over time, as policies have changed and entrance fees have been adjusted, the NPS has been careful to ensure that these public lands are available to be enjoyed by all.

Mount Rainier was the first national park to implement entrance fees. In 1908, the park began to require automobile permits. In the following years, other parks followed suit, charging fees for seasonal vehicle permits. During this time, park admission prices differed wildly from park to park, ranging from $7.50 ($162.11 USD 2018) at Yellowstone to $0.50 ($10.81 USD 2018) at General Grant. Revenue generated from these entrance fees was used at a park level for park-specific improvement and maintenance projects. When the National Park Service was established in 1918 and ownership for park revenue was transferred to the national level, the NPS stated that "the development of the revenues of the parks should not impose a burden upon the visitor." Rather than increasing revenue, the main objective of the NPS was "to promote public usage of the parks" (Watson, 2013).

A new fee structure was implemented during the late 1930s under the Roosevelt Administration. Under this new structure, fees became more consistent across parks and many parks began charging fees for the first time (Watson, 2013). Over time, however, several adjustments were made to this fee structure. The Independent Offices Appropriations Act of 1952 encouraged federal agencies to become more self-sustaining. Under this Act, parks were to maintain "fair and equitable" fees (Watson, 2013). In order to better enforce this, the Land and Water Conservation Fund Act of 1965 established an upper-bound for annual per-vehicle entrance fees at $7 ($56.74 USD 2018). Although this limit was adjusted over the years, it wasn't until 1996 with the passage of the Recreational Fee Demonstration Program (RFDP) that Congress granted more autonomy to the NPS in levying and collecting fees (Watson, 2013).

> The federal land management agencies shall implement a fee program to demonstrate the feasibility of user-generated cost recovery for the operation and maintenance of recreation areas or sites and habitat enhancement projects on Federal lands (16 U.S. 460l-6).

Under the RFDP, fee revenues were no longer directed to the Land and Water Conservation Fund, but instead, directly to the parks at which the fees were collected. Parks received 80% of their own fee revenues and the remaining 20% was to be allocated to other parks under the NPS Director's discretion. The RFDP also stipulated that the NPS was to implement new experimental fees at several fee demonstration sites. The purpose of these sites would be to evaluate the effectiveness of new fee structures in an effort to promote financial sustainability among parks. Among the sites selected were well-known national parks such as Arches, Acadia, Big Bend, Bryce Canyon, Crater Lake, Denali, Everglades, Glacier, Grand Canyon, Grand Teton, Mount Rainier, Olympic, Rocky Mountain, Sequoia, Yosemite, Yellowstone, and Zion (Watson, 2013). These parks raised their entrance fees in 1998, following the implementation of the RFDP and monitored the impact of these changes over the subsequent months and years. According to the US Department of the Interior, "increased/new fees had not noticeably affected visitation to parks participating in the RFDP" (Watson, 2013).

In 2004, the Recreational Fee Demonstration Program was replaced with the Federal Lands Recreation Enhancement Act (FLREA). Although this legislation did not change much in terms of fee collection processes, it did place restrictions on fee revenue expenditures and provided guidelines for future fee implementation. In 2005, shortly after FLREA was implemented, many of the parks experienced fee increases. Between 2006 and 2015, however, the entrance fees throughout the park system were remained relatively constant. This was due, in part, to a ban, which prevented parks from raising fees during and immediately following the economic recession (Rein, 2015). This ban was implemented in an effort to maintain normal levels of attendance during this period of economic downturn. The ban was lifted in 2015, and as a result, many of the parks experienced large-scale fee increases. In many cases, fees doubled or even tripled (Rein, 2015). Such large-scale changes were unprecedented in terms of magnitude and frequency. Because of this, they represent an interesting area of study for demand analysis. Of all of the fee changes that have occurred over the past 25 years, the 2015 changes most closely resemble the large-scale changes originally proposed for 2018.

Currently, fees are charged at 115 of the 418 sites managed by the National Park Service (Gray, 2017). All 58 parks classified as "national parks" charge some kind of entrance fee; these include per-vehicle and per-person entrance fees as well as fees for park-specific annual passes (National Park Service, 2018). Entrance fees range anywhere from \$5 to \$35 and are assigned based on park size and popularity. Free and discounted passes are available to senior citizens, current members of the military, families of fourth grade students, and disabled citizens (America the Beautiful Passes, 2018).

Several days every year are designated by the NPS as "fee-free days" (National Park Service, 2018). During these days, admission at all parks is free. Fee-free days were first implemented in 2003 and occur on different dates every year. From 2003-2008, there were two fee-free days per year (Mimiaga, 2017). This number was raised to six in 2010 and fluctuated over the next couple of years, with an average of eight or nine fee-free days per year. In 2016, in commemoration of the NPS Centennial, there were 16 free days. This number was reduced down to four in 2018 in an effort to increase revenue (Mimiaga, 2017). The 2018 free days were Monday, January 15; Saturday, April 21; Saturday, September 22; and Sunday, November 11 (National Parks Service, 2017). Although the dates for these free days change from year to year, they are typically held on weekends or on national holidays.

1.3 Literature Review

Although recreation is a growing field of study in economics, little research exists concerning recreation at national parks. Of the research that does exist, only a small percentage analyzes the impact of recreational fees on visitor use, and even less addresses demographic-specific demand. Understanding both the findings and limitations of prior literature in this area reveals areas for further research.

Scholarly research in the area of national park recreation has assessed the demand for parks from a variety of approaches. Some scholars have utilized surveys to assess public attitudes concerning use of federal lands (Duffield et al. 2000; Field et al. 1998; Lundgren et al. 1997; Taylor et al. 2011; Ostergren et al. 2005). These survey studies rely on stated preferences to assess the influence of entrance fees on visitation rates. In the most recent survey study, respondents reported that entrance fees played only a minimal role in their decision to attend national parks and cited overall travel expenditures associated with park attendance as a greater barrier to visitation. Other studies have incorporated revealed preference results to assess the effect of per-vehicle entrance fees on park-level visitation (Factor, 2007; Watson, 2013). Factor (2007) uses a difference-in-differences approach to compare attendance across parks over a ten-year time span, 1996-2006. His analysis does not reveal any statistically significant correlation between entrance fees and park visitation over this time period. However, when performing a similar analysis over an extended time frame, 1993-2010, Watson (2013) finds a significant, inverse correlation between visitation rates and entrance fees at sites designated as "national parks," but not at historic sites or national monuments. He concludes that visitor responsiveness to entrance fees is highly dependent on park type and seasonality.

Although existing research offers valuable insights to understanding the relationship between park fees and visitation, scholars have yet to reach a definitive conclusion regarding the impact of entrance fees on park attendance. Some claim that visitors are responsive to changes in price and that entrance fee increases would reduce visitation (Watson, 2013). Others argue that fluctuations in fees do not significantly impact park attendance (Factor 2007; Ostergren et al. 2005). To justify this finding, they point out that park fees represent only a minimal fraction of the total cost associated with visiting national parks. It follows that small price increases would have little to no effect on visitation rates. In addition to travel cost, several other non-entrance-fee factors have been found to impact national park visitation. These include national average income, population, location, and macroeconomic factors such as national unemployment rate, business cycle index, and consumer expected inflation (Ngure and Chapman, 1999; Hanink and Stutts, 2002; and Poudyal et al., 2013).

Considering prior literature, it is clear that there are other factors associated with attending national parks aside from cost of admission. This means that analyzing visitor responsiveness to park fees is extremely nuanced. To add to the complexity of this issue, fees are not universal across all parks and, due to varying park popularity, neither is attendance. The ambiguity left in measuring the impact of entrance fees on park visitation provides justification for further research.

In addition, although several studies have analyzed the impact of entrance fees on park visitation, these studies provide only a basic understanding of general attendance trends; most fail to examine responsiveness of subgroups within the population. It is possible that, although higher entrance fees do not pose much of a threat to the majority of park visitors, there may be subgroups within the population who are being "price[d] out" of parks (Dupuy, 2017). Therefore, in order to determine a "fair and efficient" fee structure, it is necessary to consider not only overall park attendance, but also attendance by individual demographic groups.

More and Steven's (2000) article, "Do User Fees Exclude Low-income People from Resource-based Recreation?" is one of the only studies to address demographic-specific responses to fees. This study examines the varying opinions of socio demographic groups with regard to recreation fees as reported in a mail survey. This study surveyed households of various income levels in New Hampshire and Vermont about their use of recreational lands. The results of the survey indicated that park entrance fees may substantially reduce participation by those earning less than $30,000 per year. According to the survey, 23% of low-income respondents indicated that they had either reduced use or gone elsewhere as a result of recent fee increases, while only 11% of high-income users had made such changes. When considering the implementation of a $5 daily fee for use of public lands, 49% of low-income households reported that this would affect their decision to attend as compared to 33% of high-income respondents. Moore and Stevens show powerful evidence to support the claim that individuals from different socioeconomic backgrounds may respond differently to changes in recreational fees. Their research indicates that, at least among households in Vermont, raising recreation fees could decrease attendance of the lower-income visitors disproportionately to those of a higher-income bracket.

Although More and Stevens offer valuable insights for better understanding demographic specific responsiveness to entrance fees, their research possesses some limitations. One of the limitations of their study is that their results represent only a small, isolated sample. Because the survey only included residents in Vermont, it does not necessarily reflect the attitudes of the greater American public. In addition, because their study is based on the stated preferences from a survey, rather than on revealed preferences, it may not reflect the actual behavior of the respondents. Through their demographic analysis of park visitation, More and Stevens identify some of the nuances associated with designing a fair and efficient fee structure. However, the limitations of their research indicate areas for additional analysis.

