Economic Impacts of the US National Park System*

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Abstract

This paper studies the economic effects of the US National Park System, the largest national conservation entity in the world. We assemble a new dataset on the history of the system, and find that parks increase overall employment and income in the local economy. These effects cannot be explained by direct government spending on park budgets. Instead, they indicate substantial multiplier effects on the economy driven by visitation. We also investigate potential negative externalities from parks due to traffic, air pollution, and the shifting of resource extraction. Our findings provide evidence relevant to conservation policy in the US and elsewhere.

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"Conservation means development as much as it does protection."

Theodore Roosevelt

1 Introduction

US government policy on the management and conservation of public lands has experienced several large shifts over the past decade. The period 2008-2016 saw the creation of a record number of protected areas but deferred maintenance on many existing parks in the National Park System.[1] Between 2017 and 2020, protections were lifted from over 2 million acres of federal land in Utah as well as 9 million acres of the Tongass National Forest in Alaska. In the same period, four new national parks were established, and the Great American Outdoors Act substantially increased funding for the park system. In 2021, the Tongass protections were reinstated and the administration announced a goal of conserving 30 percent of US lands and waters by 2030.[2]

One common theme in these policy changes, whether toward or away from conservation, is an emphasis on economic impacts. The Tongass protections were removed to help the logging industry, national parks created to boost local economies through tourism, and the "30 by 30" directive aims to create jobs through conservation.[3] Given these stated goals, understanding the economic impact of different approaches to land management and conservation seems crucial. Furthermore, as with other policies that impact both the local economy and the environment, evaluating local economic impacts helps understand as well as inform the interests that support or oppose conservation (Bartik et al., 2019).

In this paper, we study the local economic impacts of the US National Park System (NPS). The NPS is the largest and best known national conservation entity in the world. Since the opening of Yellowstone in 1872, national parks, sometimes dubbed "America's best idea," have become an international model for conservation efforts.[4] Over 100 countries currently have national parks, with new parks being created every year. France and Tanzania

[1] https://www.wsj.com/articles/national-parks-lost-in-the-wilds-of-neglect-1461531553

[2] https://www.doi.gov/sites/doi.gov/files/report-conserving-and-restoring-america-the-beautiful-2021.pdf

[3] According to the Department of the Interior, "Conserving and restoring the nation's lands and waters can yield immense economic benefits." (https://www.doi.gov/sites/doi.gov/files/report-conserving-and-restoring-america-the-beautiful-2021.pdf, p15). This forms an interesting contrast to the early days of the National Park System, when the economic costs of parks on the mining, logging, and farming industries were perceived to be so large that supporters often had to demonstrate that an area was economically "worthless" before a new park would be approved (Runte, 2010, Ch 3).

[4] While the national park concept seems to have originated with Yellowstone, legally protected nature preserves established earlier include the Tobago Main Ridge Forest Reserve and the Bogd Khan Uul Biosphere Reserve in Mongolia, both established in the late 18th century.

established their newest national parks in 2019, Mozambique in 2020, and Romania is currently working to create a new "European Yellowstone."[5] In recent decades, the NPS itself has seen large increases both in the type and number of parks in the system, and steady growth in the number of annual visitors. Currently the system includes over 400 parks, has a budget over $4 billion, and receives more than 300 million visitors annually.

We collected and digitized what is, to our knowledge, the most comprehensive dataset on the history of the NPS. The dataset contains detailed information on essentially all parks in the system for the second half of the NPS's 100-year history, with some variables extending back to the early 1900s. We followed parks backward in time, gathering information on name changes, park mergers, boundary changes, and designation changes to create a park-level panel. For each park, we collected data on annual visitors, budgets, and size (acreage). We combined this with US county-level economic variables in order to estimate parks' impact on overall local employment and income. We also study outcomes for the retail, hotel, construction, mining, forestry, and farming sectors to pinpoint the nuanced economic effects of the NPS. We use data on traffic fatalities, pollution, and timber extraction in other federal forests to quantify some of the potential negative externalities associated with parks.

Our data makes it possible to measure the economic impacts of major changes affecting parks in the system since 1970. Our first exercise estimates the impact of national parks (NP). Often referred to as the "crown jewels" of the NPS, these are the best-known and most visible areas within the system. During our period of study almost all NP's were established by upgrading an already-existing park. Thus, in this exercise we estimate the impact of conferring the NP designation onto a park that is already part of the NPS. Our second exercise estimates the opening of a new park, i.e., the inclusion of a new area in the NPS. A third exercise, reported in the Appendix, measures the impact of park expansions, i.e., increases in the acreage of an already-existing park.

Our empirical strategy uses event study specifications: we compare the *path* of an outcome in areas experiencing a treatment (e.g., NP designation) to areas not experiencing the treatment. The event study specification allows us to measure dynamic treatment effects (e.g., the impact of NP designation on visitors or local employment may develop gradually over time), and to directly inspect pre-trends in order to assess whether the estimates warrant a causal interpretation.

We find that NP designation leads to more visitors and larger park budgets, and increases employment and incomes in the local economy. After a gradual increase, employment rises to 4% above its initial level 4 years after the designation change. The implied increase in jobs in the average county is 2100 one year after the change, and 6100 four years after.

[5] https://www.nytimes.com/2021/03/15/travel/romania-national-park.html

Similar to employment, income also shows a gradual increase, to approximately 6% above its pre-change level 3-4 years after the designation change.

The opening of new parks has qualitatively similar effects. New parks lead to approximately 3% higher employment and 4% higher incomes by year 4 following the change. This is particularly noteworthy given the fact that newly opened parks during our period of study are *not* national parks. They tend to be relatively smaller, and their importance often lies in their historical, as opposed to natural, significance. Our results show that these parks, too, are conducive to local economic development.

The estimated economic impact of either NP designation or park openings cannot be accounted for by direct government spending on the parks. According to our results, on average, NP designation raises the treated parks' annual budget by $0.25 million while local incomes increase by $76-193 million. New parks' budgets are approximately $0.5 million, while opening a park raises local incomes by $75-130 million per year. These figures suggest the presence of large multiplier effects on the economy. Comparing different designation changes, we find that it is only where visitation shows a clear, sustained increase that we also see increases in employment and income. This highlights the relevance of visitors as the channel behind the economic effects.

These impacts of NP designation and new parks are not simply temporary. The magnitude and statistical significance of all these estimates is sustained for at least a decade following the treatment (although beyond that, several of the estimates become imprecise). We also show that the increase in local employment and incomes cannot be explained by simple substitution, such as parks attracting economic activity away from neighboring counties, or drawing visitors away from other parks.

Looking at specific industries, we find that the retail sector is a significant contributor to the economic gains from new park openings, while the construction industry plays an important role in the gains from NP designation. The latter result shows that the impact of national parks extends beyond tourism and visitor spending. It suggests that the expectation of future visitors creates investment in new facilities and the local infrastructure.

We also look at industries that may be hurt by increased conservation. We find little evidence that the mining, forestry, or farming sectors overall experience large losses in either employment or income as a result of NP designation and new park openings. At the same time, there is evidence suggesting heterogenous effects and costly adjustments *within* some of these industries.

Lastly, we explore some of the potential negative externalities associated with increased tourism and economic development resulting from parks. The impact on pollution is small and statistically insignificant. However, there is some evidence that the opening of parks leads to more traffic accidents. Traffic fatalities increase by 10% 3-4 years following the opening of a park - an effect that seems driven by areas far from large population centers. Finally, we investigate the possibility that by increasing resource conservation in some areas, parks may shift resource extraction to other areas. We find evidence that the opening of a new park increases timber extraction in nearby national forests.[6] To our knowledge, our estimates of these externalities associated with conservation efforts are unique in the literature.

Related literature. In spite of its sizeable budget and importance as a model for park systems around the world, the existing literature on the economic impacts of the NPS is very small. Weiler (2006) studies 8 national parks and finds that national park designation increases visitation. Our result on visitors confirms this finding in a much larger sample and with a more flexible econometric specification. Other studies include willingness-to-pay surveys (Haefele et al., 2020), and economic contribution estimates from an input-output model published regularly by the National Park Service (e.g., Thomas et al., 2018). Our methodology, which relies on estimating causal impacts using a comparison group, is conceptually different from these works. We compare some of our estimates with those of the Park Service in Section 4.1.3. Overall, we believe our paper provides the most comprehensive evaluation to date of the impact of the NPS.

More generally, our paper contributes to a diverse literature evaluating the economic impacts of conservation policies. Many of the rigorous studies in this literature analyze developing country settings (see, e.g., Sims (2010) on Thailand, Ferraro and Hanauer (2014) on Costa Rica, and Sims and Alix-Garcia (2017) on Mexico). These papers generally indicate that establishing protected areas reduces poverty, likely through an increase in tourism. However, these developing country studies face important data limitations, and are typically forced to rely on cross-sectional analyses and a limited set of outcomes. By contrast, our paper can take advantage of a 48-year panel, and detailed economic outcomes by sector, as well as data on park visitation and budgets.

Outside of the NPS, studies of US conservation programs typically focus on local initiatives and/or limited samples. Jakus and Akhundjanov (2019) and Walls et al. (2020) study the economic impacts of a small number of "landscape-scale national monuments" in the western US, and find mixed results. Unlike the parks we study, these areas are not managed by the National Park Service, but by a variety of different government agencies. They are set aside for increased protection but with no clear mandate for touristic or other development. In other settings, Rasker et al. (2013) find that federal land protection is associated with

[6]National forests are federal lands managed by the US Forest Service, an agency separate from the National Park Service.

higher per capita income in a cross section of counties in the western US. Chen et al. (2016) find that a 1994 conservation plan in Oregon increased local income growth, and Sims et al. (2019) show that increases in the acreage of protected land led to higher employment in New England towns.

Broadly speaking, our analysis confirms that some of the positive effects of conservation programs found in these studies also extend to the much larger program we study. We are able to provide a more detailed description of these positive effects by studying a larger set of outcomes (including a direct analysis of mechanisms through visitors and park budgets). At the same time, our analyses of different industries and potential externalities also provide some caveats regarding the economic benefits of conservation. Although each program is different, findings regarding the NPS may be informative for the many national conservation programs around the world that are explicitly modeled on it.

Limitations of the study. Although we investigate a broad range of economic effects, it should be noted that there are many dimensions of the NPS that our paper is not designed to study. First, we do not attempt to measure "conservation." This is a concept that the Park Service itself struggles to define in an era when the natural environment is changing rapidly. When attempting to maintain some kind of ecological baseline is infeasible, it is far from obvious how one should quantify the amount or quality of resources conserved (Schuurman et al., 2020). Alternatively, one might define conservation as the absence of extractive activities. In this case, conservation in the NPS is by law (for example, the prohibition of hunting or new mining operations in national parks), and a lack of conservation would amount to illegal activities. Although we do not have any data on this, we have no reason to believe that such activities occur at a large scale in the system.

Second, we only discuss a small subset of the potential externalities associated with parks. Examples of those we do not study include parks creating incentives for volunteerism (Kotchen and Wagner, 2019), providing utility through their "existence value" (Haefele et al., 2020), or raising issues of social justice regarding the historical treatment of native populations (Spence, 1999). Finally, we do not attempt to measure all general equilibrium effects. We do not know where people who visit the parks would spend their money in a counterfactual without parks, nor how government budgets would be allocated in that case.

All these considerations would be important elements in a full evaluation of the NPS's impact on social welfare, and our study is merely one ingredient to such an evaluation.

Outline. In the rest of the paper, Section 2 provides the relevant background on the National Park System and describes the construction of our dataset. Section 3 explains our econometric specification and Section 4 presents our main results on employment, income, visitors and park budgets. Section 5 describes the robustness checks we performed. Section

6 investigates the channels behind our findings further by looking at specific industries, geographic spillovers, and the impact of designations other than NP. Section 7 estimates some of the negative externalities of parks, and Section 8 concludes. The paper is accompanied by an Online Appendix that presents further details on our analysis, and a separate Online Data Appendix documenting our dataset.

2 Background and data

2.1 Background

Today the NPS is a collection of over 400 areas with natural and/or historical significance managed by the National Park Service, an agency established in 1916 under the US Department of the Interior. Most areas ("parks" from now on) are large natural areas - the median park in our data has 3400 acres (5.3 square miles). Many parks also have historical significance, containing, e.g., Native American dwellings, petroglyphs, Civil War battlefields, US presidents' family estates, or prehistoric fossils.[7]

The mission of the Park Service is twofold: first, to conserve the parks, and second, to make them accessible to the public in a way that does not jeopardize the first goal. As stated in the act establishing the Park Service, its mission is to "conserve 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" (Organic Act of 1916).

Parks in the NPS have a variety of titles or "designations." Designations are suggestive of a park's primary purpose and attraction, but they have no clear definition.[8] The flagship parks of the system are the national parks, often referred to as the "crown jewels" of the park system. Lesser natural areas have designations such as National Preserve, National Recreation Area, or National Seashore. Parks that are primarily of historic importance mostly carry designations like National Historic Park (typically considered to be the most prestigious designation in this category), National Historic Site, or National Battlefield. National Monument (NM) is a designation that is given to both natural and historic areas, and it is sometimes a temporary designation that later may be converted to National Park

[7] The NPS also contains some historic buildings and museums in metropolitan areas: we will drop most of these by excluding large cities from our analysis. Virtually all units of the NPS are open to the public. The few exceptions include areas located on Native American land that require special permits for access.

[8] In the 1960s an attempt was made to clearly categorize parks into "natural," "historical," and "recreational" but because most parks contain areas that fall into each of these categories, this attempt was abandoned by the mid 1970s (Rettie, 1995, 42-43). See Rose (2017) for a detailed discussion of the nomenclature and its implications.

or National Historic Park.

Designations are also suggestive of what type of activities are allowed in a park, but the exact restrictions are typically set on a park-by-park basis, and they vary over time. National parks face the most restrictions. In general, activities that extract or consume resources are forbidden, but there are exceptions. For example, while hunting is generally prohibited, fishing is typically allowed. New mining operations are forbidden, but the Mining in the Parks Act of 1976 guaranteed existing mining claims. Typically, mining companies must submit a plan of operations for approval by the Park Service, and post a bond to guarantee that they conform to the plan (Buono and West, 1986). National parks also limit motorized access. This includes recreational activities such as motorboats and snowmobiles, which are generally allowed in national recreation areas and national seashores.