1.4 This Study

This study makes two contributions to recreation fee literature. First, this paper evaluates recent price responsiveness during 2010-2018, a time period in which park attendance reached record highs. The fixed effects analysis portion of this project follows a similar approach to Watson (2013) and Factor (2007) in assessing visitor responsiveness to changes in entrance fees. However, it extends the scope of these analyses to include recent years, 2010-2018, which have not yet been analyzed in national park demand research. During these years, a number of large-scale increases in entrance fees occurred nation-wide. These fee increases were unprecedented in terms of magnitude and frequency. Because these fee increases most closely resemble the types of changes recently proposed by the NPS in 2017, they provide valuable insights into understanding the potential impact of the proposed fee adjustments.

In this study, I analyze visitation statistics and per-vehicle entrance fees at 27 national park sites from January 1993-August 2018. I estimate the impact of fluctuations in entrance fees on park visitation at the park level using fixed effects to control for serially correlated errors. I analyze the responsiveness to changes in entrance fees over the past 25 years (1993-2018) as well as over the past 12 years (2006-2018). Through this analysis, I am able to measure the responsiveness of visitation to changes in entrance fees over time. Confirming prior literature, I find that park visitation is not highly correlated with entrance fees over the period 1993-2006. However, I find evidence to suggest that attendance at national parks has become more responsive in recent years. Although total visitor attendance has increased dramatically over the past five years, my analysis indicates that increases in visitation have been disproportionately lower at parks with larger fee increases. In this paper, I examine the limitations of this finding and suggest avenues for further research.

Perhaps more notable, however, is the contribution this paper makes to the limited body of literature regarding responsiveness to fees at a demographic level. This thesis provides a unique approach to assessing demographic characteristics of park visitors. In addition, it provides observation-based evidence to support More and Stevens' (2000) claim that individuals of lower income levels are more responsive to adjustments in park pricing. Rather than evaluating stated preferences, it provides a revealed preference analysis of demographic-level responses to entrance fees and offers additional insights into the observable behavioral responses of individuals to changes in admission price. Because this study was conducted in a different geographic region of the country, it extends the scope of More and Stevens' claims to a slightly larger population.

I use a natural experiment to assess responsiveness of different demographic groups to changes in admission cost. To do this, I observed webcam footage of all of the cars that entered Arches National Park on the free admission day, April 21, 2018 and on two regular paid admission days, April 14, 2018 and May 5, 2018. I identify all of the cars by make, model, year, body type and approximate a value for each car. By using car value as a proxy for income level, I estimate and compare the income levels of visitors who visit the park on different days. I use other car characteristics such as year, country of origin, and average fuel efficiencies to distinguish between the populations who are willing to pay full admission price and those who prefer to attend when admission is free. I find that cars that entered the park on the free admission day were, on average, lower value and older than those that entered on the paid admission day. In addition, I find that a lower percentage of these cars were foreign-made. I conclude that households of different demographic backgrounds may respond differently to adjustments in price, and that lower income households may have a lower willingness to pay for public land recreation than do higher income households.

The remainder of this paper proceeds as follows. Section 2 describes the data, analysis, and results from the overall visitor responsiveness and admission price portion of my analysis. Section 3 describes the approach and results from the demographic responsiveness study. Section 4 concludes and proposes suggestions for further research.

2. **Visitor Responsiveness to National Parks Admission Fees**

2.1 Data

The first of my datasets is used for the visitor responsiveness of my analysis. This dataset is comprised of several smaller datasets made publically available by the Visitor Use Statistics department of the National Parks Service. ("National Parks Service Visitor Use Statistics, 2018). For each park, the Service provides a table summarizing the number of recreational visits per month for each national park from 1979 to the present. ("National Parks Service- Recreation Visitors by Month", 2018). To approximate the number of park visitors, the NPS counts the number of vehicles that enter the park and multiplies by a specific multiplier, ie 45 for buses, 2.7 for cars, 10 for vans ("Acadia National Park", 2017). Thus, the park achieves a reasonably realistic estimate of the number of individual visitors to the park each month. My dataset utilizes the visitor per month statistics for 27 national park sites and includes attendance data for each of these parks over 296 months, from January 1993-August 2018.

In addition to the visitor use statistics, I also include in my dataset information regarding park entrance fees over time. I obtained this data through contacting the National Park Service Public Use Statistics Office and making a records request.[1] The NPS provided two spreadsheets; one listed historical fee information for each park from 1965-2008 ("Historical Entrance Fees 1965 – 2008", 2008). Prior to 1993, this source does not list the specific price charged at each park, but indicates whether an entrance fee was charged. From 1993 onward, however, a specific price is listed for each park. The prices listed include the annual pass, per vehicle, and per person fees required by each of the national parks for each year since 1993. The NPS also provided a separate spreadsheet which includes the entrance fees charged at each of the parks over the past decade, from 2006-2017 ("Pricing Model 2006-2017", 2017). I obtained the 2018 fees and fee changes from the NPS website ("Entrance Fees by Park", 2018). Because the demographic analysis portion of my project focuses on attendance as measured by cars entering the park, I decided to utilize the "per vehicle fee" as the price in my price analysis. Of the 58 natural national park sites, 27 have consistently charged a per vehicle entrance fee over the past 25 years. For this reason, I selected to analyze attendance at these 27 parks over time (see Table 1).

At many of the parks, several fee increases have occurred over the past 25 years. While several of the fee increases occurred during the same year across multiple parks, the years in which the fee changes occurred vary from park to park. As seen in the table, few fee changes occurred from 2006 to 2015. However, in 2015, many of the parks experienced a sizable increase in the price charged per vehicle. A similar large-scale fee increase occurred in 2005 and in 1998. Many of the parks have experienced large fee increases over the past three years and are projected to experience more over the next two

[1] I obtained this data by contacting the National Park Service Public Use Statistics Office at asknps@nps.gov

years. While most of the changes have been fee increases, a few of the parks have actually experienced temporary fee reductions. For example, Bryce Canyon increased its per vehicle fee from $25 to $30 in 2008, and then reduced it back to $25 in 2009.

Table 1: Per Vehicle Entrance Fees at Selected Parks (2006-2020)

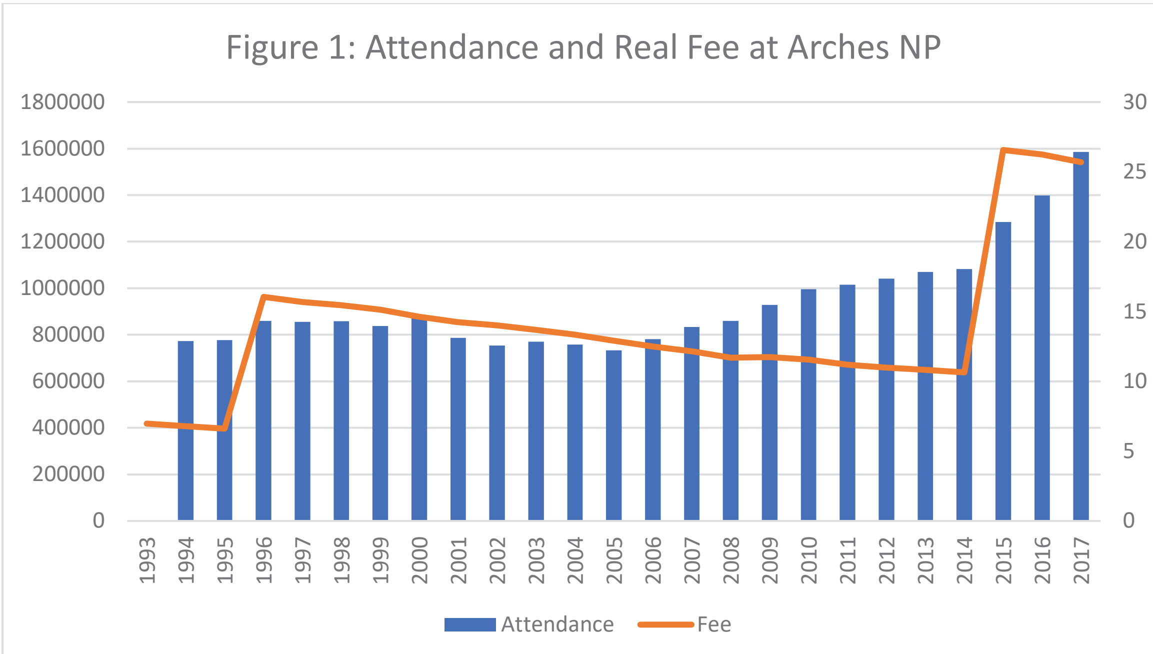
Region	Park	State	2006 Per Vehicle Fee	2007 Per Vehicle Fee	2008 Per Vehicle Fee	2009 Per Vehicle Fee	2010 Per Vehicle Fee	2011 Per Vehicle Fee	2012 Per Vehicle Fee	2013 Per Vehicle Fee	2014 Per Vehicle Fee	2015 Per Vehicle Fee	2016 Per Vehicle Fee	2017 Per Vehicle Fee	2018 Per Vehicle Fee	2019 Per Vehicle Fee	2020 Per Vehicle Fee
NER	Acadia	ME	$20	$20	$20	$20	$20	$20	$20	$20	$20	$25	$25	$25	$30	$30	$30
IMR	Arches	UT	$10	$10	$10	$10	$10	$10	$10	$10	$10	$25	$25	$25	$30	$30	$30
MWR	Badlands	SD	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$20	$20	$25	$30
IMR	Big Bend	TX	$15	$20	$20	$20	$20	$20	$20	$20	$20	$25	$25	$25	$30	$30	$30
IMR	Bryce Canyon	UT	$20	$25	$30	$25	$25	$25	$25	$25	$25	$30	$30	$30	$35	$35	$35
IMR	Canyonlands	UT	$10	$10	$10	$10	$10	$10	$10	$10	$10	$25	$25	$25	$30	$30	$30
IMR	Capitol Reef	UT	$5	$5	$5	$5	$5	$5	$5	$5	$5	$10	$10	$15	$15	$20	$20
PWR	Crater Lake	OR	$10	$10	$10	$10	$10	$10	$10	$10	$10	$15	$15	$20	$25	$30	$30
PWR	Death Valley	CA	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$25	$30	$30	$30
SER	Everglades	FL	$10	$10	$10	$10	$10	$10	$10	$10	$10	$20	$25	$25	$25	$30	$30
IMR	Glacier	MT	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$30	$30	$35	$35	$35
IMR	Grand Canyon	AZ	$25	$25	$25	$25	$25	$25	$25	$25	$25	$30	$30	$30	$35	$35	$35
IMR	Grand Teton	WY	$25	$25	$25	$25	$25	$25	$25	$25	$25	$30	$30	$30	$35	$35	$35
PWR	Haleakala	HI	$10	$10	$10	$10	$10	$10	$10	$10	$10	$15	$20	$25	$25	$30	$30
PWR	Joshua Tree	CA	$15	$15	$15	$15	$15	$15	$15	$15	$15	$20	$20	$25	$30	$30	$30
PWR	Lassen Volcanic	CA	$10	$10	$10	$10	$10	$10	$10	$10	$10	$20	$20	$20	$20	$20	$20
IMR	Mesa Verde	CO	$10	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$20	$20	$25	$30
PWR	Mount Rainier	WA	$15	$15	$15	$15	$15	$15	$15	$15	$15	$20	$25	$25	$30	$30	$30
PWR	Olympic	WA	$15	$15	$15	$15	$15	$15	$15	$15	$15	$20	$25	$25	$30	$30	$30
IMR	Petrified Forest	AZ	$10	$10	$10	$10	$10	$10	$10	$10	$10	$20	$20	$20	$20	$20	$25
IMR	Rocky Mountain	CO	$20	$20	$20	$20	$20	$20	$20	$20	$20	$30	$30	$30	$35	$35	$35
IMR	Saguaro	AZ	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$15	$15	$20	$25
NER	Shenandoah	VA	$15	$15	$15	$15	$15	$15	$15	$15	$15	$20	$20	$25	$30	$30	$30
MWR	Theodore Roosevelt	ND	$10	$10	$10	$10	$10	$10	$10	$10	$10	$20	$20	$25	$30	$30	$30
IMR	Yellowstone	ID, MT, WY	$25	$25	$25	$25	$25	$25	$25	$25	$25	$30	$30	$30	$35	$35	$35
PWR	Yosemite	CA	$20	$20	$20	$20	$20	$20	$20	$20	$20	$30	$30	$30	$35	$35	$35
IMR	Zion	UT	$20	$25	$25	$25	$25	$25	$25	$25	$25	$30	$30	$30	$35	$35	$35