Most parks become part of the NPS through legislative action by Congress followed by the president's signature. In particular, only Congress can designate a national park. The president has discretionary power to establish national monuments under the Antiquities Act of 1906.

The process by which an area becomes a *candidate* for inclusion in the park system or for NP designation (or indeed what being a candidate means) is much less clear-cut.[9] First, virtually anyone can propose a park for inclusion in the NPS. In his historical review of park proposals in California, Dilsaver (2008) lists "local chambers of commerce, editors, scientists, tourists, and neighbors" as the most common sources of park proposals. Second, many US counties have places that could be proposed: for example, out of California's 58 counties at least 46 (79%) had a park proposed for inclusion at some point.[10] This implies that an empirical strategy that relies on comparing chosen locations and candidate locations would not be practical in our case (Greenstone et al., 2010).

Both the process of including an area in the NPS and of changing a park's designation to national park are long. For example, Purcell (2019, 221-224) describes the history of redesignating Arches National Monument to national park. Soon after the national monument was established in 1929, local interests began pushing for redesignation hoping that this would attract development to the town of Moab. After failed attempts in the 1930s, redesignation

[9]Rettie (1995, 29) summarizes the entire process as follows: "Somewhere somebody becomes convinced that something should become part of the national park system. That somebody gathers the support of other individuals and groups [...] Letter writing and personal visits to state and federal legislators seek to gain public support and sponsorship of proposed legislation to create a new park. [...] A bill is introduced in Congress. [The Park Service] may already have an opinion on the subject or it may then undertake a new area study. [...] Hearings are held. [...] Administration and public witnesses express their views. If successful, the bill is reported out of committee and sent to the floor of Congress. The Senate may do essentially the same thing. [...] The bill is voted on in the House and Senate."

[10]Authors' calculation based on the location of existing parks and the list of proposals in Dilsaver (2008).

was revisited in 1948 without success. Bills to create the national park failed in Congress in 1961, 1962, and 1963, reportedly because the National Park Service wanted time for a comprehensive area study to determine the park's exact location and how it should be managed. The legislative push that eventually led to the national park designation in 1971 began in 1969 but was delayed because of disagreements about the park's proposed new boundaries. These lengthy processes mean that economic shocks are unlikely to have a contemporaneous impact on park opening or designation.[11]

Although our empirical strategy does not rely on this, it is interesting to note that the process of establishing or redesignating a park also seems highly unpredictable. In his famous study cited above, Rettie (1995) predicted that Death Valley National Monument would not become a national park, and used it as an example of parks that "probably qualify for National Park status in terms of resource values and size but existing patterns of mining, hunting, or other factors prevent reclassification in the foreseeable future." (Rettie, 1995, 44). In fact, Death Valley was redesignated a national park as the book was being printed, in 1994.[12]

2.2 NPS data and sample

We collected and digitized what is, to our knowledge, the most complete dataset on the history of each unit of the NPS. We followed parks backward in time, gathering information on the number of visitors, annual park budgets allocated by the federal government, acreage, and administrative histories (name changes, park mergers, boundary changes, etc.) in order to create a park-level panel. Assembling the dataset required digitizing information from multiple archival sources, and keeping track of the definitions of different variables over time. Details on data sources and the construction of our variables are in the separate Online Data Appendix, here we provide a brief summary.

Visitors. The NPS partially digitized data on visitors, which is available on the NPS website. We cleaned this data by comparing park names, years of operation and visitor numbers with the annual publication *National Park Statistical Abstract* and, for earlier years, *Public Use of the National Parks: A Statistical Report.* We used these publications to correct a small number of obvious errors, and to fill in missing years and/or parks.

[11] As noted by a referee, the opening of *historic* parks could in principle be timed to coincide with an important event such as the death or inauguration of a president, which could independently increase visitor interest in the site. We reviewed the history of all historic parks that opened during our sample period and found no obvious coincidences. For example, of the two presidential boyhood homes, President Clinton's opened as a National Historic Site nine, and President Carter's seven years after the president left office.

[12] Our empirical strategy will make it possible to directly test for anticipation effects. If economic actors are able to forecast when the treatment is likely to occur and adjust their behavior, we should see treatment effects occurring before the treatment.

Budgets. The data collection for park budgets relied on Congressional appropriations documents of the Department of the Interior and related agencies. These documents list budget figures for each park, and we digitized all available data going back to 1972. Earlier documents list budget figures by groups of parks, rather than individual parks, and we found that numbers for 1970 and 1971 could not be matched to subsequent observations without losing information and/or making strong assumptions regarding the breakdown of budgets between different parks.

Acreage. Park acreage information comes from the appropriations documents described above, as well as the NPS publication *National Parks Index* (previously called *Areas administered by the National Park Service*), which goes back to 1942.

Administrative histories. We also collected additional variables from the National Parks Index, including year of authorization / establishment of the park, designation, designation changes, boundary changes, and other titles awarded to park units, such as World Heritage Site. Our main sample contains a total of 28 different NPS designations, which can be categorized into designations whose significance is primarily natural or primarily historical (Appendix Table A.1).

In some cases, multiple parks are treated administratively as a group by the National Park Service. These groups contain between 2 to 4 parks that are typically located close to each other. For these parks, visitor and/or budget data is not reported separately, only as the combined total. If any parks were treated as a group for some or all of our main sample period (1970-2017), we combine their data for the entire period and treat them as one park. We similarly treat as one combined park parks that are located in the exact same counties (in every case, this is a single county). This avoids the duplication of observations on economic variables in our park-level regressions. A combined park is coded as a national park in a given year if at least one of its units is a national park.[13]

Creating the sample. As of 2017, the National Park Service reported visitors in 379 individual parks. To create our sample, we excluded from this set parks that were not located in the 48 contiguous states.[14] We also drop units (mostly museums) located in large metropolitan areas.[15] Counting combined parks as one, this results in 269 parks in 2017. Because our main outcome variables are available starting in 1970, our analysis of the NP

[13]The only combined park receiving NP designation during our period of study is Saguaro NP (which includes Saguaro NP and Organ Pipe Cactus NM, both located in Pima county, Arizona).

[14]A substantive reason for excluding parks in Alaska, Hawaii, and US territories is that their relative remoteness is likely to make them different from other parks (e.g., harder for tourists to visit). A practical reason is that the economic data for these areas has many missing values.

[15]See Section 1.5 of the Online Data Appendix for details. The NPS has units in downtown New York, Washington DC, Boston, and Philadelphia and we drop these from the data. The contribution of these units to the local economy or tourism is likely to be tiny, and many potential confounders are present.

designation of existing parks focuses on the 189 parks that were established before 1970, marked in black on Figure 1. Our analysis of park opening is based on all 269 parks.

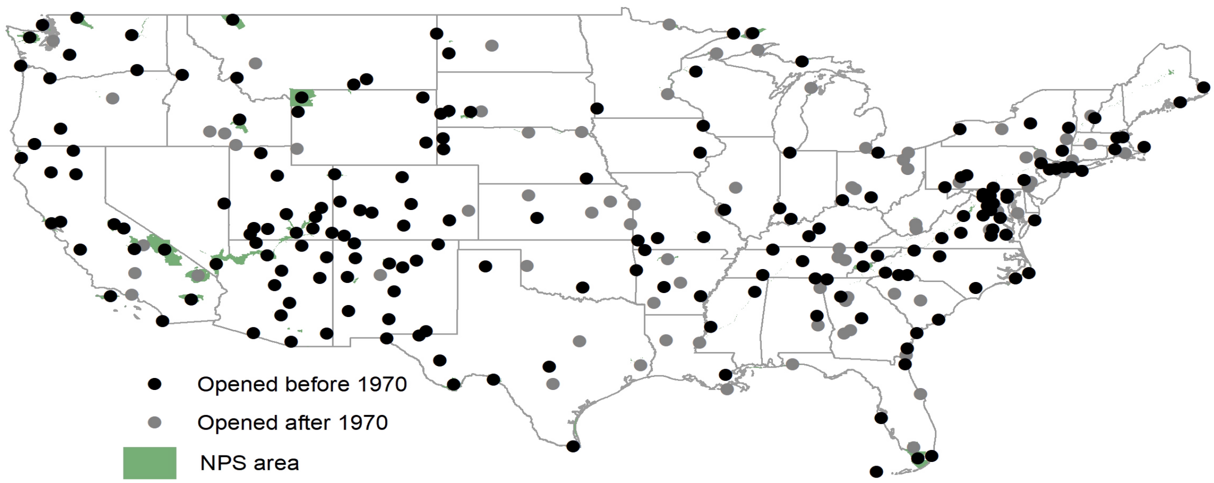

Figure 1: Location of parks in the sample
Markers indicate the centroid of each park. When a park's geographic footprint is larger than the marker, the park's area is shaded in green.

2.3 Evolution of the park system over time

Summary statistics of the main NPS variables are in Table 1. Over the period 1970-2017, the median park had 234,843 annual visitors and a budget of $693,113 per year. National parks received more visitors and had larger budgets: their median is over 3 times the overall median for both variables. National parks also tend to be larger and older than others. Appendix Tables A.2-A.3 show the distribution of these variables over time. Between 1975 and 2015, the number of visitors increased by 6.5% in the average park. Since this period also saw a 28% increase in the number of parks, the total number of visitors to the park system increased considerably. The average park budget over this period increased by 38.5% in real dollars.

Figure 2 presents information on the evolution of the park system. The left panel shows the number of parks in our data over time. Our main sample starts in 1970, after a period of intensive park openings and renovation projects known as "Mission 66." The right panel

Table 1: Summary statistics of NPS data, 1970-2017

Variable	Mean	Std. dev.	10%	50%	90%	N
All parks						
Visitors	862.222	1910.206	28.273	234.843	2125.081	10990
Budget	1431.003	1951.221	213.466	693.113	3430.795	10714
Acreage	111.966	330.252	0.043	3.393	241.865	11082
Age	50.290	29.869	12	48	90	11606
National Park	0.164					11606
National Monument	0.252					11606
National Historic Park	0.091					11606
Nature park	0.477					11606
National Parks						
Visitors	1429.67	1671.875	171.451	857.031	3216.681	1893
Budget	3343.676	2886.144	865.517	2280.311	6889.57	1833
Acreage	427.615	569.927	35.835	218.2	1013.572	1895
Age	72.418	30.160	34	73	107	1900

Notes: Number of parks: 269. Visitors: annual, in 1000. Budget: annual, in 1000 1982-84 dollars. The budget series starts in 1972. Acreage: 1000 acres. National Park, National Monument and National Historic Park are indicators for some of the main designations. Table A.1 in the Appendix gives the list of designations categorized as "nature parks." See the Data Appendix for sources and further details.

shows the number of national parks over time, separating national parks that were newly added to the park system, and national parks that were already part of the system but had a different designation. There are 46 national parks in our dataset, out of which 22 were newly created while 24 received their title through redesignation. The period after World War II saw a long pause in the establishment of national parks. Subsequently, national parks were established through redesignation in all cases but one (Voyageurs NP, created in 1971), and our main identification strategy will use these redesignation events. As the figure indicates, our sample period, which begins in 1970, contains all but one of the redesignation events of the past 80 years.

In the overwhelming majority of cases, once a park becomes part of the NPS, it will remain part of it permanently. During our period of study, only one park was moved out of the NPS (Oklahoma City National Memorial, established in 1997, moved out in 2004). Prior to this, the last park moved out of the NPS was Flaming Gorge NRA, in 1968. National parks being moved out of the NPS is even less common. Since 1940, no national park has been moved out of the NPS, and only one national park was downgraded to a lesser designation (Platt NP, established in 1906, became Chickasaw National Recreation Area in 1976).[16]

[16] As shown on Figure 2, there were only two years with drops in the number of national parks: 1976, when Platt NP was downgraded to Chickasaw NRA, and 1940, when two parks were downgraded, Abraham Lincoln Birthplace (NP between 1919-1940, redesignated to National Historic Site) and Fort McHenry (NP between 1925-1940, redesignated to National Monument).

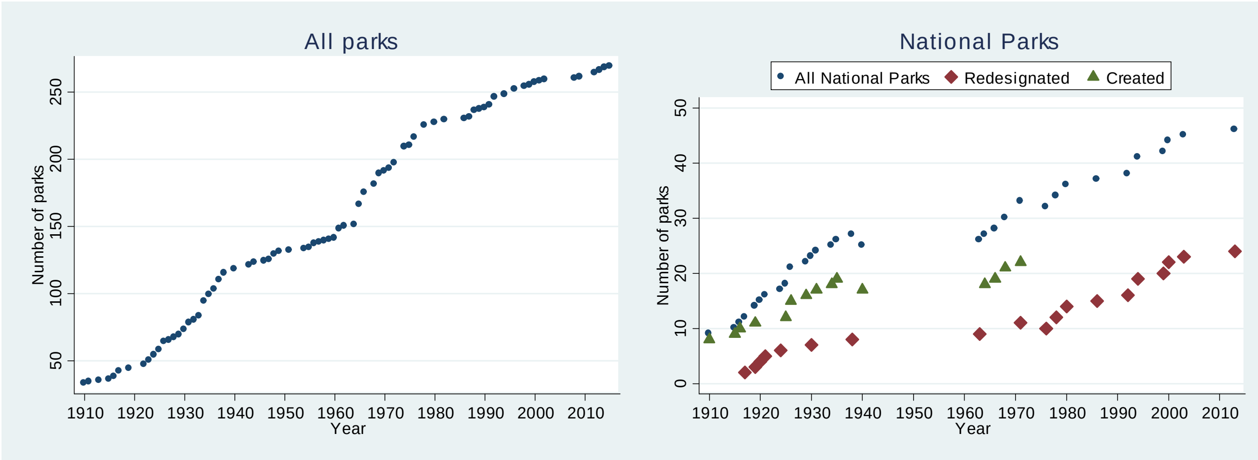

Figure 2: Evolution of the number of parks over time
Cumulative number of parks over time in the sample. The left panel shows all parks, the right panel shows national parks only. Each marker indicates a change in the number of parks; years with no markers had no change. The right panel shows separately the (cumulative) number of national parks created as a national park or redesignated from an existing park.

2.4 Defining the treatments

In practice, the creation of a national park or any other unit of the NPS is a process rather than a binary event. In most cases, the area that will eventually become the park has been there for many years (e.g., in the case of the Grand Canyon, 5-6 million years). Prior to the creation of the park, the area may not be easily accessible: there may be no paved roads, or visitation may be possible only by appointment (as in the case of some caves and historic sites). When the federal government authorizes the creation of the park, this may mean the transfer of federal land to the National Park Service from another agency (such as the Bureau of Land Management), followed by the development of park infrastructure.

This means that studying the impact of parks requires defining what the treatment is. In this paper, we study three treatments: an existing park acquiring National Park (NP) designation, the opening of a new park, and (in the Appendix) a large expansion in the area of an existing park.

Treatment 1: NP designation. To study the impact of national parks, the most visible units in the system, we estimate the impact of NP designation for an existing park, i.e., a park that is already part of the NPS but has a different designation. The comparison group for these estimates consists of other parks in the NPS that are not receiving NP designation in the given period.

By focusing on existing parks, we are not subject to the potential confounds that may arise in connection with a park being newly established. These may include political and economic factors that affect the federal government's ability to acquire land or establish a local jurisdiction, as well as developments in the local economy that may make the park more accessible to tourists (since we are focusing on existing parks that tourists are already visiting). Studying existing parks also offers a clear counterfactual: in the absence of NP designation, the park would still be part of the NPS - for example, it would not undergo commercial or industrial development.

Of the 46 national parks in the contiguous 48 states, 17 acquired their NP designation during our sample period, and an additional national park (Platt NP) lost its NP designation. Thus, there are a total of 18 designation changes involving national parks in our period of study. Of these, 3 involve parks established after 1970, so we drop them from the analysis when focusing on parks that existed throughout our period of study. We drop an additional park, Theodore Roosevelt NP, where an oil discovery adjacent to the park in the year of the designation would confound our estimates of economic impacts (biasing our main results *upwards*) - see Section 5 for details. Our identification will thus come from designation changes in 14 parks, listed on Figure 3.

We code NP designation changes as happening in the year in which they took place. This is the year in which the president signs the bill designating the park, and in all cases but one, this also corresponds to the year in which Congress passed the final version of the bill.[17] Although most NP designations are signed into law in the Fall, Congress passed these bills earlier in the year. Thus, some economic decisions (e.g., investment) in response to a designation change could be made throughout the year of the treatment as NP designation becomes all but guaranteed.

Treatment 2: Opening of a new park. Our second treatment is the inclusion of a new park in the NPS (we will refer to this simply as "park opening"). Compared to NP designations, this event is more frequent but also more heterogenous. Typically, the opening of a new park will mean that the federal government has authorized the Park Service to begin spending money on developing the park. In practice, changes range from mere formalities to the start of actual construction and development of park facilities. At the same time, there are a number of common elements: all parks included in the NPS are managed by the same agency, are listed in the same publications, and are generally distinguished by the NPS "brand."[18] Because parks can be expected to remain in the NPS indefinitely, a park's

[17] The exception is Pinnacles NP, where the legislation redesignating the park was passed by Congress in December 2012 but signed by President Obama in January 2013. As we show below, excluding this park does not affect our findings.

[18] Compared to areas managed by other agencies, the NPS has a number of well-recognizable features. These include uniformed park rangers, visitor centers offering interpretative programs, annual passes valid

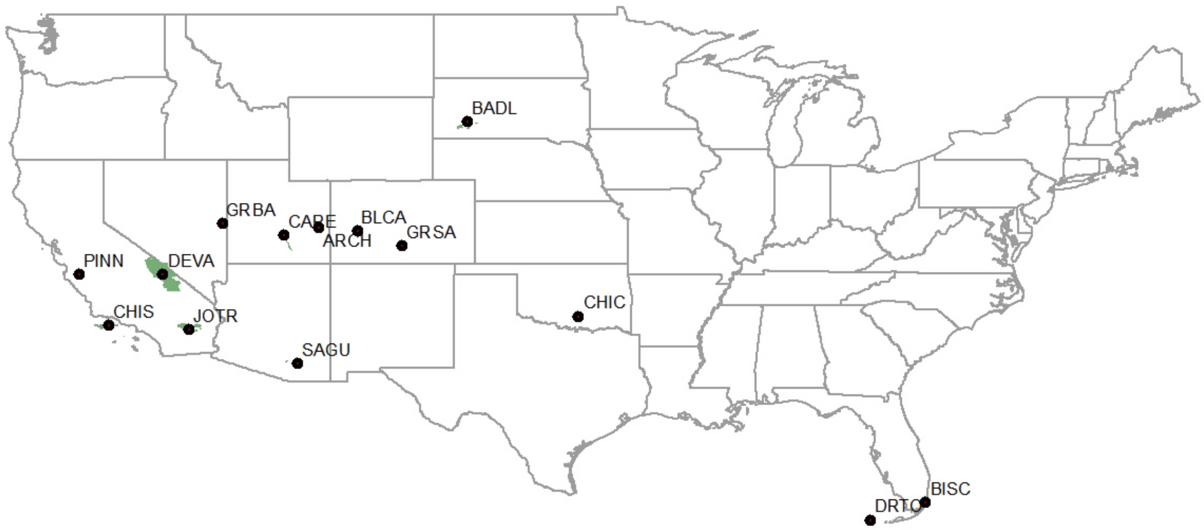

Figure 3: Parks experiencing an NP designation change in the sample
Markers indicate the centroid of each park. When a park's geographic footprint is larger than the marker, the park's area is shaded in green. ARCH: Arches, BADL: Badlands, BISC: Biscayne, BLCA: Black Canyon of the Gunnison, CARE: Capitol Reef, CHIC: Chickasaw National Recreation Area, CHIS: Channel Islands, DEVA: Death Valley, DRTO: Dry Tortugas, GRBA: Great Basin, GRSA: Great Sand Dunes, JOTR: Joshua Tree, PINN: Pinnacles, SAGU: Saguaro.

opening also represents a commitment on the part of the federal government regarding the future prospects of the area. To exclude events that were mere formalities, we will drop parks that did not begin reporting visitors within 10 years after opening.[19]

For this exercise, we extend the sample to parks included in the NPS after 1970 (i.e., we consider all parks on Figure 1) and also include counties without any parks (subject to various restrictions).[20] The comparison group for our estimates are areas that do not experience a park opening in a given period.

This treatment helps answer the question of the economic impacts of conservation com-

in all NPS parks, and NPS "passports" in which visitors can collect stamps at each park.

[19]The median park begins reporting visitors within 4 years after being included in the NPS. The 10-year threshold drops 14 parks. In the robustness checks, we increase this threshold to 5 years, and also remove it completely.

[20]Just like for parks, we follow counties backward in time, from 2017 to 1970. Counties that share a park in 2017 are aggregated into one observation throughout the period (including any years in which they do not yet have the park). Counties that never have a park enter the data individually.

pared to a counterfactual without conservation. This is different from the NP designation treatment: in that case, an area also enjoys some protection in the counterfactual. In this sense, the opening of a new park represents an increase in conservation on the "extensive margin," while NP designation increases conservation on the "intensive margin."

As discussed above, our sample starts after Project 66, an intense period of park construction (Figure 2). Of the parks opened between 1966-2017, over 40% opened in the period 1966-74. This poses a challenge for our analysis, because given that our data starts in 1970, parks opened in 1966-1974 do not have all their lags and leads observed in the $[-5, +5]$ event window. Including all these parks would result in large imbalances in the observations used to estimate the different coefficients. To avoid this issue, in the main analysis we estimate the impact of parks created between 1975 and 2013 (i.e., we drop parks created between 1966-74 or after 2013[21]). This leaves 45 opening events in our sample. In the robustness section we expand this set by reducing the number of leads included in the regression, and find similar results.

Treatment 3: Large park expansions. As an alternative measure of the impact of parks, in Appendix 6 we consider large additions to their area.[22] Several parks receive a major addition at least once after their establishment. Figure 4 shows the location of parks with major (at least 50%) additions during our period of study. To study the impact of large additions in an event study, we define the treatment as additions of least 60% to a park's area (we also present results for thresholds of 50, 70, and 80% that are substantively similar).[23] Using this threshold, we have 31 expansion events in 27 parks (some parks experience multiple large expansions).

Like the NP designation measure, this measure also focuses on already existing parks so the estimates will not be confounded by factors that may affect the establishment of new parks. An advantage of this measure is its higher frequency. Its disadvantage is that it is unknown exactly what the change represents: the new areas added to the parks may be a combination of additional recreational opportunities and infrastructure (e.g., roads and campsites), as well as remote natural areas that are less relevant for tourism and economic activity.

[21] Only 5 parks opened after 2013, and only 2 after restricting to parks reporting visitors within five years.

[22] Conceptually, this treatment features elements of both the NP designation and the park opening treatments: it affects already existing parks (intensive margin) and increases the footprint of the NPS (extensive margin). Several previous studies (e.g., Sims, 2010; Sims et al., 2019) use land area to measure the impact of conservation - our approach here is a variant of this strategy.

[23] The advantage of using an event study here is twofold. First, using the same estimation framework as for NP designation and park opening allows our results to be easily compared across the different measures. Second, the acreage data contains small fluctuations over time, likely due to the difficulty of precisely measuring the size of large natural areas. Using a threshold for "large" changes rather than a more parametric specification makes our results robust to these fluctuations.

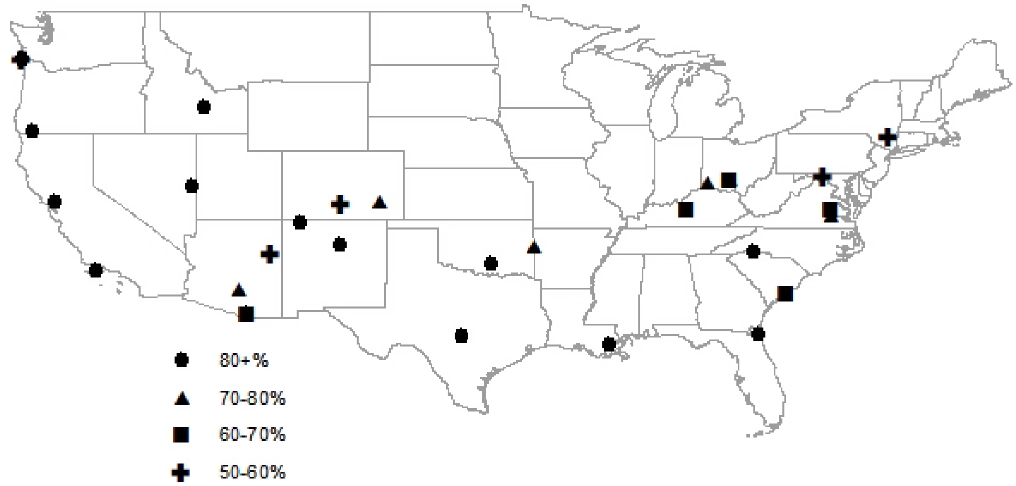

Figure 4: Parks with large area additions in the sample
Parks receiving large area additions during our period of study. Our main analysis uses additions of 60 percent or above.

2.5 Other data

We merge a number of different datasets to our NPS data - details are in Section 3 of the Online Data Appendix. Our main source of county-level economic measures is the Bureau of Economic Analysis (BEA), which publishes information on population, employment and income beginning in 1969. Employment and income are available both overall, and broken down by specific industries. Our measure of income is earnings by place of work, which consists of compensation of employees and proprietors' income generated in the given county. This is consistent with the employment measure, which is also calculated on a place-of-work basis. Together, the employment and income measures capture the extent of economic activity taking place in a county.

We consider six specific industries, three of which could be expected to gain from increased tourism and infrastructure development associated with the NPS (hotels, retail, and construction), and three that may lose from increased conservation (mining, farming, and forestry and logging[24]). For the hotel sector, we can only look at income because employment is not available. In addition, changes in the industry classification in 2000 require adjustments for two of the series we use, retail and forestry, to make them consistent over time.

[24] Throughout we use the term "forestry" as a shorthand for a set of industries referred to as "Agricultural services, forestry, and fishing." This category includes timber production and nurseries, forestry services, fishing, hunting and trapping as well as some support services for agriculture.

The adjusted retail series always contains restaurants, while the adjusted forestry series always contains logging, as well as lumber and wood products manufacturing. For both series, these adjustments can only be done for income, we do not have data on employment that is consistent over time in these categories. Detailed summary statistics of all employment and income variables are in Tables A.4-A.7 in the Appendix.

As we show below, our results warrant taking a closer look at some of these industries. For a closer look at construction, we add the house price index published by the Federal Housing Finance Agency (available since 1975) and the number of building permits issued in the county from the Census Bureau (beginning in 1990). For a closer look at the mining industry, we add to our dataset mine level information from the Mine Safety and Health Administration, available for 1983-2017. We use this data to calculate the number of mines, as well as employment in the average mine, in each county. In contrast to the BEA mining data, the mine level data does not include oil extraction. For more details on the forestry sector, we include data on the number of establishments from the County Business Patterns database of the Census Bureau. This data is available in consistent form for 1974-2016. Finally, for a closer look at farming, we add data from the USDA Census of Agriculture on farm product sales, cattle inventories, and the number of farms in the county. During our period of study, this data is available in 1974, 1978, 1982, and every 5 years after that.

County level information on population age groups comes from the Census Bureau and starts in 1970. County level weather information is from the National Climatic Data Center of the U.S. Department of Commerce.

To measure some of the possible negative externalities associated with parks, we collected data on traffic accidents, pollution, and timber harvested from national forests. Data on traffic accidents comes from the Fatality Analysis Reporting System of the US Department of Transportation. This can be used to compute the annual number of accidents and the number of fatalities in each county beginning in 1975. Data on the average annual concentration of various air pollutants is published by the EPA starting in 1980. We use data on NO_2 and ozone, two major pollutants linked to motor vehicles. Data on the annual volume of timber cut in each national forest is obtained from the Forest Products Cut and Sold reports of the US Forest Service, available starting in 1977.

Finally, one of our robustness checks adds data on local government spending from the Census of Governments database of the Census Bureau. Total local government spending at the county level is collected every 5 years and is available in consistent format for 1972-2012 during our period of study.

All county-level datasets can be matched by county FIPS codes (see the Online Data Appendix for details). This data is matched to our dataset on the NPS using GIS boundary files. All monetary values are transformed to real 1982-84 dollars using a consumer price index from the Bureau of Labor Statistics.