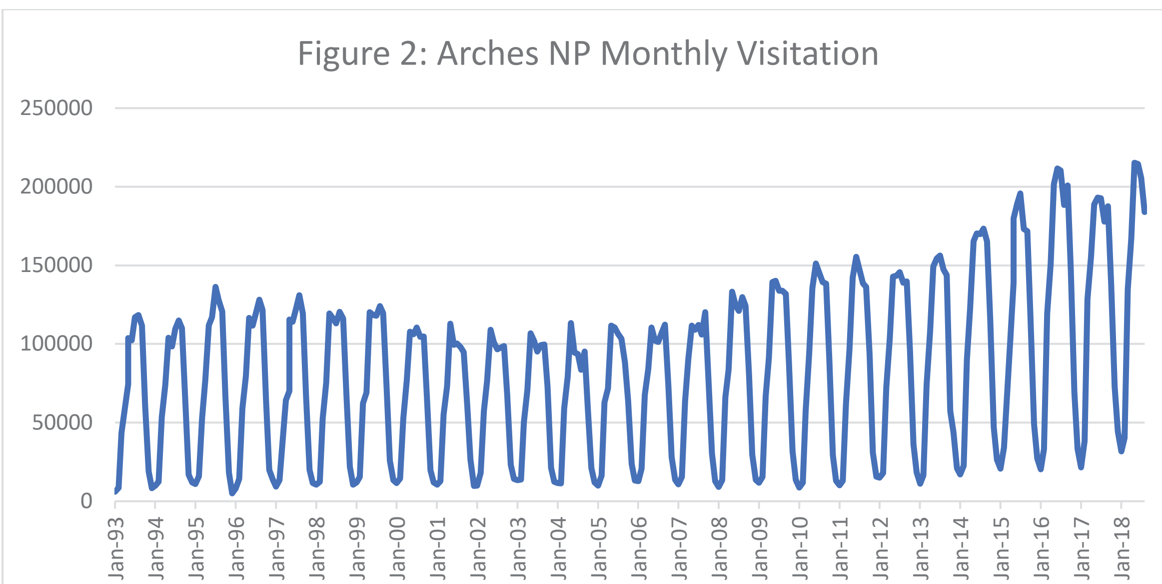
Due to inflation over the past 25 years, a $15 entrance fee charged in 1995 is not equivalent to $15 in 2018. To adjust for this, I converted each of the nominal fee values into real terms, using a CPI deflator. I used the official Federal Reserve Bank of St. Louis Personal Consumption Expenditures Price Index to perform this calculation (US Bureau of Labor Statistics, 2018). Each of the "real fee" values listed in my dataset represent the value, in terms of August 2018 U.S. dollars, of each fee. By converting fee values to real terms, I am able to accurately compare the fees over time.

After collecting this data, I compiled it into a single dataset, with per-vehicle entrance fees listed by month from January 1993- August 2018. I organized the attendance and entrance fee data into panel data (see Table 2). For each of the 27 parks in my dataset, there are 296 observations, one for each month from January 1993- August 2018. Each observation indicates the park attendance during that month and the per vehicle entrance fee in real terms charged at that park. In addition to attendance and entrance fee, I include variables for month and year. I also include variables for state and region of each park. To assign geographic regions to each park, I used the official regions defined by the NPS. The regions represented in my dataset include Intermountain, Midwest, Northeast, Pacific West, and Southeast.

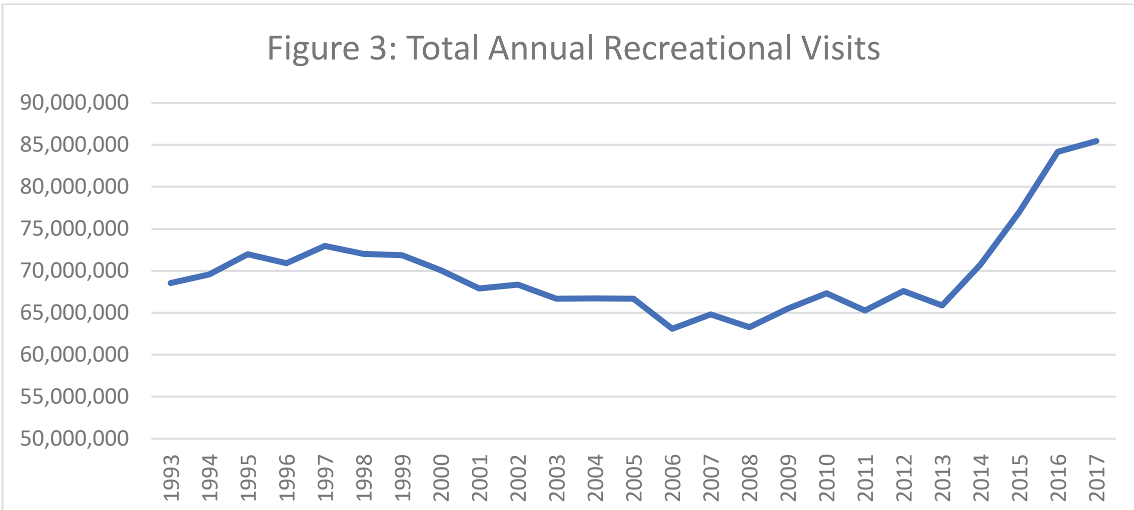
Table 2: Description of Visitation Responsiveness Variables

Variable	***Cross-Section Observation Level***	***Time-Series Observation Level***	***Description***	***Source***
Attendance	National Aggregate Individual Park	Annual Monthly	Total recreation visits.	NPS Public Use Statistics Office
Entrance Fee	Individual Park	Monthly	Fee per vehicle for a 7-day pass.	Received directly from a program analyst for the National Park Service Public Use Statistics Office.
CPI-Adjusted Entrance Fee	Individual Park	Monthly	Fee per vehicle adjusted with Federal Reserve Bank of St. Louis Personal Consumption Expenditures Price Index.	US Bureau of Labor Statistics



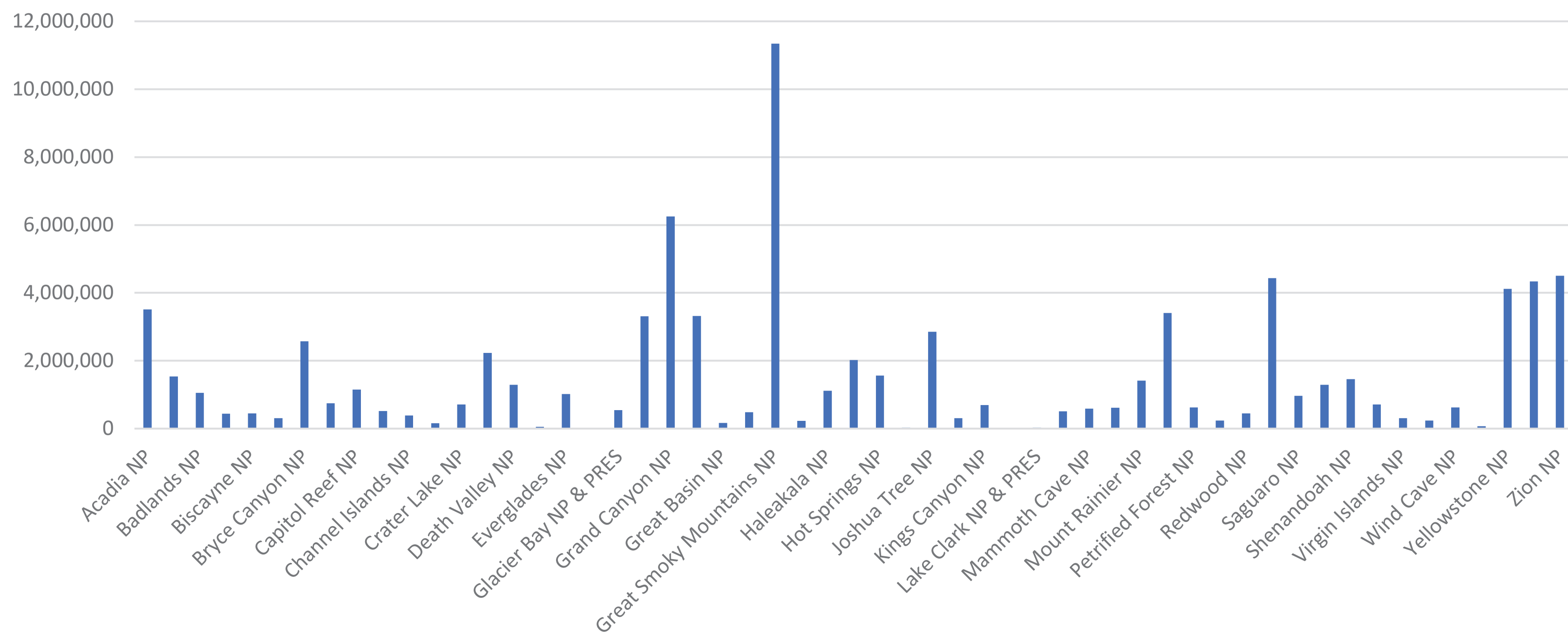


As demonstrated in Figure 2, attendance at national parks is extremely cyclical with high peaks during the summer months and much lower attendance during the winter months. In addition to seasonal trends, there are also general national trends in park attendance. These trends are not park-specific, but rather, affect overall attendance at national parks. Attendance trends at a national level can be impacted by policy changes, such as the 2015 "Every Kid in a Park" initiative, which provided fourth graders and their families free park admission for an entire school year ("Fact Sheet", 2015). In addition to this, the National Parks Service celebrated its 100th anniversary in 2016. In conjunction with the centennial celebration, the NPS launched its #FindYourPark campaign, which contributed to a 5% increase in total park attendance that year (Jarvis, 2016). Both of these initiatives coincided with an increase in park attendance at the national level and have likely contributed to the rapid growth in attendance at national parks over the past five years (see Figure 3).



Although parks tend to follow similar national trends, attendance differs from park to park. The average attendance is considerably higher at some of the National Park System's most well-known parks than it is at the lesser-known parks. The top five highest attended parks in 2017 included Great Smoky Mountains, Grand Canyon, Rocky Mountain, Yosemite, and Zion National Parks. As seen in Figure 4, these parks attracted far more visitors than lesser-attended parks such as Conagree, Dry Tortugas, Gates of the Artic, and Isle Royal National Parks. In addition to entrance fees, attendance is affected by other park-specific factors including accessibility, weather conditions, and popularity.

Figure 4: Attendance by Park (2017)



2.2 Methods and Approach

To assess the visitor responsiveness to price at national parks over time, I regress monthly park attendance on the CPI-deflated entrance fee at each park over the past 25 years. I use log transformation of the real entrance fee variable so that my results are reported in terms of percent changes in price, rather than dollar terms. Because my data is panel data with longitudinal observations for each park, I use a fixed effects model. This allows me to control for the unobserved heterogeneity that occurs at the individual park level. Through my model, I am able to assess the differences in entrance fees and individual responses in attendance at each of the 27 individual parks in my dataset.

While running my regression, I control for other factors that may affect park attendance such as seasonality, national attendance trends, and geographic location. I control for seasonal fluctuations by including month and year factor variables. I also include in one of my models a month*year interaction term. This allows me to control for overall national trends that may influence attendance at all parks. In this way, I am able to isolate responses to changes in admission price at each of the individual parks over time. I also cluster my standard errors at the park-level. By clustering my standard errors, I am able to account for bias that may occur due to serial correlation at the park level. Rather than assuming the variance-covariance matrix for the error term to be diagonal, clustering at the park level allows for a block diagonal matrix, thus adjusting for correlation of error terms within each park over time (Bertrand, 2004).

In addition to running my regression with data from the full 25-year span, I also run regressions with data from only the past 12 years. This smaller dataset includes 141 observations for each park and ranges from January 2006-August 2018. By limiting the range of time included in my dataset, I am able to isolate the most recent entrance fee increases and assess the responsiveness to price during the past decade. I selected 2006 as the starting date for my reduced dataset because it is the first year following the major fee change that occurred in 2005. In 2005, the majority of the parks in my dataset experienced significant fee increases. From 2006-2015, however, very few changes occurred. My reduced dataset, therefore, isolates the most recent fee changes that occurred in 2015, 2016, 2017, and 2018. Because attendance at national parks has increased significantly during the last 5 years, and because fee increases during these years were so dramatic, these years are of particular interest to my analysis.

The validity of my estimated parameters depends heavily upon my assumption that attendance trends at untreated parks (parks at which fees did not increase) are representative of trends that would have occurred at treated parks (parks at which fees increased) if the fee increase had not occurred. Although it is impossible to prove this counterfactual, we can assess its plausibility. In order to claim that differences in attendance patterns following the treatment is due to entrance fee changes and not due to some other factor, the parallel trends assumption must hold. This means that attendance across parks must follow parallel trends prior to any fee change. To assess this, I examine the period 2006-2014, the period preceding the major fee change of 2015. I group parks that experienced a 50% or greater fee increase in 2015 (indicated as "high treatment") and those that experienced no increase or an increase of less than 50% (indicated as "low treatment"). From a strictly graphical perspective, it appears that these groups do in fact follow parallel trends prior to 2015 (See Figure 5). Following the change in 2015, those parks indicated as "high treatment" parks experienced slight declines in visitation rates, while those indicated as "low treatment" parks experienced increased visitation.

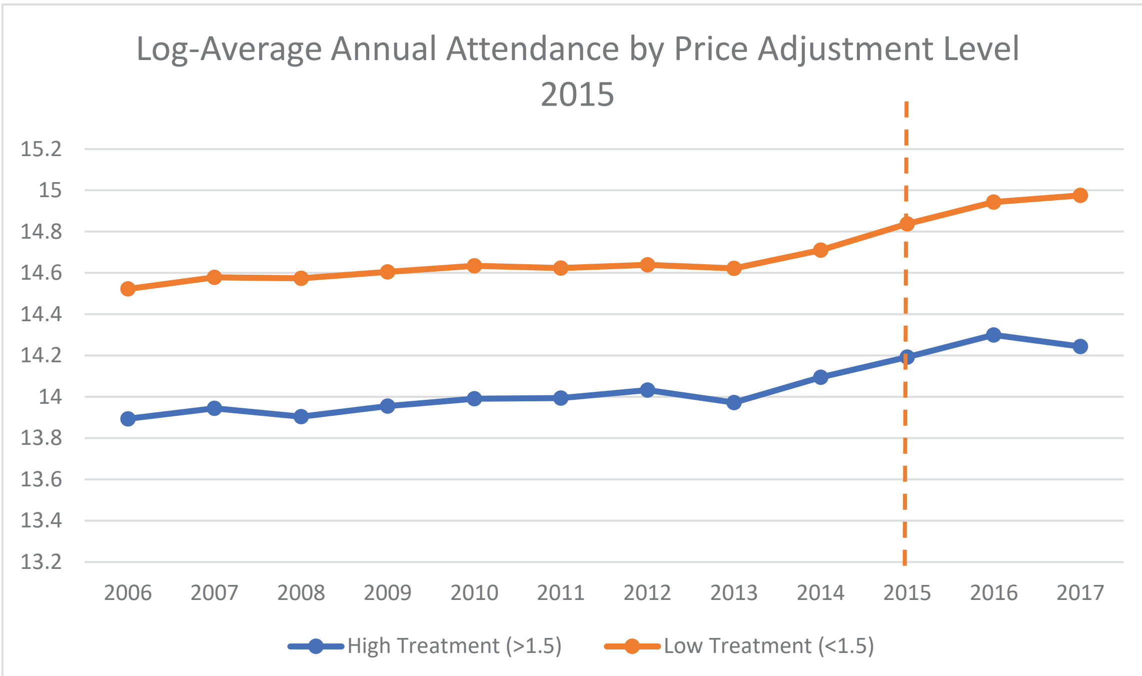


Figure 5: Log-Average Annual Attendance by Price Adjustment Level 2015

In addition to examining these trends graphically, I also include in my model group-specific linear trends. To do this, I interact each group effect with a linear time index. In the case of my model, I interact park with year. This allows me to test the null hypothesis that parks follow parallel trends in visitation rates and that variation in these rates is caused by fluctuation in entrance fees, rather than by other unmeasured variables. Assessing the parallel trends assumption with group-specific linear trends is especially valuable in my model because the parks in my analysis experienced different treatments. Therefore, in order to account for varying treatment exposures at multiple parks during multiple time periods, I must assess park-specific trends over time (Wing et al., 2018). I use the following model to assess park-specific linear trends: $Y_{pt} = a_p + b_t + \beta_p (a_p \times t) + D_{pt}\delta + \varepsilon_{pt},$. In this model, a_p represents time-invariant characteristics of each park, b_t represents time-varying, park-invariant factors, $a_p \times t$ represents the individual park linear time trends, and D_{pt} represents treatment, in this case, entrance fees. By running this regression, I assess the plausibility of the parallel trends assumption and the robustness of my results.