3 Specification

Our goal is to estimate the effect of parks on the local economy. Because park characteristics are measured at the park level and economic variables are measured at the county level, and because there is not a one-to-one correspondence between counties and parks,[25] we must choose the unit of analysis. We chose to focus on the park level for three reasons. First, this is the level at which most policy questions of interest arise. What would happen if a park became a National Park, or if a park was enlarged? What would happen if a particular area was included in the National Park System? Except in special cases, the thought experiment of creating a park in one county alone is not meaningful. Second, two of our treatments capture changes to existing parks. In this case, we only want to use data from counties that have parks (i.e., use in the comparison group counties with existing parks that do not experience changes). Counties that do not have *any* park could potentially be very different from the treatment group. Third, since all the treatments we exploit take place at the park level, focusing on this level ensures that our regressions are specified at the same level as the treatment. This avoids the need to deal with the difficulties of conducting inference from clustered treatment.

To estimate the impact of parks, we use an event study specification. The long process which leads to the treatment (see Section 2.1) means that most factors that might simultaneously cause both the treatment and the outcomes we consider are likely to accumulate gradually over time. For example, economic conditions in surrounding areas, local politics, or changes in media attention and tourism will undoubtedly play a role in the likelihood of treatment. However, these factors are likely to be reflected in our outcomes (e.g., employment or the number of visitors) over a period of several years prior to the treatment. By contrast, the treatment happens discontinuously at a particular point in time. Thus, the causal interpretation of the treatment can rely on a discontinuous change in the *path* of the outcome around the treatment. Compared to a "static" difference-in-differences, the event study specification directly allows us to test for this change. Moreover, an event study is the appropriate specification when treatment effects can be expected to change over time.[26] For example, in our case the change in employment or park visitation is likely to occur gradually

[25] 43% of the parks in our analysis are located in 2 or more counties.

[26] A number of recent papers emphasize the limitations and possible bias in static specifications in the presence of time-varying treatment effects (see Goodman-Bacon (2021), de Chaisemartin and D'Haultfoeuille (2020), and studies cited therein).

over time following the treatment.

If each park experiences at most one "positive" event (e.g., acquiring NP designation), the standard event study specification is

$$Y_{pt} = \sum_{j=-4, j\neq -1}^{4} \beta_j \mathbf{1}(\tau_{pt} = j) + \widetilde{\beta}_5 \mathbf{1}(\tau_{pt} \geq 5) + \widetilde{\beta}_{-5} \mathbf{1}(\tau_{pt} \leq -5) + \boldsymbol{\gamma} \mathbf{X}_{pt} + \delta_p + \lambda_t + \varepsilon_{pt}, \quad (1)$$

where Y_{pt} is an outcome of interest for park p in year t. The variable τ_{pt} denotes time since the event, with $\tau_{pt} = 0$ if the park experiences the event in year t, $\tau_{pt} = -1$ if it will experience the event in year $t+1$, $\tau_{pt} = 1$ if it experienced the event in year $t-1$, etc. We estimate the impact of each event using a window of +/-5 years around the event, with "binned" indicators for 5 or more years before/after the event. Our excluded category is $\tau_{pt} = -1$, the year before the event. We chose 5 as the upper end of the event window because with our data ending in 2017, this is the highest number of lags that we observe for the last park acquiring NP designation (in 2013). We chose -5 as the lower end for symmetry.[27] To obtain some estimates over a longer time horizon, we will also extend the event window to 15 years before/after the event. Controls include variables $\mathbf{X}_{pt}$ that vary at the park-year level, and park and year fixed effects.

To allow for the fact that some parks may experience negative events (e.g., a loss of NP designation) we extend specification (1) to

$$\begin{aligned} Y_{pt} = & \sum_{j=-4, j\neq -1}^{4} \beta_j \mathbf{1}(\tau_{pt} = j) + \widetilde{\beta}_5 \mathbf{1}(\tau_{pt} \geq 5) + \widetilde{\beta}_{-5} \mathbf{1}(\tau_{pt} \leq -5) \\ & - \sum_{j=-4, j\neq -1}^{4} \beta_j \mathbf{1}(\tau^*_{pt} = j) - \widetilde{\beta}_5 \mathbf{1}(\tau^*_{pt} \geq 5) - \widetilde{\beta}_{-5} \mathbf{1}(\tau^*_{pt} \leq -5) \\ & + \boldsymbol{\gamma} \mathbf{X}_{pt} + \delta_p + \lambda_t + \varepsilon_{pt}. \end{aligned} \quad (2)$$

Here τ^{*k}_{pt} denotes time since the negative event. We assume that the impact of positive and negative events (e.g., gaining and losing NP designation) is symmetric, so that the coefficients on the negative event are $-\beta_j$. See Schmidheiny and Siegloch (2019) for a review of the different event study specifications used in the literature.

The time varying controls $\mathbf{X}_{pt}$ include log population density in order to normalize our

[27] Because our data begins in 1970 and two parks acquire NP designation in 1971, the set of parks used to identify the leads $\tau \leq -2$ differs from the rest. We will check whether this affects our results in two ways. First, we simply drop these two parks from the sample. Second, we extend the data to 1969. This requires dropping some of the control variables for which no data is available, but it allows us to estimate an event window $[-2, 5]$ using a balanced set of parks.

dependent variable (which is also in logs).[28] As additional controls, we include variables that could conceivably affect government policy towards the parks as well as tourism and the local economy: the share of the population under age 19, the share above 65, a precipitation and a drought severity index, and, for the NP designation and park expansion regressions, the park's age squared to control for reputation effects.[29] As we show below, adding these controls improves precision but is not crucial for the results.

Some outcomes of interest are measured at the park level (visitors, budgets), while others are measured at the county level (economic variables). In the latter case, we create Y_{pt} based on the average of the county-level variables for the counties that overlap with park p. (Note that we take logs and control for park fixed effects. Therefore taking the total or the average across counties is equivalent: the number of counties being aggregated is captured by the park fixed effects.) We follow the same procedure for creating the control variables $\mathbf{X}_{pt}$.

Note that the data on county-level total employment and income, as well as the control variables, has no missing values, so that we are always aggregating the same set of counties for a given park in our main regressions. When we study specific industries (Section 6.3), we must deal with the well-known issue of missing cells. This arises because, for privacy reasons, the BEA suppresses sectoral income and employment information for counties with few establishments in that sector. The set of suppressed cells varies across years, creating artificial variation over time in the values of these variables when we aggregate across counties. To fix this issue, for each year that is part of an event window, we only use counties with no missing observations in the *entire* event window when we create a park-level measure. This does not affect the internal validity of our sectoral estimates, but does mean that our results for, e.g., mining, may not be representative of counties with very few mining firms, since those are likely to appear as missing in the BEA data.

We estimate both unweighted specifications and specifications where we weight each park by the number of counties it overlaps. Standard errors reported in the main text are asymptotic standard errors clustered at the park level. The Appendix also reports bootstrapped standard errors, and standard errors that allow correlation within *groups* of parks that share a county. For the latter, we partition parks into the smallest sets such that each park has a county in common with at least one park in the same set. For estimates on different industries, we also report multiple-inference adjusted p-values.

Unless noted otherwise, our regressions cover the years t from 1970 to 2017 (1972 to 2017 in the case of park budgets).

[28] As it turns out, the coefficient on population is always close to 1, so using (log) per capita values as dependent variable instead of controlling for population yields almost identical estimates.

[29] Note that a linear function of the park's age is subsumed in the year and park fixed effects.

4 Main results

4.1 Employment and income

4.1.1 NP designation

We begin by estimating the impact of NP designation on local employment. We estimate the event study specification in (2) using as dependent variable the average number of people employed in the counties containing a park, in logs. The estimates are in Column (1) of Table 2 and the first panel of Figure 5. The figure plots the coefficients β_j, their 95% confidence interval, and indicates the p-value of the estimates in brackets.[30] Throughout we focus on the results with control variables but the estimates without these are very similar (Table A.8).

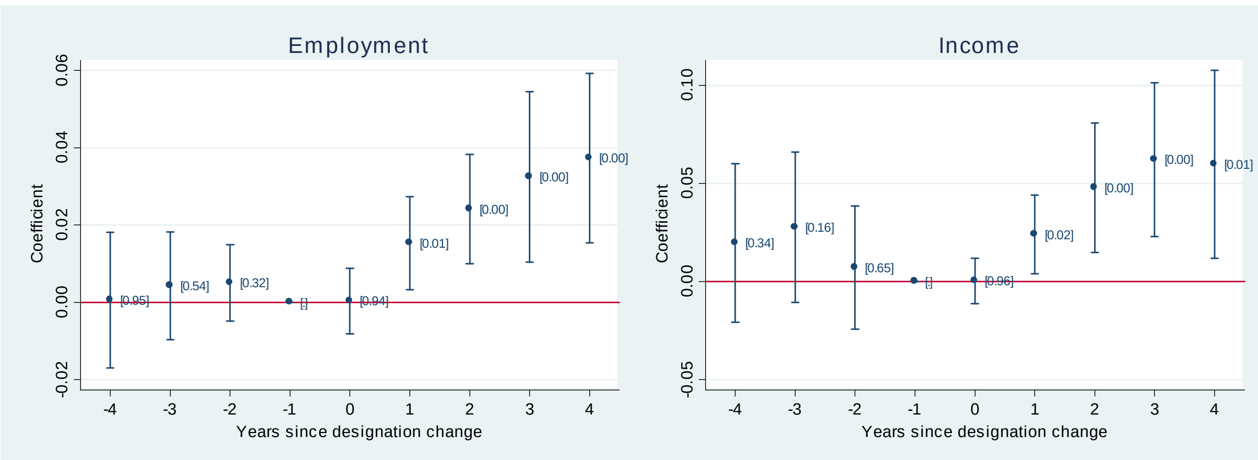

Figure 5: The impact of NP designation on employment and income
Event study coefficient estimates for the impact of NP designation on log employment and income, corresponding to Columns 1 and 3 in Table 2. Estimates are relative to the year before the designation change. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. N = 9024.

We find that NP designation increases employment. Employment begins to rise significantly one year after the designation change, reaching around 4% above its initial level 4 years after the designation change. This implies an increase in employment in the average county between 2100 (year 1) and 6100 (year 4) jobs.[31] Coefficient estimates for periods

[30] Recall that years before and after the event window (≤ -5 and ≥ 5) are binned and these coefficients are therefore difficult to interpret. Because different parks are treated at different times, these indicators reflect different numbers of periods for different parks. As is common, we omit them from the graphs throughout.

[31] These figures are obtained as $(\exp(\beta_j) - 1)\bar{Y}$ where β_j is the coefficient estimate and $\bar{Y} = 162,769$ is

before the change are flat at 0, supporting the interpretation of these effects as being causal. If there was some other change, such as an increase in media attention and tourism in years -1 or -2 that caused both NP designation and higher economic activity, we would expect to see employment beginning to increase *before* the designation change. The estimates clearly show that this is not the case. Extending the pre-period further back in time yields similar conclusions (Figure A.9 in the Appendix).

Appendix Table A.11 shows that we obtain similar statistical inference from p-values computed using alternative clustering procedures, including a clustered wild bootstrap.

Column (2) of Table 2 shows that the results are similar when we weight observations by the number of counties that a park overlaps. Weighting is motivated by the fact that economic variables reflect averages across counties, and parks overlapping more counties may therefore have an error term with lower variance in the regression. As suggested by Solon et al. (2015), the similarity of the weighted and unweighted estimates provides a check on the specification. Because the unweighted estimates are more straightforward to interpret, we focus on these in what follows, but include comparisons to the weighted estimates when these are relevant.

Columns (3-4) and the second panel of Figure 5 show the corresponding results for local income. Similarly to employment, income also shows a gradual increase, to approximately 6% above its pre-change level by year 3 following the designation change.[32] The implied increase in income in the average county overlapping the redesignated parks is between $76 million (year 1) and $193 million (year 4).[33]

Figure 5 clearly highlights the importance of the event study approach, and the limitations of static difference-in-differences in this setting. The full extent of economic impacts is not immediate, but develops gradually over a period of several years. Because a static specification estimates a *weighted* average of the treatment's impact over the post-treatment period, and *underweighs* long-term impacts (sometimes assigning them a negative weight), it would bias the estimated impact of NP designation downward (Borusyak and Jaravel, 2017). In our case, the static specification would yield statistically insignificant estimates of 0.006 (s.e. 0.022) for employment and 0.001 (s.e. 0.030) for income.

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average employment in the counties overlapping the treated parks in the year before the designation change.

[32] Parks about to undergo a designation change are very similar to the comparison group between year -2 and -1. Between year -3 and -2, their income is (statistically insignificantly) higher and converging. Because, if anything, the pre-trend is declining, it cannot provide a mechanical explanation for the increase in income we observe following the designation change. For example, it is possible that the process leading to a designation change is given a final push when policymakers see slow economic growth and hope to boost local economic activity. This would still be consistent with a causal interpretation of our estimates (unless there are other measures enacted to increase economic activity in the same counties at the same time).

[33] Average income in these counties in the year before the designation change is $3,114.366 million and we multiply this by $(\exp(\beta_j) - 1)$ to obtain these figures.