2.3 Results

In running my initial regressions, I find no statistically significant negative correlation between real admission price and attendance (see Table 3). This would suggest that attendance at national parks is not responsive entrance fee pricing and that demand for national parks is inelastic. When considering attendance and entrance fees over the past 25 years, I find that visitors to national parks are not deterred by increases in the cost of admission. This finding holds when controlling for seasonality and national trends.

Table 1: Monthly Visitation by Park 1993-2018

	(1)	(2)	(3)	(4)
Ln(real fee)	14,218**	-5,352	-1,186	-7,036
	(6,579)	(10,335)	(8,498)	(10,446)
Month		X	X	
Year		X	X	
Year*Region			X	
Year*Month				X
Constant	97,344***	52,694*	13,237	53,716*
	(17,922)	(27,682)	(29,822)	(26,739)
Observations	8,281	8,281	8,281	8,281
R-squared	0.356	0.631	0.634	0.637

When I narrow my data to include only the past 12 years, however, I find a statistically significant, negative correlation between park attendance and entrance fee price. By isolating my data to a limited scope, I find that park attendance has been much more responsive to price changes that have occurred over the last decade. In all of my models, the estimated parameter relating admission prices to park attendance is negative and statistically significant at the 5% level (see Table 4). When controlling for month and year and clustering at the park level, I find that, on average, with each 1% increase in entrance fee charged, there is an average decline in monthly attendance of 455 visitors per park. Both of my other two models produce similar results. When controlling for regional trends, I find a 366 decline in average visitors per month at each park for each 1% increase in admission price. When controlling for national trends, I find that a 1% increase in admission price is associated with a 507 decline in monthly attendance per park. When aggregated over a year, these monthly declines in attendance are quite significant. If considered on the average, a 100% increase admission price, like those proposed in 2017, could lead to a 546,204 decline in yearly attendance at each park.

Table 2: Monthly Visitation by Park 2006-2018

	(1)	(2)	(3)	(4)	(5)
Ln(real fee)	49,883***	-45,517**	-36,577**	-50,668***	-13,205
	(12,753)	(17,641)	(16,036)	(17,897)	(13,643)
Month		X	X		X
Year		X	X		X
Year*Region			X		
Year*Month				X	
Park*Year					X
Constant	-3,974	153,619***	103,019**	189,729***	1.68e+07***
	(17,922)	(27,682)	(29,822)	(48,274)	(479,896)
Observations	4,070	4,070	4,070	4,070	4,070
R-squared	0.362	0.635	0.637	0.642	0.642

My results suggest that attendance at national parks has become increasingly responsive to entrance fee price in recent years. From my analysis, it would appear that attendance was not responsive to price during the 90s and early 2000s. However, in more recent years, my results suggest that there may be a statistically significant negative correlation between park attendance and entrance fee prices. This finding may be driven by a variety of causes. First, it is important to note the national trend which has occurred over the past 5 years. The nationwide increase in park attendance occurred during the same years in which many parks experienced significant fee increases. The parks which experienced fee increases may not have seen decreases in attendance during these years. However, my model suggests that they did not see the same magnitude of attendance increases as did the parks at which fee changes did not occur. In other words, the parks which raised their entrance fees would likely have received many more visitors during the past 5 years had they not increased their fees.

It is important to recognize however, the limitations of my findings. When controlling for park-specific linear time trends, I find that these trends are statistically significant. This indicates that variation in park visitation rates between parks may be driven by time-varying factors other than entrance fees. This finding is consistent with prior literature (Ngure and Chapman, 1999; Hanink and Stutts, 2002; and Poudyal et al., 2013; Watson, 2013). In addition, the treatment effect is sensitive to the alternative specification, revealing that attendance may not be as responsive to price as my other models predicted. Because my identifying assumption does not hold, it is impossible to make any conclusive argument regarding the causal impact of entrance fees on park visitation rates.

In the appendix, I also include alternative log-log models which can be used to assess the price elasticity of demand for national park visitation. In these models, I find no statistically significant correlation between park admission price and monthly visitation. This finding is consistent across all models and when isolating the data to include only the past 12 years. Similar to my alternative specification model, this finding suggests that the observed responsiveness to price in Table 4 is inconclusive (see Appendix 2).

Although my results report a statistically significant correlation between park attendance and entrance fees, these findings are more suggestive than definitive. I find that visitors to national parks may have responded differently to fee changes during recent years than they have historically. However, unless a more thorough analysis is conducted, it is impossible to make this claim with any level of certainty. The main contribution of this finding therefore is that it highlights a potential area for further research and analysis.

3. Demographic Responsiveness Analysis

3.1 Data

I use a second dataset for the demographic analysis portion of this project. I collected these data through a mannual collection process, which involved tracking and identifying the specific types of all of the cars entering the Arches National Park on 3 different days— a free admission Saturday, April 21, 2018, as well as two regular paid admission Saturdays, April 14, 2018 and May 5, 2018. By identifying the make, model, and year of each of these cars, I am able to generate an approximate car value. For my analysis, I use the estimated value of these cars as a proxy for income level. This allows me to perform a general comparison between the socio-economic demographics of those who attended Arches on the free day to those who paid full admission price to attend. I am also able to draw conclusions about the populations of free-day-park-attendees and regular-admission-attendees based on differences between the types cars that entered on each of the days.

In order to collect this data, I recorded webcam footage from the front entrance gate of Arches National Park (See Figure 6). The feed for this webcam is publically available online and tracks every car as it enters the park. The webcam at Arches National Park takes a photo every 60 seconds, which it instantaneously uploads to the live online feed. By recording this feed, I was able to obtain footage, which I then used to identify each car as it entered the park.

Figure 6: Webcam Image from Entrance Gate at Arches National Park (May 5, 2018)

I collected data the Saturday prior to the National Parks Free Day and the Saturday following. With the exception of April 14, the day prior to the free day, the video footage was collected during regular visiting hours: between 7:30am and 5:30pm. Due to technical difficulties, I was only able to record footage on April 14 between the hours of 2pm and 5pm. Thus, the data from this day represents only a small portion of the total cars that entered the park on this day. However, the information gathered on this day still serves as an important control in my analysis and as an instrument to test robustness. By collecting the data during the same hours on the same day of the week, I attempt to minimize non treatment-related variation between control and treatment groups. Although it is impossible to eliminate variation entirely, I find it plausible to assume that these days are, in all aspects except admission price, comparable. All three days are Saturdays, during the beginning of the peak park visitation season. The weather on each of these days was comparable: hot and sunny, with and average temperature ranging from 50-65 degrees Fahrenheit.[2]

After obtaining the video footage, I employed a research assistant to identify the cars in each of the snapshots. During the 23-hour time period in which we recorded from the front entrance gate, 3,179 cars entered the park. We were successfully able to identify 2,596 of these cars by their make, model, and approximate year (see Table 5). There were 22 additional cars that we were able to identify by their make, but not by their model. We included these vehicles in our country-of-origin analysis. However, cars which were unidentifiable by model or year were omitted from our other analyses.

The main obstacle we encountered in identification was the quality of the video feed. There were several instances during the recording process in which the live feed stalled, causing us to lose valuable footage. This occurred most frequently on April 21, the fee-free admission day, which is why a smaller proportion of cars on this day were identified (see Table 6). From the footage we have, we were able to identify the cars closest to the entrance gate. However, the cars further toward the back were more difficult to identify. Because the image did not refresh, we did not get closer views of these cars and thus did not get a clear enough image to accurately identify them. Because stalls in the video footage occurred randomly, I have no reason to assume that any particular type of car was systematically excluded from the analysis. This suggests that the cars that were identified do not differ systematically from cars that were unidentifiable.

2

April 14: Low 28, Hi 61
April 21: Low 45, Hi 68
May 5: Low 46, Hi 79

After having identified each car, I used The Official Kelley Blue Book price index to assign an approximate value to each car ("Used Cars & Used Car Prices", 2018). Kelley Blue Book gives an estimate for each car by averaging the prices of all cars on the market of that particular make, model, and year. This value is known as the "Fair Market Price." I used the official Fair Market Price listing for each identified car as an estimate of each car's approximate value. For any car whose year was estimated as a range of possible years, I used the mean year between the two listed years to obtain the Fair Market Price. Although all of the Fair Market Price values are estimates, they do provide a reasonable measure of the relative value of each of the cars listed. The approximated value for each car serves as a proxy for income level in my analysis.

In addition to the date and time of entry, make, model, year, and market price, I include a variable indicating the country of origin of each car, as well as a variable for average fuel efficiency for highway and city driving. I also add dummy variables to identify luxury and foreign-made vehicles. I obtained this information through Kelley Blue Book's vehicle index car ("Used Cars & Used Car Prices", 2018).

Table 3: Description of Demographic Responsiveness Variables

Variable	*Description*	*Source*
Day	Date in which vehicle entered Arches National Park	Collected April 14, 2018; April 21, 2018; May 5, 2018
Make, Model, Year, Body Type, Country of Origin	Descriptive characteristics of each identified vehicle	Collected, Identified
Value (Fair Market Price)	Estimated Fair Market Price for each identified vehicle	Retrieved from Kelley Blue Book
Average Fuel Efficiency	Average MPG city MPG highway	Retrieved from Kelley Blue Book

Table 4: Summary of Cars by Day

	April 14 (Paid)	April 21 (Free)	May 5 (Paid)
Hours	3	10	10
Total Cars	230	1,245	1,695
Identified Makes	215	862	1,524
Identified Models	215	852	1,512
Average Value	16,191.1	14,903.6	16,083.8
	(8758.61)	*(8736.34)*	*(8457.86)*
Average Year	2012.84	2011.94	2012.77
	(5.13)	*(5.90)*	*(5.72)*
Average MPG	23.98	23.53	23.52
	(6.69)	*(5.95)*	*(7.64)*
Foreign-Made	56%	50%	53%

3.2 Methods and Approach

In my approach to answering this question, I use car type (which includes the make, model, approximate year, body-type, and estimated car value) as a proxy for income level. Vital to my analysis is the assumption that car-type preference is correlated with other demographic characteristics of car owners. If this assumption holds, I can draw conclusions about specific populations based on the distribution of car types within that population. This assumption, though difficult to prove, is consistent with prior literature.