Table 2: The impact of parks on employment and income

Years since change	NP designation				Park opening			
	Employment		Income		Employment		Income	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
≤-5	0.030	0.031	0.036	0.057*	-0.018	-0.009	0.000	0.012
	(0.023)	(0.021)	(0.036)	(0.034)	(0.015)	(0.013)	(0.025)	(0.022)
-4	0.001	-0.001	0.020	0.028	0.000	0.005	-0.006	-0.004
	(0.009)	(0.008)	(0.020)	(0.020)	(0.009)	(0.008)	(0.016)	(0.014)
-3	0.004	0.011	0.028	0.034*	0.010	0.012**	0.009	0.006
	(0.007)	(0.007)	(0.019)	(0.020)	(0.007)	(0.006)	(0.012)	(0.011)
-2	0.005	0.005	0.007	0.023	0.006	0.006*	0.013	0.008
	(0.005)	(0.006)	(0.016)	(0.016)	(0.005)	(0.004)	(0.010)	(0.007)
0	0.000	-0.002	0.000	0.002	0.003	0.002	0.006	0.003
	(0.004)	(0.005)	(0.006)	(0.005)	(0.003)	(0.003)	(0.008)	(0.007)
1	0.015**	0.017***	0.024**	0.031*	0.007	0.004	0.021*	0.009
	(0.006)	(0.005)	(0.010)	(0.018)	(0.006)	(0.005)	(0.012)	(0.011)
2	0.024***	0.028***	0.048***	0.065**	0.017**	0.014*	0.036*	0.031**
	(0.007)	(0.006)	(0.017)	(0.027)	(0.008)	(0.007)	(0.019)	(0.014)
3	0.032***	0.032***	0.062***	0.054*	0.025**	0.020**	0.040**	0.032**
	(0.011)	(0.008)	(0.020)	(0.028)	(0.011)	(0.009)	(0.016)	(0.014)
4	0.037***	0.043***	0.060**	0.071*	0.028***	0.024***	0.036**	0.035***
	(0.011)	(0.011)	(0.024)	(0.038)	(0.010)	(0.009)	(0.017)	(0.013)
5≤	0.031	0.055***	0.029	0.061*	0.009	0.001	0.057**	0.041*
	(0.022)	(0.019)	(0.030)	(0.032)	(0.015)	(0.015)	(0.026)	(0.023)
Weighting	no	yes	no	yes	no	yes	no	yes
Adj. R^2	0.93	0.95	0.87	0.90	0.85	0.86	0.72	0.74
N obs.	9,024	9,024	9,024	9,024	129,744	129,744	129,730	129,730
N units	188	188	188	188	2,703	2,703	2,703	2,703

Notes: Event study estimates of the impact of NP designation and park opening on log employment and income, 1970-2017. Coefficients represent changes relative to year -1 (the year before the event). All specifications control for park and year fixed effects, population density, the share of population under 19 and above 65, precipitation and droughts, and (in NP designation regressions) the park's age squared. Regressions in even numbered columns are weighted by the number of counties aggregated to create each observation. Robust standard errors clustered by park in parantheses. ***, **, and * indicate significance at 1, 5, and 10 percent, respectively.

4.1.2 Park opening

We now turn to our second treatment, the opening of new parks. The specification is the same as above except that the park's age is omitted from the vector of control variables $\mathbf{X}_{pt}$. The estimates are on Figure 6 and in columns (5-8) of Table 2.

The results show evidence of a gradual increase of both employment and income following the opening of a park. The estimates for employment indicate an increase of 2% by year 2 and 3% by year 4. For income, we see an increase of 2% after one year, which rises to around 4% in subsequent years. For the treated areas, the implied increase in income is between \$75 million (year 1) and \$130 million (year 4).[34] Estimates for a longer pre-period (Appendix Figure A.10) or using different standard errors (Appendix Table A.12) reinforce our findings.

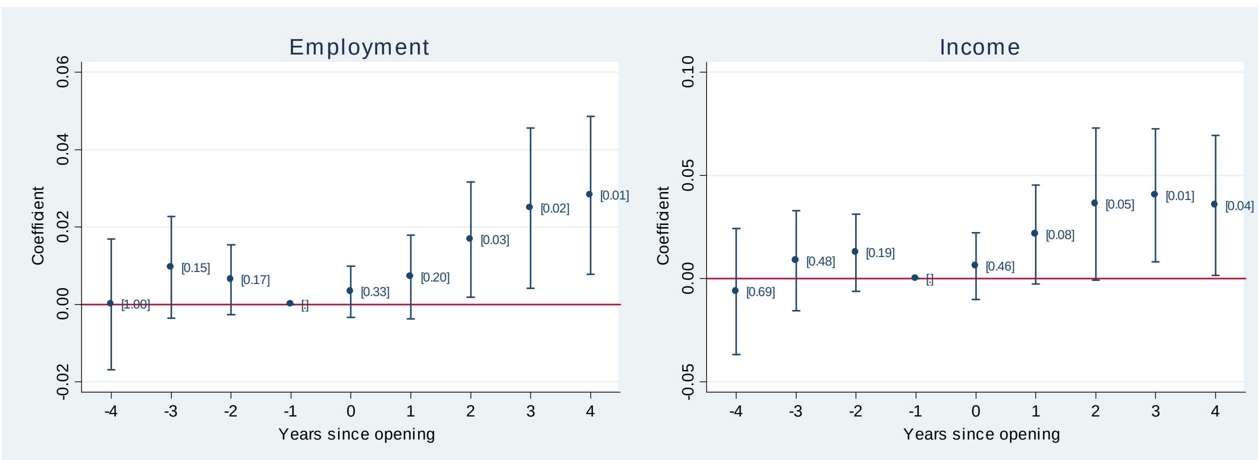

Figure 6: The impact of park opening on employment and income

Event study coefficient estimates for the impact of park opening on log employment and income, corresponding to Columns 5 and 7 in Table 2. Estimates are relative to the year before the park opening. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. N = 129,744 (employment) 129,730 (income).

It is noteworthy that newly opened parks during our period of study are *not* national parks. The average park included after 1966 is less than 1/2 the size of parks included earlier; most of the parks included later are historical, and the modal designation is National Historic Site, a relatively less prestigious designation in this category. Over this period, only one park was created as a national park (Voyageurs NP in 1971) and this park is not part of the sample. According to some observers, the "quality" of the NPS has been diluted over time through the addition of these less prestigious parks (Foresta, 1984, Ch 3).

[34] Average income in these counties in the year before the park opening is \$3,538.845 million and we multiply this by $(\exp(\beta_j) - 1)$ to obtain these figures.

Our results indicate that even this pool of parks has a substantial positive impact on the local economy on average. The development impact of new parks is clearly not restricted to national parks.

In Appendix 6, we find that our third treatment, large park expansions, also yields positive effects on employment and income but these appear to be short-lived.

4.1.3 Comparison to the Park Service's economic contribution estimates

It is interesting to compare our estimates to measures of the parks' economic contribution published annually by the Park Service. These "official" measures inform policy makers and have been used by analysts as a basis for evaluating proposed changes to the park system (Headwaters Economics, 2018).

To compute the number of jobs and the income created in the local economy by each park, the Park Service multiplies estimated visitor spending with regional economic multipliers derived from an input-output model. The multipliers account for both direct contributions (tourism) as well as indirect contributions created by increased economic activity (Thomas et al., 2018, p2). At the same time, the Park Service's figures are explicitly not meant to provide an estimate relative to a counterfactual without parks: they "should not be confused with an economic impact analysis ... the economic activity that would likely be lost from the local economy if the National Park was not there." (Thomas et al., 2018, p3)

To compare these measures to our estimates, we look at the contribution of the 45 newly opened parks in our sample (i.e., the treated parks in the park opening regressions). Based on the Park Service's figures, for 2017, the contribution of the average park in this group is 220 jobs (with a range of $[0, 1723]$ across the 45 parks) and \$20.340 million in economic output (with a range of $[0.106, 164.862]$ million) at current prices.[35] For the same year and the same set of parks, our point estimate for β_0 shown on Figure 6 implies 1259 new jobs and an extra \$151.596 million in local income for all counties overlapping with the average park.[36] By computing economic impacts relative to a counterfactual without parks, we obtain larger estimates.

Recall however that our estimate for β_0 was not statistically different from 0, and that we found larger effects a few years after a park opening. For example, using the coefficients from Figure 6, in year 2 we estimate an extra 6440 jobs, and an extra \$913,763.441 million

[35] These figures are computed from Table 3 in Thomas et al. (2018, p18-30), using the "Jobs" and "Economic Output" columns.

[36] We obtain these figures as $(\exp(\hat{\beta}_0) - 1)\bar{Y}$, where $\hat{\beta}_0$ is the point estimate from the regression, and $\bar{Y}$ is the relevant benchmark. To compute $\bar{Y}$, we take the 2017 total of the dependent variable across all counties overlapping with a park, and then take the average across the 45 parks. In the employment regression, $\hat{\beta}_0 = 0.0032978$ and $\bar{Y} = 381,021$. In the income regression, $\hat{\beta}_0 = 0.0060824$ and $\bar{Y} = 24,847.922$ million.

in local income.[37] By ignoring dynamic treatment effects, the Park Service's figures may considerably underestimate the economic impact of parks in the NPS.

4.2 Mechanism: Visitors and park budgets

Two natural possibilities for the mechanism behind increased employment and income are more visitors and more government spending. To investigate this, we estimate the impact of NP designation on park visitors and budgets using the same specification as above.

The left panel of Figure 7 shows that NP designation puts park visitation on a path of gradual increase, eventually leading to 17% more visitors. The year of NP designation shows a 5% increase, which rises to 7.5% by year 1 and a statistically significant 17% by year 2. Coefficients for subsequent years suggest a sustained long-run increase in visitation as a result of NP designation.

These estimates for visitors are interesting in their own right as they can shed light on the difference in visitation between national parks and other parks in the system. In our sample, visitation in national parks is higher by a factor of 1.9 (Table 1). A priori, there could be a number of reasons for this: national parks may have unique natural features that make them inherently more interesting, they may be more easily accessible through major airports, etc. Our estimates indicate that about one fifth of the difference in visitation can be explained simply by the national park label.

The right panel of Figure 7 estimates the impact of NP designation on park budgets. We find that the average park budget increases by 8.4% one year after the designation change, and 22-26% in subsequent years. NP designation appears to have a sustained positive effect on annual park budgets.[38]

While the increase in budgets is sizeable in percentage terms, its absolute value is small. For the average park experiencing a designation change, a 20% annual budget increase means an extra $256,652 per year. This is several orders of magnitude smaller than the income increase we found above, indicating that economic impacts go well beyond direct government expenditures on local goods and services associated with the parks.

While it is not possible to provide a similar estimate for park openings (since parks that are not yet created have no budgets), we note that the average annual budget of newly opened parks in their first 5 years is $481,390. This is again much smaller than the corresponding

[37] These are obtained as above, using the point estimates $\hat{\beta}_2 = 0.016762$ (employment) and $\hat{\beta}_2 = 0.0361142$ (income).

[38] Some of the delay in the increase of budgets is likely due to the timing of the fiscal year. In most cases fiscal year t runs from Oct 1 of calendar year $t-1$ to Sept 30 of calendar year t. Since most designation changes happen in the Fall, the contemporaneous budget may not yet include new appropriations for these parks.

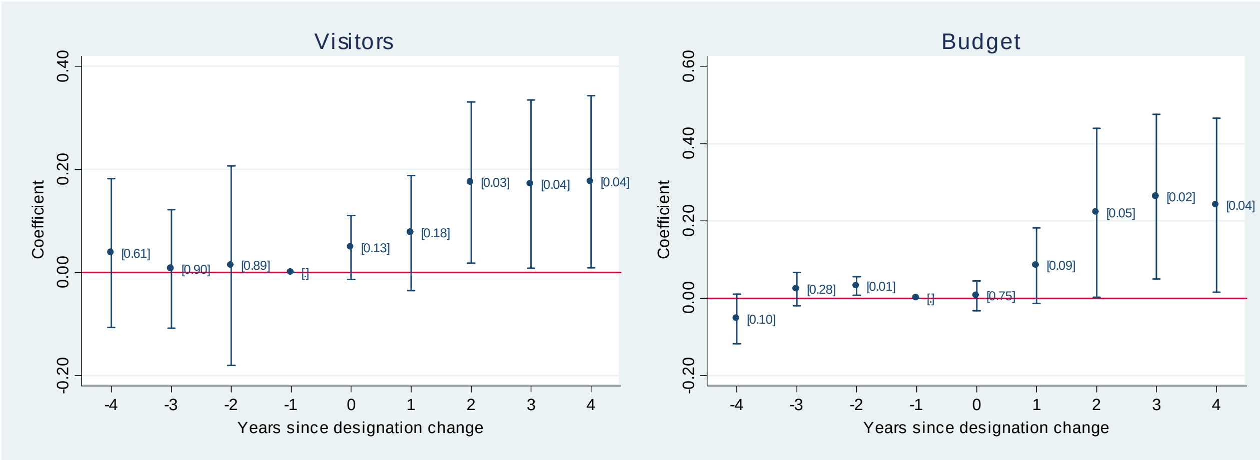

Figure 7: The impact of NP designation on visitors and park budgets

Event study coefficient estimates for the impact of NP designation on the log number of visitors and log park budgets. Estimates are relative to the year before the designation change. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. N = 8880 (visitors), 8568 (budget).

income effects we found above, suggesting that the economic impact of new parks also cannot be accounted for by direct government spending on these parks.

These findings point to more visitors and their multiplier effects on the local economy as the main mechanism behind increased employment and income. We explore this and other possible mechanisms further in Section 6.

4.3 Longer run effects

To obtain some evidence on longer-run effects, we now extend our specifications to include lags up to 15 years. As usual, long-run estimates should be interpreted with caution as many things unrelated to parks can change in the local economy over time.

Figure 8 looks at park visitors and budgets following NP designation and finds that the increases identified above remain in the longer run as well. By year 10, visitors increase by around 30% and budgets by close to 40% compared to their pre-redesignation levels. The visitor results in particular indicate that the impact of NP designation on tourism is more than just a temporary "novelty" effect.

Figure 9 shows the results for our main economic variables, employment and income. Each figure shows both the unweighted estimates and the estimates weighting each park by the number of counties to provide a specification check (Solon et al., 2015). As can be seen, both estimates indicate sustained positive, statistically significant effects on employment and income for about 10 years after NP designation.

Starting around year 5 the weighted and unweighted estimates begin to diverge. While the weighted results indicate gains above 5% for employment and above 10% for income throughout this period, the unweighted results show a declining pattern, particularly for employment. Although the 95% confidence intervals cannot rule out that the effects are constant, the point estimates in the unweighted regressions decline to close to 0.[39] Based on both the large standard errors and the difference between the weighted and unweighted results, our conservative interpretation is that compared to its robust effects in the short run, the long-run impact of NP designation, particularly after a decade, is more uncertain. This also justifies our focus on a narrower event window in most of the paper.

Figure 10 shows the corresponding estimates for the impact of new parks on employment and income.[40] Here too the standard errors of the estimates grow over time, but the weighted and unweighted estimates now remain close to each other. Both sets of estimates show a positive long-run effect for income, which after year 6 remains consistently above 5% and is statistically significant throughout. The estimates for employment are also fairly stable, showing about a 2% increase throughout, but these lose significance in the last few years of the event window. The opening of new parks appears to have a sustained positive impact on the local economy, particularly in terms of income.

5 Robustness

In this section we describe the robustness checks that we performed on the findings above. We focus on the NP designation results in the main text and present the park opening results in Appendix 2.2.

[39]The variance of the estimates is not due to compositional changes in the event study. Only one park (PINN) does not have all 15 lags in the sample period; excluding it leads to similar results.

[40]Because the sample composition depends on the event window, these estimates are identified from a smaller set of parks than the short run results presented above. Regressions with the [-5,+15] event window include 39 newly opened parks (these are the parks with a full set of lags and leads in the sample period). Comparing the short run coefficients on Figure 10 to the estimates presented earlier provides a robustness check on the earlier results.

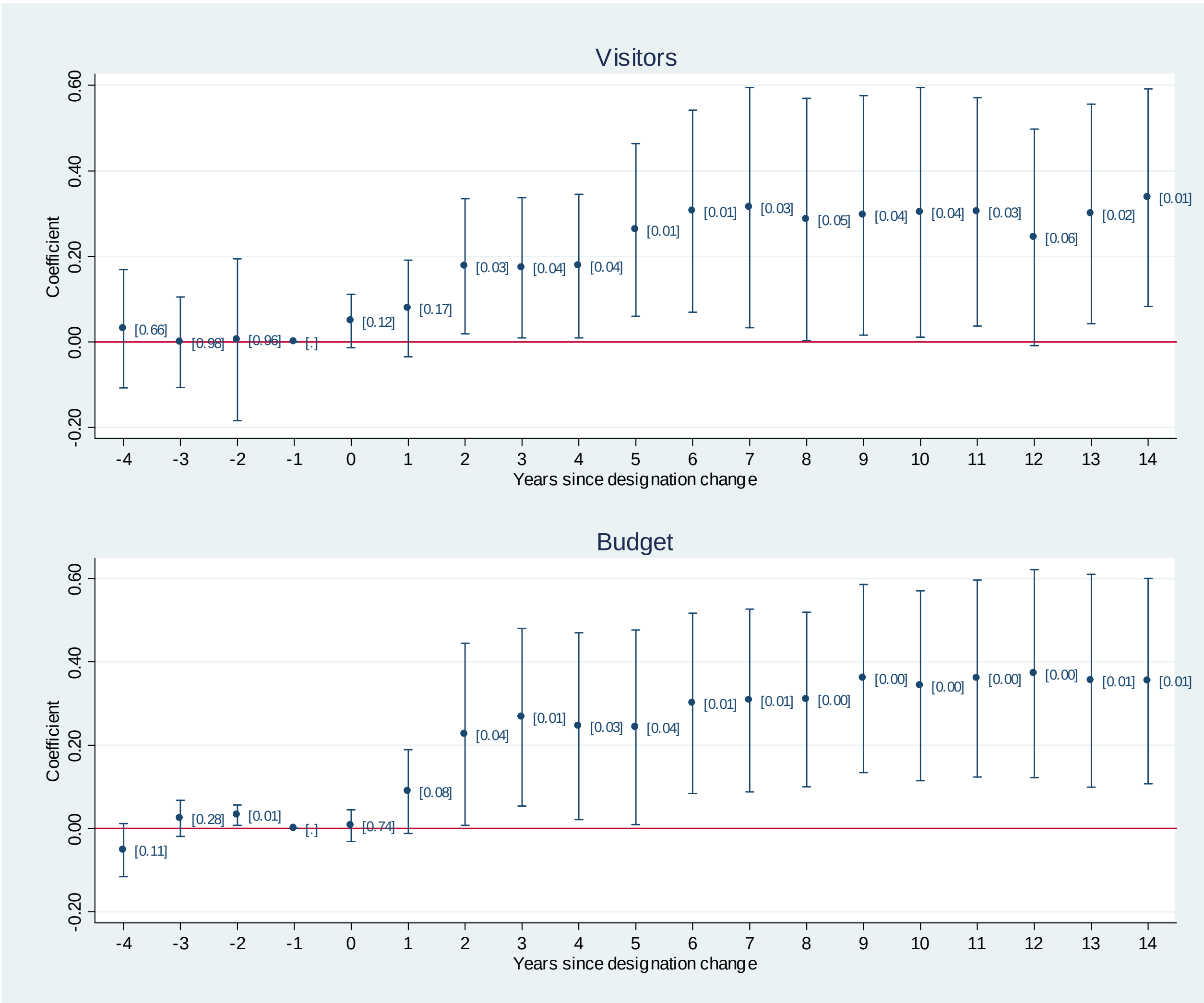

Figure 8: The impact of NP designation on visitors and park budgets in the long run
Event study coefficient estimates for the impact of NP designation on log visitors and budgets. Estimates are relative to the year before the designation change. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. N = 8880 (visitors), 8568 (budget).

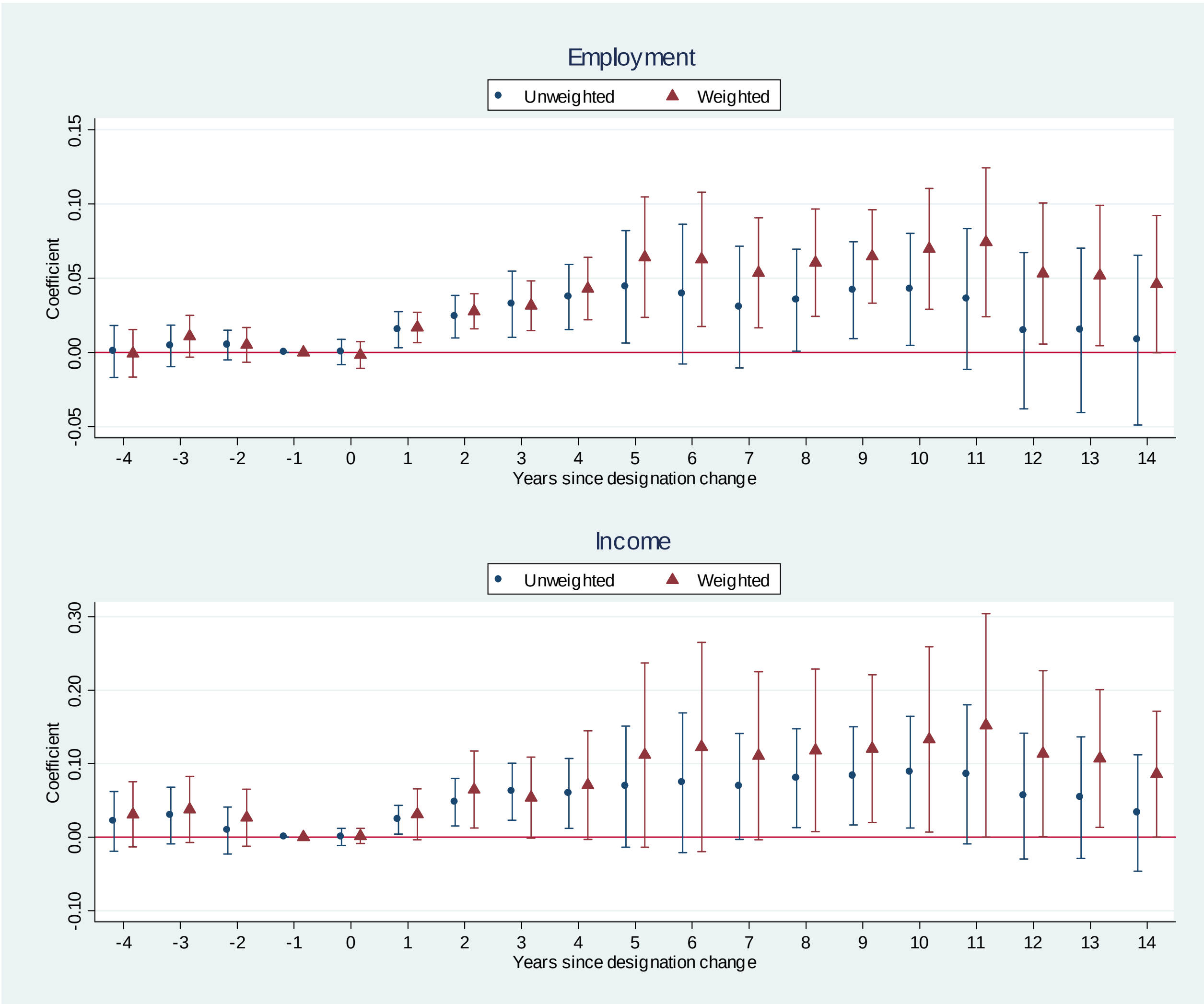

Figure 9: The impact of NP designation on employment and income in the long run

Event study estimates for the impact of NP designation on log employment and income. Each panel shows estimates from two regressions. One is unweighted, the other weights observations by the number of counties aggregated to create the dependent variable. Estimates are relative to the year before the designation change. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. N = 9024.

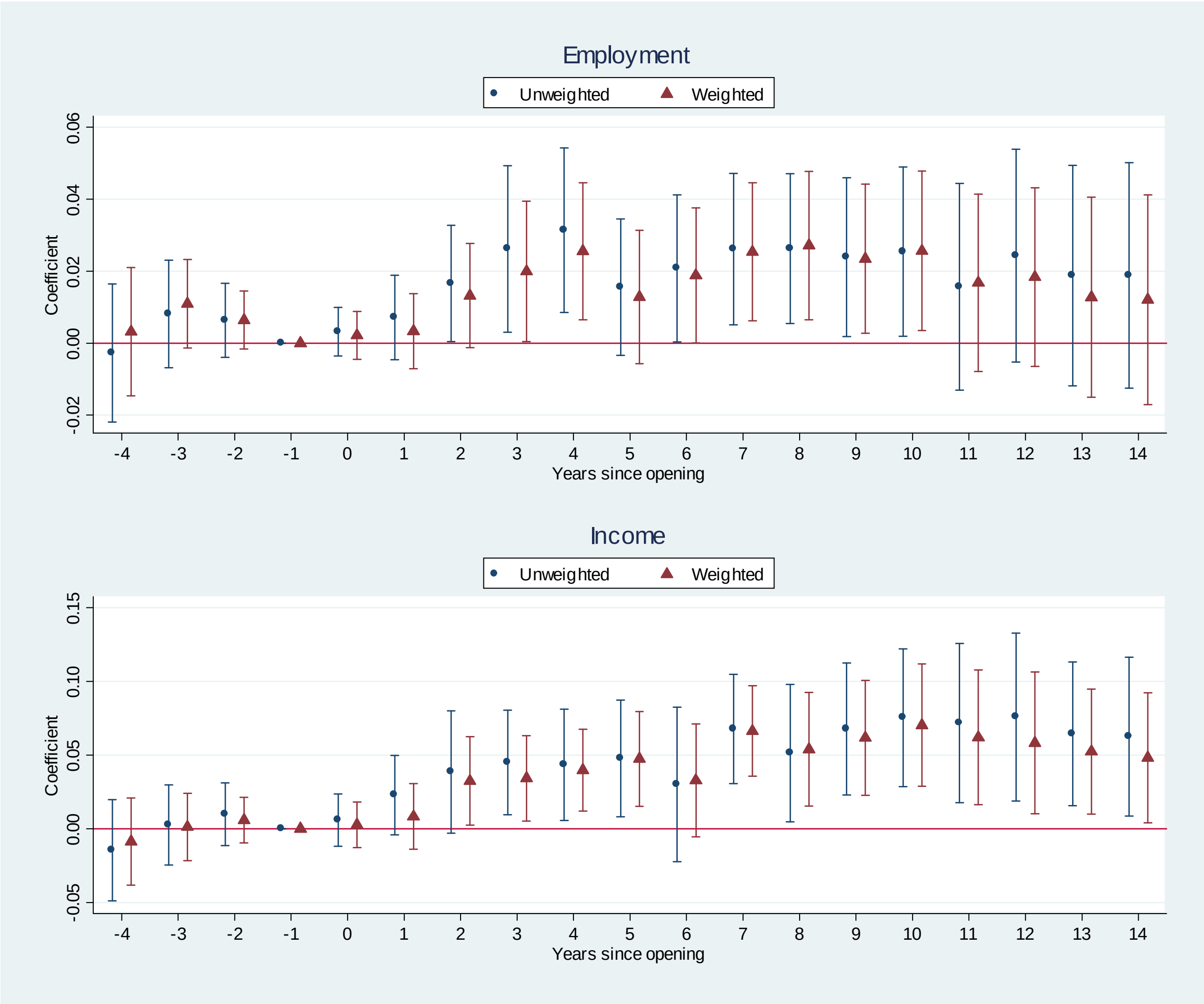

Figure 10: The impact of park opening on employment and income in the long run

Event study estimates for the impact of park opening on log employment and income. Each panel shows estimates from two regressions. One is unweighted, the other weights observations by the number of counties aggregated to create the dependent variable. Estimates are relative to the year before the designation change. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. N = 127,776 (employment) 127,762 (income).

Sample composition. In the NP designation regressions, two parks which acquired NP status in 1971 are not observed before year -1 relative to the designation. We checked whether this lack of balance in the sample affected our estimates in two ways. First, at the cost of dropping some of the control variables, we can extend the data by one year, to 1969. This allows us to estimate an event window beginning in year -2 on a balanced sample. The results, are very similar to those obtained earlier.[41] Second, we simply exclude these two parks from the estimation. Here too the estimates are statistically significant and qualitatively similar to those in our main specification. Compared to the previous exercise, some of the point estimates are now lower in magnitude, which suggests that the economic impact of NP designation was larger than average for the two excluded parks.

Different comparison groups. The treatment effects above are identified by comparing changes relative to comparison groups that include all parks that do not receive NP designation in a given year. (Note that because the year of treatment varies by park, the comparison group varies as well: for an NP designation event in year t, the comparison group includes both parks that receive NP designation in a year other than t, and parks that never receive NP designation.[42]) While the lack of clear pre-trends suggests that these comparison groups offer a reasonable counterfactual for the treated parks, we now explore limiting them to parks that may offer even better comparisons.

First, we restricted the sample to "nature" parks. As described in Section 2, some parks in the NPS are primarily historical (e.g., National Historic Parks), and these parks do not typically acquire national park status.[43] All parks acquiring NP designation in our sample period are nature parks - thus, restricting attention to nature parks might make the treatment and comparison groups more similar. We also pursued the same objective in a different way, by restricting the sample to parks that were national monuments in 1969. The rationale for this is that all but 1 of the parks that acquired NP designation in our sample period were initially designated national monuments. This restriction leads to our smallest sample, dropping over 60% of observations. In both of these specifications we found very similar results to those presented earlier.