Prior literature reveals a strong correlation between consumer preferences for car type and demographic characteristics (Choo and Mokhtarian, 2004). Vehicle type choice literature suggests that, relative to low-income households, medium and high-income households have a high preference for new SUVs. (Kitamura et al., 2000 and Choo and Mokhtarian, 2004). In addition, medium and high-income households have a relatively low preference for old vans, pickup trucks, minivans, and station wagons compared to the baseline preference of low-income households. Overall, low-income households have a higher baseline preference for older vehicles, indicating that high-income households are more likely to purchase newer cars. Households with children younger than four years of age are more likely than other households to use compact and midsize sedans and SUVs. Households with senior adults tend to prefer compact, midsize, and large sedans to coupes and subcompact sedans and have a higher baseline preference for old station wagons and vans than other households. Unsurprisingly, larger households are more likely to own larger cars, such as midsize to large sedans, station wagons, SUVs, vans and minivans. In addition, larger households tend to prefer older vehicles to newer vehicles (Bhat, 2009). Bhat et al. suggest that this may be due to the lower level of discretionary income among these households. Congruent with this hypothesis is their finding that households with more employed members tend to prefer new vehicle types.

A recent study performed at Stanford University analyzed the relationship between car type, as measured from cars photographed on the streets of specific cities and neighborhoods, and socio-demographic characteristics, as reported in census records (Gebru, 2017). The study used 50 million images taken by Google Street View and a sophisticated machine-learning program to identify every car on every street in 200 cities. By comparing the results with census records for those same specific neighborhoods, they found that car type is not only correlated with income level, but also could be "used to accurately estimate income, race, education, and voting patterns, with single-precinct resolution" (Gebru, 2017). For example, if, during a 15-minute drive through a city, the number of sedans is higher than the number of pickup trucks, the city is likely to vote for a Democrat during the next Presidential election. This study is similar to mine in that it uses concentrations of certain types of cars to predict demographic characteristics of populations. In the Stanford study, the machine learning models were able to classify specific precincts with high accuracy based on populations of specific car types identified within each geographic area.

Prior literature confirms the assumption that car type preference is highly correlated with demographic factors such as income level, age, family size, political affiliation (Choo and Mokhtarian, 2004; Kitamura et al., 2000; Bhat, 2009; Gebru, 2017). With this assumption as the backdrop for my analysis, I compare the car types present at Arches National Park on the regular paid admission days to those that were present on the free admission day. By comparing the concentrations of cars present on these days, I am able to make inferences about the people that drive these cars. This allows me to compare the population of people that visit Arches on regular paid admission days to those that chose to visit on free admission days.

3.3 Results

To assess the variation in cars entering Arches National Park between free and regular paid admission days, I run several regressions. These regressions compare the average car value, average car age, and average fuel efficiency of the cars that entered the park each day and provide insights into the distributions of specific types of cars across paid and non-paid admission days. In running my regressions, I find results consistent with my hypothesis that the cars that entered Arches National Park on the free admission day would have a lower value, on average, than those that entered the parks on the two regular paid admission days. My results also indicate that the cars that entered Arches National Park on the free admission day were, on average, older and that a lower percentage of these cars were foreign-made. I find evidence to support my hypothesis that the cars that enter the park on the free admission days represent a different population demographic than the cars which enter the park on regular paid admission days.

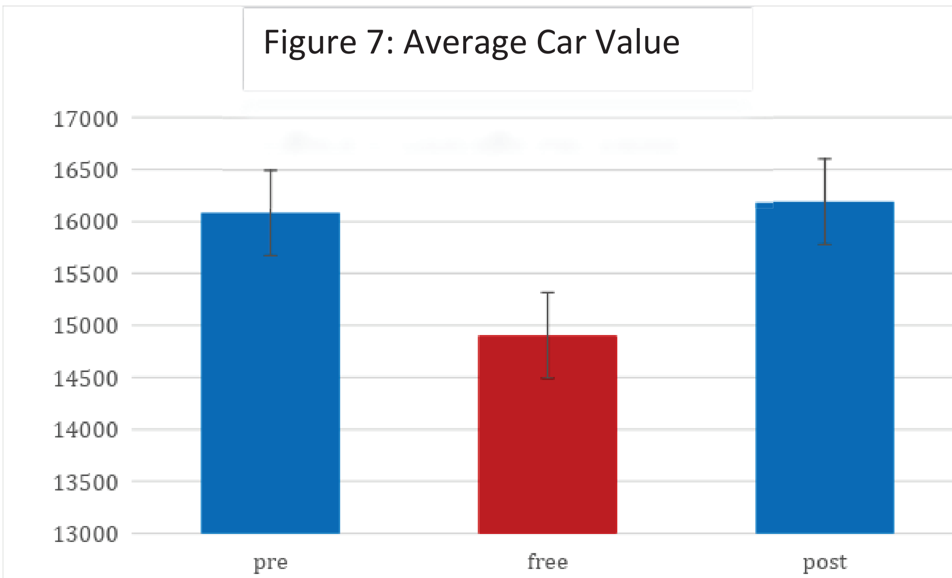
Regressing estimated car value on free admission status, I find that the cars that entered the park on the free day were worth, on average, $1,274 less than the cars that entered on regular paid admission days. This result is statistically significant at the 1% level (See Table 4). When running the same regression using log car value, I find that the cars that entered the park on the free day were, on average, worth 11.8% less than those cars which entered on regular pay days.

Table 5: Car Valuations with Admission Iterations

	(1)	(2)	(3)
Free-day	-1,274***	-1,287***	-1,256***
	(369.7)	(378.4)	(375.7)
Pre-day		-107.3	
		(640.9)	
Morning			354.6
			(712.7)
Afternoon			837.1
			(713.9)
Hour Controls			X
Constant	16,178***	16,191***	15,634***
	(212.3)	(227.1)	(660.60
Observations	2,520	2,520	2,520
R-squared	0.005	0.005	0.006

When I include an additional dummy variable to control for variation which may occur between the two regular admission days, I find that there is no statistically significant difference between the value of cars which entered the park the Saturday prior to and the Saturday following the free admission day (see Table 7). That is, the cars that entered the park on the two regular paid admission days represent comparable populations in terms of average car value. The fact that car value remains constant across regular admission days provides evidence to support the identifying assumption that the value of cars entering the park does not typically vary from day to day. Thus, I conclude that the large variation between the paid admission days and the free admission day is likely driven by the change in admission cost between the free and regular admission days, rather than by some other seasonal factor.

Although there is no significant difference between average values of the cars that entered on the two admission days, the coefficient representing the correlation between car value and free admission remains statistically significant at the 1% level, even when controlling for day (see Table 7). The estimated parameter *-1,287*, is very similar to the reported estimate from the initial regression model and indicates that the cars that entered the park on the free day were, on average, worth $1,287 less than those which entered the Saturday following the free day (see Figure 7).

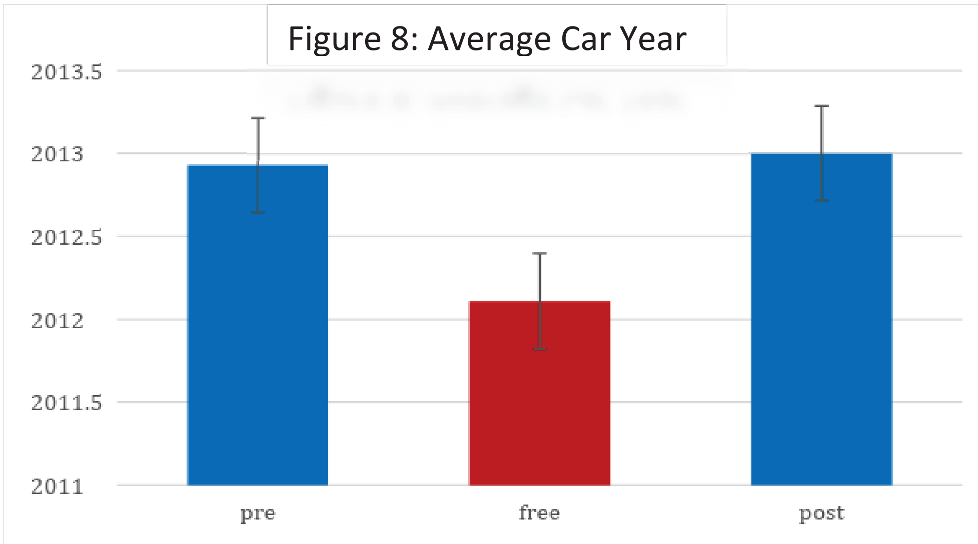


As stated earlier, the data collected on the Saturday prior to the free admission day only represents a small fraction of the cars that entered the park that day. Due to technical difficulties, I was unable to collect data from the morning hours on that day. While the data collected on the free day and "post free day" represent all the cars that entered the park between the hours of 7:30am and 5:30pm, the data collected on the first control day only represent those cars that entered the park between the hours of 2pm and 5pm. To adjust for bias that may occur due to the incongruence of hours during which data was collected, I include an additional control variable for time of day. I used the recorded the time of entry for each car to create a dummy variable for each hour of the day. Running the same regression with the added time-of-day control, I find that the same results remain. With the added time-of-day control, the above-mentioned parameter remains almost identical and is statistically significant at the 1% level (see Table 7). I run an additional regression with dummy variable controls for morning, afternoon, and evening. With both hour-specific and time range controls, I find that time of day of car entry is not significantly correlated with the type of car entering the park (see tables 7, 8, 9). Because temperature is highly correlated with time of day, I extrapolate that the types of cars entering the park are also not correlated with temperature.