As an additional robustness check, we omitted from the regressions parks with a Parkway designation. These NPS units extend over 20 counties and may have a substantial amount of non-recreational traffic. Finally, we repeated the regression without the 26 combined parks

[41] Unless noted otherwise, all detailed estimates for this section are in Table A.13 (employment) and Table A.14 (income) in the Appendix.

[42] See Goodman-Bacon (2021) and Sun and Abraham (2021) for illuminating discussions of the role of different observations in the identification of time-varying treatment effects.

[43] An exception is Mesa Verde NP (est. 1906), which preserves Ancestral Puebloan cliff dwellings and cultural artifacts.

described in Section 2. These again yielded similar estimates to our original findings for both employment and income.

Controlling for state-level changes. The key identifying assumption behind the above results is the lack of policies adopted simultaneously with NP designation that may impact economic development in the affected counties. One possible concern could be state-level policies, or federal spending targeting specific states. For example, legislation establishing a NP in a given state could be bundled with a federal aid package to that state, and this aid package could confound our estimates above. To control for this possibility, we used state-time fixed effects. This allows controlling for any state-level changes that may occur in a given year in a fully flexible way.

The resulting estimates for employment and income show a similar picture as before. In both cases the increase following the designation change is still there once any state-level changes are accounted for. Based on this, for any confounding policy to call into question the causal interpretation of our estimates, it would have to be the case that (i) the policy is implemented in the same year as the designation change, and (ii) it affects the counties that contain the redesignated park differentially *within the state* in that year.

Local government spending. To check for any confounding spending programs at the local level, we used data from the Census of Governments and estimated our main specification using total spending of all local governments within the county as a dependent variable. This data is published every five years, resulting in 9 data points per state during our period of study. Because of this, the identification of individual lags and leads would rely on very different numbers of observations. Our solution is to combine the event indicators into groups: we estimate a single parameter for years relative to the event $\tau \in [-10, -6]$, one for $\tau \in [0, 4]$, and one for $\tau \in [5, 9]$, with years $\tau \in [-5, -1]$ serving as the excluded category. We find no evidence of large changes in government spending programs simultaneously with NP designation (Figure A.15).

Park openings as potential confounders. Focusing on parks that already existed at the start of our sample period allows us to ignore confounds that may impact the establishment (as opposed to the redesignation) of parks. There is a remaining concern, however, because parks opening during our sample period could impact some of the counties which also contain parks that we do include in the analysis. For example, Death Valley NP (established in 1933, designated NP in 1994) overlaps 4 counties. One of these counties experiences a new park opening in 1992: Manzanar NHS. Although Manzanar is not included in our sample, its opening could impact the outcomes we measure for Death Valley. This would be of particular concern if the new park opening happened in the same year as the NP designation of the existing park, but this is never the case in the data. As an additional robustness check, we repeat the analysis dropping all parks that share a county with a park established after the start of our sample period. We find that our findings above for employment and income are even stronger in this sample. This may be an indication that some park openings *in the comparison group* happening around the time of NP designations (in the treatment group) lead us to underestimate the impact of NP designation in the main analysis.

As an additional robustness check, we also estimated a specification that used both the NP designation event and the park opening event in the same event study. The estimates for both treatments are similar to those shown individually on Figures 5 and 6 (Figure A.16).

World Heritage Sites as potential confounders. The UNESCO World Heritage Site program began during our period of study, in 1975, and one might therefore wonder about its potential confounding effect on NP designations. Under this program, countries nominate areas with historical and/or natural significance, and each year an international committee decides on which areas receive the designation. Among the parks in our main sample, 13 eventually received the World Heritage Site (WHS) designation. The first of these was designated in 1978 and the last one in 2017. Eleven of the designated areas were national parks (one a national historic park and one a national monument) - however, all of these 11 national parks received their NP designation before 1938 so these changes are not used to identify the effect of NP designation in our regressions above.[44] Not surprisingly, controlling the WHS designation event (and its lags and leads) results in virtually identical estimates for NP designation as those reported above.[45]

Changing the sample by one park at a time. Because the variation used to identify the impact of NP designation comes from a relatively small number of designation changes, we checked that our main results were not driven by any one park. On Figure A.17 we show results for employment and income, dropping each park that contributes to the identification of the effect of NP designation, one at a time. Changing the sample in this way does not affect our findings, indicating that our results are robust to potential confounding events that may affect any individual park in the same year as their designation change.

Recall that we have excluded Theodore Roosevelt NP (North Dakota) from the estimation. We find that including this park would double the magnitude of our estimates. It turns out that in the same year that this park acquired NP designation (1978), a series of oil discoveries occurred in the two counties where the park is located.[46] Between 1977 and

[44] Theodore Roosevelt NP, which is excluded from our estimation, received its NP and WHS designation in the same year, in 1978.

[45] We return to the implications of these regressions for the effects of WHS designation itself in Section 6.1.

[46] Roosevelt NP is comprised of two units, a North unit located in McKenzie county and a South unit in Billings county. Exploratory drilling had been taking place between the two units along a formation known as Billings Nose. In 1978, three fields along this formation struck oil for the first time: Bull Moose, close to

1978, mining employment in these two counties almost doubled, and continued to increase steeply over the next five years. This shock likely leads us to *overestimate* the impact of NP designation when this park is included in the sample.

Treatment effect heterogeneity. By estimating an event study, we are explicitly allowing for heterogeneity of the treatment effects across time periods (i.e., we are not assuming that a unit treated 3 periods ago has its outcomes on a path that is parallel to those of a unit treated 4 periods ago). As with most policies in other contexts, the treatment effect is also likely to be heterogenous across units. The impact of designation changes is likely to be heterogenous both because the affected units are heterogenous (counties are different from each other) and because the policy itself is heterogenous (parks are different entities). While conceptually this does not preclude the estimation of meaningful average treatment effects (ATEs), a recent literature shows that in the presence of heterogeneity across units, whether the estimates are meaningful must not be taken for granted (Borusyak and Jaravel (2017), Goodman-Bacon (2018), Sun and Abraham (2021), de Chaisemartin and D'Haultfoeuille (2020)). In short, these papers show that, when units (or cohorts of units) are treated at different points in time, difference-in-differences estimates of ATEs, which are weighted averages of the treatment effects across cohorts and time periods, may not be meaningful. For example, weights can be negative, resulting in an overall ATE that has the opposite sign of the individual treatment effects.

In the specific context of event studies, Sun and Abraham (2021) show that problematic ATE estimates can arise when some cohort's treatment effect in period j' relative to treatment has a large weight in the estimate of the period-j ATE (β_j in Eqn (1)). For example, the problem could arise if some park-observations 3 periods after NP designation had a large weight in the estimate for β_1, the ATE of NP designation 1 year after the designation change. Sun and Abraham (2021) propose a method to evaluate how serious this concern is by calculating the weights of different cohorts in each treatment effect β_j. Ideally, for each treatment effect β_j and each treatment cohort, the weights should only be nonzero for relative period j, and the excluded category (relative period -1 in our case). Remarkably, in each case this is exactly what we find (Figure A.18). Intuitively, treatment effect heterogeneity is likely to lead to estimation problems when many cohorts have overlapping event windows. In our case, because (i) we have a large number of parks in the comparison groups, and (ii) designation changes are spread out over time, overlapping event windows arise infrequently in the data. Our estimates can be interpreted as meaningful averages of potentially heterogenous treatment effects.

the North unit, and TR Billings and Four Eyes, close to the South unit (Gerhard and Anderson, 1979).

6 Further evidence on mechanisms

6.1 Visitors, development, and other designations

There is a long history of various designations in the NPS (see Section 2.1). Parks can also have non-NPS designations such as World Heritage Site (see the discussion in Section 5). It is instructive to compare the impact of NP designation to others.

Our sample contains 28 different designations. Some of these are shared by very few parks, and the hierarchy between the designations is not always clear. For example, there are at least 5 different designations to describe sites with military significance without a clear definition of each of these.[47] There are 37 designation changes for parks already in existence at the start of the sample period. After NP, the second most common designation change is to National Historic Park (NHP), with 11 such changes in our sample. As the name suggests, these parks are primarily of historical interest, and the NPS considers NHP the most prestigious designation in this category. NHPs are often created through an upgrade from an existing designation, such as a national historic site or a national monument.[48]

We estimated the event study specification in (1) for the NHP designation event (Appendix Figure A.22). We find that NHP designation yields an increase in park budgets of around 26%, but it causes at most a temporary increase in visitors (we see a statistically insignificant 14% increase that falls by a half 4 years after the designation change). Estimates for employment and income are flat both before and after the designation change.

We also estimated the impact of WHS designation (Appendix Figure A.23). These also show no effects on visitors, with point estimates close to zero. Here the budget estimates are also insignificant, and we again do not find any increase in employment or incomes.

Comparing the three designation changes (NP, NHP, and WHS), we find that it is only where visitation shows a clear, sustained increase that we also find increases in employment and incomes. This underscores the relevance of visitors as the channel behind increased economic activity. It also explains why areas that are protected but do not have extensive visitor infrastructure, such as the national monuments outside the NPS studied by Jakus and Akhundjanov (2019) and Walls et al. (2020), do not result in economic development at the scale we observe here.

[47] National Battlefield, National Battlefield Park, National Battlefield Site, National Military Park and Military Preserve.

[48] There are no instances of a park losing its NHP designation in the data.

6.2 Geographic spillovers

6.2.1 Spillovers to neighboring counties

Some of the positive employment and income effects of NP designation may simply reflect the relocation of economic activity from surrounding areas. In response to increased demand, businesses from neighboring counties may relocate, and workers from these counties may start commuting to work closer to the parks. If this was driving our results above, those may not indicate a net gain in employment and income, but simply a corresponding decline in other counties. Conversely, it is possible that neighboring counties also experience positive effects. Depending on the shape of the park and counties, neighbors could be well positioned to service the park units, or restrictions on certain activities could induce businesses to move further from the park, to neighboring counties.

To study possible spillover effects, we look at the *neighbor* counties of the treated parks in our regressions. We define neighbors simply as the counties neighboring the county or counties a park is located in. In the NP designation (park opening) regressions, the average treated park has 6.8 (8.8) neighbors, with a minimum of 2 (2) and a maximum of 15 (33). For each park, we take the average across its neighbors, and run our previous regressions using these variables.

The results for employment and income are on Figure 11. We do not find any evidence of a decline in employment and income in neighboring counties for either NP designation or park opening. In fact, we see the opposite: there are positive spillovers on employment and income in neighboring counties. For NP designation, the point estimates are approximately 1/2 of the results we found above (1-2% for employment and 2-3% for income) but most estimates are not statistically significant. For park opening, the estimates are similar in size to the main results and are statistically significant throughout. There is no evidence that our main results are driven simply by the relocation of businesses and employees from neighboring counties to the counties that contain the treated parks. If anything, we see positive economic impacts that extend beyond the counties that parks are located in.

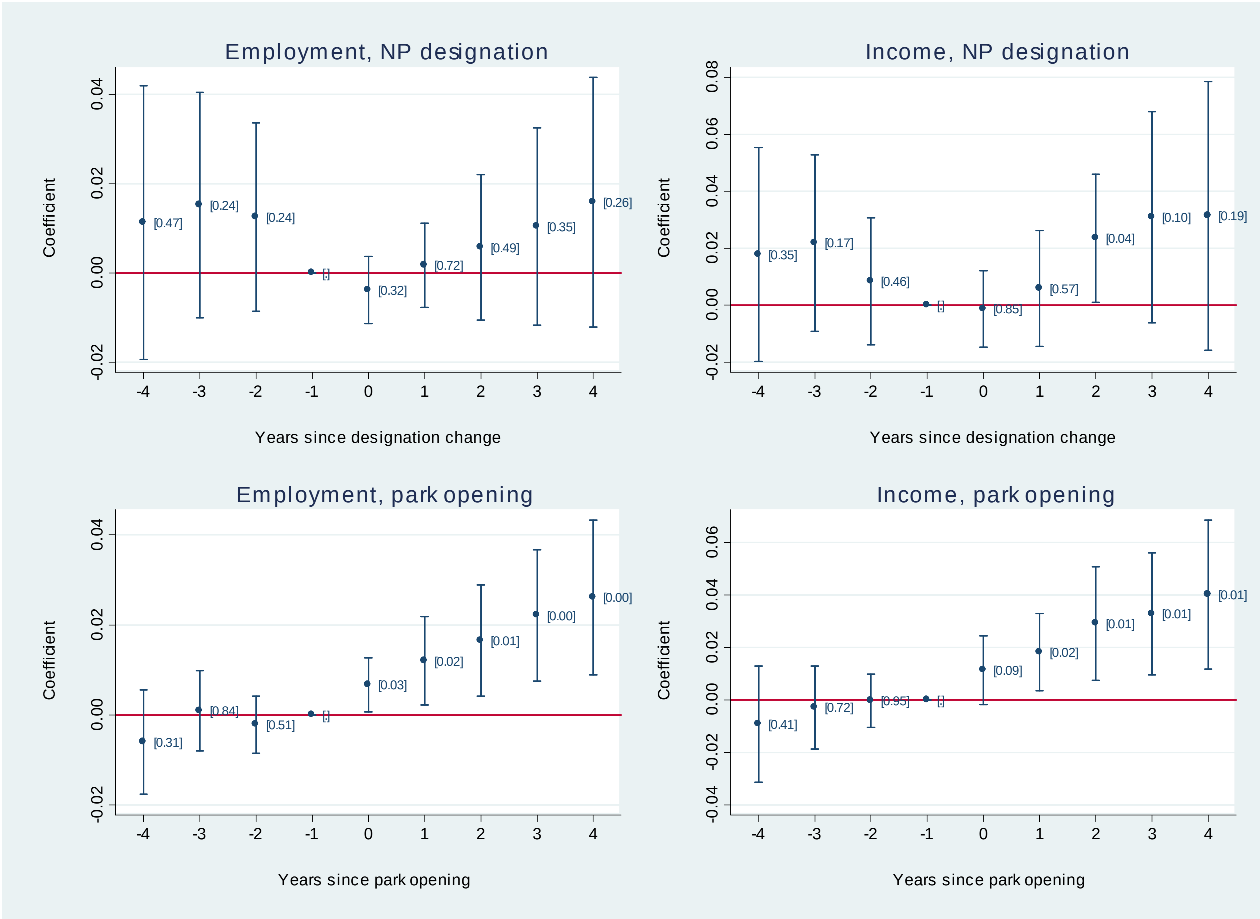

Figure 11: The impact of parks on neighboring counties

Event study coefficient estimates for the impact of NP designation or park opening on log employment and income of neighboring counties. Estimates are relative to the year before the designation change. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. N = 9024, 9024, 129744, 129730.