In addition to testing for differences in average car value between the free and paid admission days, I regress estimated car year on day to measure the difference in car age between the free and paid admission days. I find that the cars that entered Arches National Park on the free day were also, on average, .892 years older than those cars that entered the park on paid admittance days (see Table 8). Similar to the above-mentioned finding regarding car value, I find no statistically significant difference in car age between two control groups. The average estimated year of the cars on both paid admission days was the same: 2013 (see Figure 8). The similarity in car ages across both control days this indicates that the cars that entered the park on the two control days represent similar populations. This again provides evidence in support of the assumption that the observed variation in car age between free and non-free days is driven by difference in admission cost and not by some other unobserved variable. The parameter that describes the relationship between free admission and car year remains statistically significant and at the 1% level. When controlling for variation across days, I find that the cars that entered the park on the free day were still, on average, nearly a year older than the cars which entered on the other two days (See Table 8).

Table 6: Car Year with Admission Iterations

	(1)	(2)	(3)
Free-day	-0.892***	-0.901***	-0.847***
	(0.215)	(0.22)	(0.218)
Preday		-0.0718	
		(-0.391)	
Morning			-0.209
			(-0.428)
Afternoon			0.182
			(0.43)
Hour Controls			X
Constant	2013***	2013***	2013***
	(0.129)	(0.138)	(0.399)
Observations	2,808	2,808	2,808
R-squared	0.006	0.006	0.007



When considering the difference in average value between cars that entered the park on free and paid admission days, it is important to consider the extent to which this variance is driven by depreciation. As the results confirm, cars that entered the park on the free day were worth, on average, $1,274 less than cars that entered the park on paid admission days. However, these cars were also nearly a year older on average. Therefore, it is possible that the difference in car value demonstrated is driven primarily by car age.

In order to better understand the correlation between age and value for the cars used in my model, I run a simple regression. I generate a new variable *age* derived from each car's year subtracted from the current year, 2018. Then, I regress age on value to estimate the extent to which depreciation affects car value. My results highlight an estimated $1,099 decline in value with each year that passes after a car is produced (see Table 9). Although I recognize that this result provides an imprecise estimate for the impact of aging on car value, it allows me to better identify the key drivers behind the observed difference in car value across days. By dividing the approximated age coefficient in my age-value model by the free-day coefficient for my value model, (1,099/1,274) I find that approximately 86% of the difference in car value across days is driven by car age. This would indicate that age is the chief driver behind the observed difference in car value between free and paid admission days. This finding also suggests that a relatively smaller 14% of this variation is due to other differences between the cars that entered the park on these days such as differing makes, models, and car types.

Table 7: Car Value with Age

	(1)
Age	-1,099.247***
	(23.574)
Constant	21757.56***
	(181.228)
Observations	2,520
R-squared	0.463

I run an additional regression to compare the fuel efficiency of cars across days. For this regression, I use a fuel efficiency measure, which comes from calculating the combined average city and highway fuel efficiencies for each car ("Used Cars & Used Car Prices", 2018). I find that there was no statistically significant difference in fuel efficiency between the three days in which data was collected (see Table 10). This indicates that, although the cars that entered the park on the free day tended to be older and less valuable than the cars that entered the park on the regular admission days, there is no significant difference in terms of fuel efficiency level of these cars. Adding the dummy control for the first regular admission day, I find that average fuel efficiency does not vary across any of the days in any statistically meaningful way (see Table 10).

Table 8: Average Fuel Efficiency (MPG) with Admission Iterations

	(1)	(2)	(3)
Free-day	-0.397	-0.454	-0.331
	(0.295)	(0.302)	(0.3)
Pre-day		-0.46	
		(0.512)	
Morning			-0.483
			(0.569)
Afternoon			-0.136
			(0.57)
Hour Controls			X
Constant	23.92***	23.98***	24.20***
	(0.169)	(0.181)	(0.527)
Observations	2,520	2,520	2,520
R-squared	0.001	0.001	0.001

In addition to testing for trends in car value, age, and fuel efficiency, I also compare the distribution of specific types of cars between days. One of the ways I do this is by running a logit regression model to compare the percentage of cars classified as "luxury vehicles" which entered the park on the free admission day to the percentage which entered on the full-price admission day. After running the logit model, I assess the marginal effects at the means. I find no statistically significant difference in the percentages of cars categorized as "luxury vehicles" between the free and regular admission days. There is also no statistically significant difference in distribution of luxury cars between the two paid admission days (see Table 11). The OLS regression reports similar findings (see Table 11, model 3). Although the cars that entered the park on the paid admission days were, on average, younger, higher value cars than those that entered on the free day, they did not represent a higher proportion of luxury vehicles. It is important to note that only a very small percentage, 5% of the total cars classified as "luxury vehicles." It is possible that failure to detect a correlation between admission and luxury vehicle status is due to the small sample size and lack of statistical power.

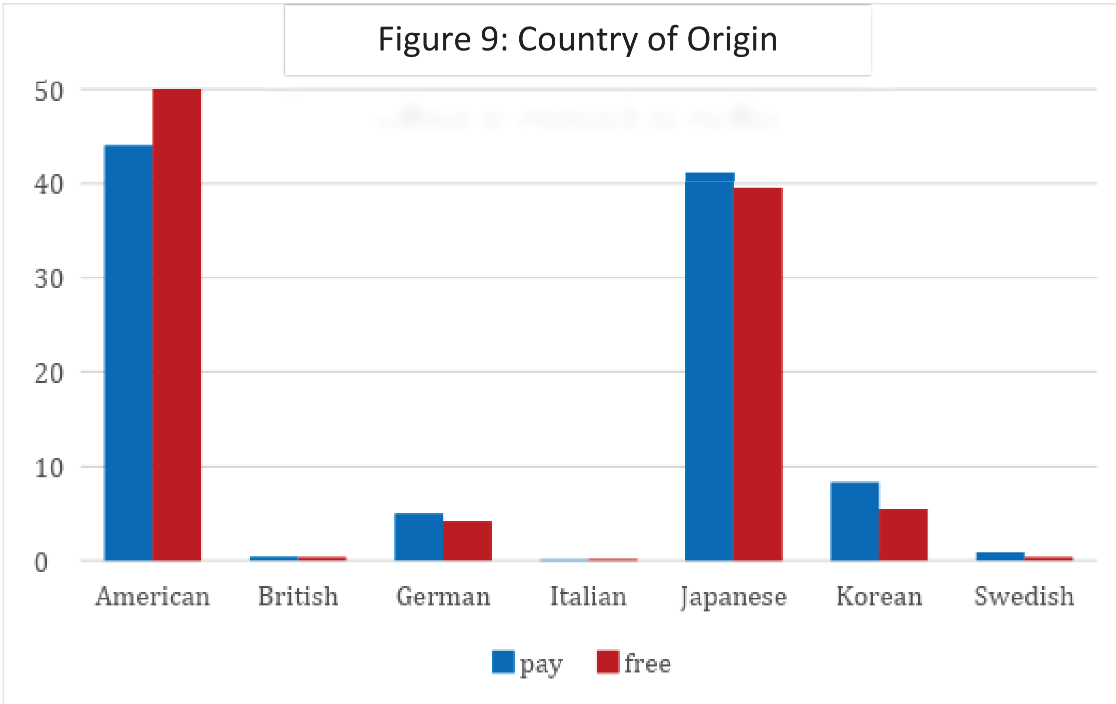
Table 9: Luxury Vehicle Logit Model with Percent Change at Means

	(1) Logit	(2) Logit	(3) OLS
Free-day	-.0119	-.0125	-.0122
	(.011)	(0.011)	(.010)
Pre-day		-.0049	-.0051
		(.018)	(.018)
Constant	-2.692***	-2.696***	.0702***
	(0.098)	(0.105)	(0.006)
Observations	2,664	2,664	2,664

Table 10: Foreign-made Vehicle Logit Model with Percent Change at Means

	(1) Logit	(2) Logit	(3) OLS
Free-day	-.0587***	-0.0634***	-.0634***
	(0.020)	(0.021)	(0.021)
Pre-day		-0.0379	-0.0379
		(0.036)	(0.036)
Constant	0.236***	0.255***	0.5634***
	(0.048)	(0.052)	(0.013)
Observations	2,598	2,598	2,664

I run a similar model to test for the difference in country of origin of cars. My logit model reveals that for each car entering the park on the free admission day, that car is approximately 6% less likely to be of foreign origin that its counterparts entering the park on a regular paid admission day. This result is statistically significant at the 1% level (see Table 12). By comparing the actual distribution of the country of origin of cars between free and paid admission days, I find that a higher percentage of the cars that entered the park on the free day were American-made: 50.0% as compared to 44.12% of American-made cars that entered on the paid admission days. The percentage of German and Japanese cars between days is comparable, though slightly lower for the free admission day: 5.01% as compared to 4.18% for German cars, and 41.24% as compared to 39.56% for Japanese cars. The gap for South Korean cars between days is slightly more dramatic: 8.29% of paid admission cars compared to 5.45% of free admission cars. The percentages of British, Italian, and Swedish cars are comparable across free and paid admission days (see Figure 9).



The results from my analyses provide evidence to support my hypothesis that cars that entered park on the free day vary from those that entered on full price admission days. I find that the cars that entered Arches National Park on the national parks free admission day were, on average, lower value and older than those which entered on the full-price admission days. I also find that a smaller percentage of the cars which entered the park on the free day were foreign-made. It is plausible to conclude from these results that the cars entering the park on the free day represent a different demographic than those entering the park on regular paid admission days.

4. Conclusion

4.1 Findings

Through my price responsiveness analysis, I find that visitation at national parks has become increasingly responsive to changes in admission price over the last decade. Although total park attendance has increased to all-time highs over the past five years, this has not been the case at all parks. Admission price is negatively correlated with attendance over the past twelve years. This indicates that the parks which experienced the greatest increases in entrance fee price did not experience the same magnitude of rise in attendance as the parks at which fees remained relatively constant. The evidence suggests that potential park visitors were deterred from attending the parks at which fees increased. These visitors may have substituted away from the most expensive parks and instead selected to attend parks with lower fees or may have chosen to avoid parks altogether. The question then arises: who are these potential park visitors? Who is being excluded from parks due to fee increases?

Evidence suggests that people of a lower income bracket may be more responsive to changes in cost of admission to parks than are people of higher incomes. In my demographic responsiveness analysis, I find that the cars that entered Arches National Park on the national parks free admission day were, on average, worth $1,274 less than cars that entered the park on paid admission days. In addition, I find that these cars were nearly a year older, on average, than the cars that entered the park on the Saturdays prior to and following the free day. Although not every car that entered the park on the free admission day was worth less than every car that entered on the paid admission days, a greater proportion of these cars represent older, cheaper makes than those that entered on the paid admission days. Because of this, I find it plausible to assume that the cars that entered the park on the free admission day represent a different population than the cars that entered on the regular paid admission days.

Due to budget constraints, low income families and individuals are more likely to drive cheaper, older cars than people of a higher income bracket. In addition, lower income families and individuals are more likely to drive American-made cars than wealthier people who, statistically speaking, more frequently drive Asian and German-made cars. Thus, the greater percentage of the lower valued, older cars that entered on the free day likely represent a greater proportion of lower-income park visitors. The decision of these low-income visitors to attend the park was likely influenced by the reduced cost of entry. Many of these visitors are likely families and individuals such as students who may have been otherwise excluded from attending the park due to budget limitations. For these individuals, the regular price $30 admission fee exceeds their willingness to pay for leisure activity. However, these people still value leisure and use of public lands, as evidenced by the fact that they do choose to attend the park when cost of admission is low.

Low-income families and individuals experience different budget constraints than people of higher income brackets. Because of this, their willingness to pay for recreational public land use is also different. According to my analysis, low-income individuals (or at least individuals who drive less-expensive cars) are more responsive to changes in price from a regular full admission day to a free admission day than are higher income individuals (or individuals with more expensive cars). This means that although demand for national parks is relatively inelastic for the majority of the population, it may be more elastic for this specific subset of the population. This indicates that in producing a “fair and equitable” fee structure, the NPS must consider the affect that fee increases may have on lower-income families and individuals who may otherwise be excluded from enjoying public lands.

4.2 Policy Implications

Given the need for maintenance funding as well as the rapid increase in park attendance over recent years, it seems the rational response on the park of the National Park Service to raise entrance fees. Because demand for parks is relatively inelastic, increasing entrance fees will have a minimal impact on park attendance, and is likely to increase revenue considerably. From a purely economic perspective, it is in the best interest of the NPS to raise entrance fees. Entrance fee-generated revenue will be valuable to parks as it will provide funding for maintenance projects and general park upkeep.

However, when considering the issue of public land use, it is important to consider it from a broader perspective. Instead of simply considering the impact of fee changes on aggregate park visitation, it is important to consider responsiveness of individuals to park pricing. Although changes in entrance fees may not dramatically adversely affect total park visitation, evidence from this analysis suggests that they may disproportionately reduce park visitation by low-income individuals and families. In order to compensate for this, the NPS could consider implementing a more flexible pricing structure, adjusted to differences in willingness to pay between low and higher income households. Identifying such a fee structure will require careful analysis and experimentation.

There are several challenges that arise in identifying policy solutions for this issue. First, the NPS must identify a fair way to assess the income level of potential park visitors. This is nearly impossible to determine at the entrance gate; park employees lack the time required to inquire about income level and the information required to verify visitor reports. Therefore, it would be necessary to assess and signal income level prior to arriving at the park. The most obvious solution to this would be implementing some type of voucher system to reduce the cost of admission for low-income households. The challenge then arises of distributing vouchers to qualified candidates. Low-income individuals are unlikely to apply for national parks scholarships or reimbursements, especially when such scholarships would require additional paperwork. This is consistent with behavioral economic literature which studies barriers faced by individuals living below the poverty line (Bertrand, 2006). One potential solution would be to distribute vouchers based on tax information. This information is already available at the federal level and provides an accurate reporting of income for each household. It is possible therefore, that the NPS could issue vouchers based on reported income from tax forms. These vouchers could be distributed in conjunction with tax returns. Households in lower income brackets would therefore be given opportunities to attend national parks.

4.3 Further Research

Although this thesis provides new insights for better understanding visitor responsiveness to entrance fees at national parks, there are many questions left unanswered. Further research will require additional analysis of price responsiveness over recent years. This analysis would benefit from including a broader set of parks. This would allow scholars to draw more definitive conclusions regarding the causal impact of entrance fees on park visitation rates. In addition to including more parks, research would benefit from including a wider range of years. Because such little time has passed since the 2015 fee changes, it is difficult to measure the long-term impact of these changes on park attendance. Including additional years into the analysis would allow scholars to trace the impact of recent fee changes with more accuracy and better assess this study's finding that visitation is becoming increasingly responsive to price changes.

In addition to improving the visitation responsiveness analysis, further research should take a deeper look into demographic responsiveness to entrance fees. Such research could follow a similar approach to this thesis, by analyzing the cars entering parks on free and regular admission days. However, rather than examining only one specific park during a one specific time span, further research could examine multiple parks over a longer time span. Gathering more data would allow us to better understand overall trends on a national level. By employing a machine-learning technique similar to that used at Stanford, we could efficiently identify large magnitudes of vehicles and make predictions about the populations attending national parks. This would allow us to better target the demographic populations that may be excluded from visiting national parks. Further research in this area will allow the National Parks system to maintain their goal of establishing a "fair and efficient" fee structure and of ensuring that public lands are enjoyed by all.

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APPENDIX

Appendix 1: Data Sample

Table 11: Annual Visitation at Arches NP and Top 5 Most-Visited National Parks (1993-2017)

	Arches	Great Smoky Mountains	Grand Canyon	Zion	Rocky Mountain	Yosemite
1993	773,678	9,283,848	9,283,848	2,392,580	2,780,342	3,839,645
1994	777,178	8,628,174	8,628,174	2,270,871	2,968,450	3,962,117
1995	859,374	9,080,420	9,080,420	2,430,162	2,878,169	3,958,406
1996	856,016	9,265,667	9,265,667	2,498,001	2,923,755	4,046,207
1997	858,525	9,965,075	9,965,075	2,445,534	2,965,354	3,669,970
1998	837,161	9,989,395	9,989,395	2,370,048	3,035,422	3,657,132
1999	869,980	10,283,598	10,283,598	2,449,664	3,186,323	3,493,607
2000	786,429	10,175,812	10,175,812	2,432,348	3,185,392	3,400,903
2001	754,026	9,197,697	9,197,697	2,217,779	3,139,685	3,368,731
2002	769,672	9,316,420	9,316,420	2,592,545	2,988,475	3,361,867
2003	757,781	9,366,845	9,366,845	2,458,792	3,067,256	3,378,664
2004	733,131	9,167,046	9,167,046	2,677,342	2,781,899	3,280,911
2005	781,670	9,192,477	9,192,477	2,586,665	2,798,368	3,304,144
2006	833,049	9,289,215	9,289,215	2,567,350	2,743,676	3,242,644
2007	860,181	9,372,253	9,372,253	2,657,281	2,895,383	3,503,428
2008	928,795	9,044,010	9,044,010	2,690,154	2,757,390	3,431,514
2009	996,312	9,491,437	9,491,437	2,735,402	2,822,325	3,737,472
2010	1,014,405	9,463,538	9,463,538	2,665,972	2,955,821	3,901,408
2011	1,040,758	9,008,830	9,008,830	2,825,505	3,176,941	3,951,393
2012	1,070,577	9,685,829	9,685,829	2,973,607	3,229,617	3,853,404
2013	1,082,866	9,354,695	9,354,695	2,807,387	2,991,141	3,691,191
2014	1,284,767	10,099,276	10,099,276	3,189,696	3,434,751	3,882,642
2015	1,399,247	10,712,674	10,712,674	3,648,846	4,155,916	4,150,217
2016	1,585,718	11,312,786	11,312,786	4,295,127	4,517,585	5,028,868
2017	1,539,028	11,338,893	11,338,893	4,504,812	4,437,215	4,336,890
Total	**34,116,984**	**533,285,951**	**533,285,951**	**115,815,890**	**184,513,824**	**194,741,451**

Appendix 2: Price Elasticity Models

Table 12: Log Monthly Visitation by Park 2006-2018

	(1)	(2)	(3)	(4)
Ln(real fee)	0.446**	-0.012	.0631	0.234
	(0.134)	(0.161)	(0.085)	(0.141)
Month		X	X	
Year		X	X	
Year*Region			X	
Year*Month				X
Constant	9.856***	9.964***	9.902***	11.234***
	(0.386)	(0.605)	(0.325)	(1.142)
Observations	4,070	4,070	4,070	4,070
R-squared	0.410	0.743	0.745	0.410

Table 13: Log Monthly Visitation by Park 1993-2018

	(1)	(2)	(3)	(4)
Ln(real fee)	0.121	0.024	0.076	-0.024
	(0.085)	(0.121)	(0.103)	(0.067)
Month		X	X	
Year		X	X	
Year*Region			X	
Year*Month				X
Constant	10.797***	10.002***	9.774***	10.747***
	(0.232)	(0.605)	(0.360)	(.248)
Observations	8,281	8,281	8,281	8,281
R-squared	0.390	0.730	0.734	0.391