6.2.2 Spillovers to other parks

A related question is whether some of our results reflect the relocation of tourism from nearby parks, and a corresponding relocation of, rather than a net increase in, economic activity. To address this, for each park in the NP designation regressions we check if there are any treated parks within 100 miles. We create a new set of event study indicators based on this, and include both the NP designation event and the "NP designation in a nearby park" event in the regressions. We find no reduction in visitors when a nearby park receives NP designation (Appendix Figure A.24). The effect of NP designation on visitors is not simply due to substitution away from nearby parks.

Overall, our results do not seem to reflect substitution from nearby counties or nearby parks. Of course, it is not possible to measure every conceivable place and activity that tourists and economic actors may substitute away from. For example, we do not know where tourists who visit national parks would have spent their money otherwise. Along with parks' local effects, these general equilibrium considerations are likely to be important in a full welfare evaluation of the park system.

6.3 Specific industries

The positive effect of the NPS on total employment and income can mask substantial heterogeneity by industry. Which local industries drive the increase in employment and income? Are there industries that experience a decline? We look at three industries that may win and three industries that may lose from NP designation or park openings.[49]

6.3.1 Industries that may win

Because of increased tourism, the winners might include the hotel and retail industries, whose products and services may now be in higher demand. In addition, since establishments and infrastructure may need to be built or upgraded, we may also see more demand for the construction industry.

The top panel of Figure 12 looks at income in the hotel sector separately for the NP designation and park opening events. Though the estimates are noisy, neither graph shows a clear positive impact, especially in the first 3 years following the event. This lack of short-run effects could mean that the extra tourism initially comes from day visitors (e.g., from the local area or nearby cities) who do not use hotels. It could also reflect investment activities: for example, if proprietors undertake renovation projects or build extra capacity, these increased costs would reduce measured income. To check this, we looked at longer run estimates for hotels. These are consistently positive, though also imprecise (Figure A.25).

The next two panels show results for the retail and construction sectors. For park openings, we see a clear impact on retail income, which rises by 2-4% beginning one year after a park's opening. NP designation has a sizeable positive impact of construction income, showing a 15-20% increase following the designation change.[50] In both cases the increase is

[49]To address concerns of multiple testing, the reader can use the p-values we report to adjust inference for any desired subset of hypotheses. In Appendix Table A.26 we present one possible adjustment that controls for the false discovery rate by treatment, industry group, and year relative to the event.

[50]For construction, employment data is also available, and this yields similar results to construction income (Figure A.27).

sustained for at least the next 4 years. These findings provide evidence of positive economic spillovers to sectors outside of tourism. For example, the construction results are consistent with an interpretation where increased expected tourism from the designation change creates investment in new or updated buildings and infrastructure, and this contributes to the rise in local employment and income we found in Section 4.[51]

6.3.2 Industries that may lose

Three industries are typically highlighted as potential losers of US conservation programs: mining, forestry, and farming (e.g., Walls et al., 2020). While it is intuitive that restrictions on drilling, logging, and grazing are costly for these industries, in principle there is also scope for some positive effects if firms benefit from improved infrastructure (e.g., roads) around the parks, or if they experience an increase in demand (e.g., local farms may see higher demand as a result of tourism; forestry companies may be hired to provide services to the Park Service).[52]

We first look at the effect of parks on the mining industry. As discussed in Section 2.1, although no *new* mining operations are allowed in national parks, NP designation does not prohibit existing mining operations. Consistent with this, the first panel of Figure 13 shows no evidence of a decline in the number of mines following NP designation.[53]

On the next panel, we find a *positive* effect of NP designation on mining employment. A possible explanation for this is suggested by anecdotal evidence on the "slippery slope" mentioned above. Fearing future restrictions, mining companies may ramp up their activities either to extract as much revenue as possible before restrictions are implemented, or to improve their bargaining position relative to the government for when such restrictions might be considered. For example, Rothman and Miller (2013) describe how, in the case of Death Valley National Monument, "[m]ining companies responded to the prospect of legislation by aggressively trying to expand development, identifying and exposing additional mineral fields, and by increasing the transfer of stockpiles to areas outside of monument boundaries." This kind of response would explain an increase of *both* employment and income.[54]

[51] To check that construction primarily reflects commercial rather than residential buildings, we looked at the number of residential construction permits issued, and found no effect. We also did not find any effect on a house price index (Table A.28).

[52] Furthermore, conservation may not lead to immediate restrictions, creating opportunities for various adjustments in these industries over time. Indeed, according to anecdotal evidence opposition to the parks is often based on fears of a "slippery slope" leading to more *future* restrictions. See, for example, "Wilderness Proposal Criticized at Medora," *The Bismarck Tribune (Bismarck, ND)*, Sep. 16, 1978, p1.

[53] Every treated park has some mining activity (positive number of mines, mining employment and income).

[54] Estimates for income are on Figure A.29. We also look at employment at the mine level. There is no evidence that employment in the average mine decreased - if anything, we see the opposite. An increase in mine-level employment would be consistent with increased mining activity in response to NP designation.

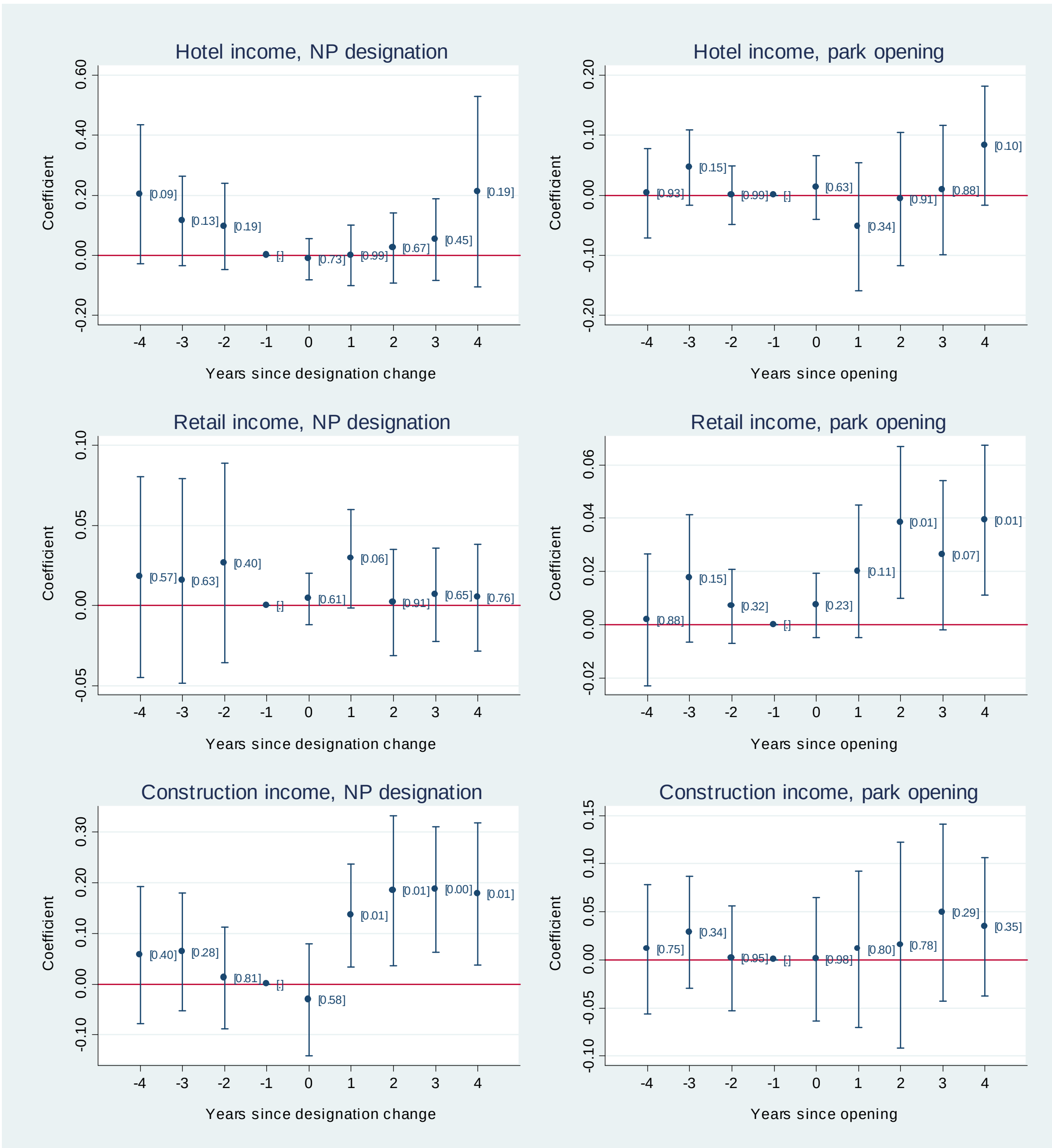

Figure 12: The impact of parks on the hotel, retail, and construction sectors

Event study coefficient estimates for the impact of NP designation or park opening. Estimates are relative to the year before the designation change. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. N = 8287, 86465, 8846, 119843, 8812, 122816.

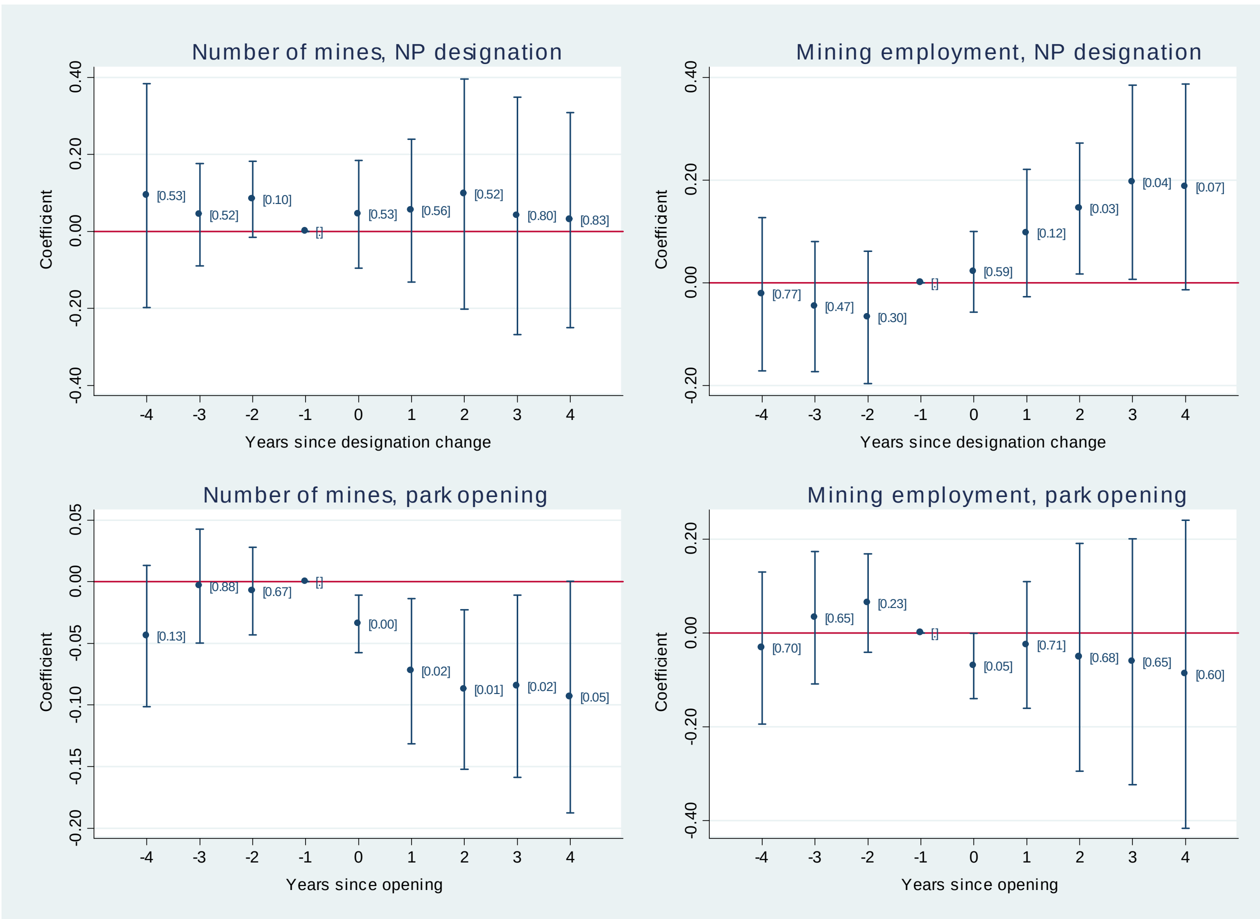

Figure 13: The impact of parks on the mining sector

Event study coefficient estimates for the impact of NP designation or park opening. Estimates are relative to the year before the designation change. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. Data on the number of mines begins in 1983. N = 6545, 7567, 87885, 92116.

Another potential explanation for increased mining activity could be that some mining companies gain cheap labor or market share as other companies are being driven out of business. However, this would suggest that the number of mines should decrease while total mining employment should decrease or stay the same. There is no evidence for either of these patterns in the data. Yet another possibility is if the increased conservation efforts resulting in NP designation were a response to increased mining activity. However, given the fact that designation change is a multiyear process, if NP designation was the effect rather than the cause, we would expect to see a clear pre-trend, with mining activity starting to increase several years before the designation change and continuing on the same path after the change. This is not what the estimates on Figure 13 indicate.[55]

The bottom panels of Figure 13 show that park openings lead to mine closures: the number of mines suffers a permanent decline of just under 10%. Compared to NP designation, the opening of new parks appears more disruptive for the mining industry. Interestingly, employment at the industry level does not show a clear decline corresponding to the reduction in mines. In fact, we find that employment in the average mine rises (Figure A.29 in the Appendix). This is consistent with a story where the remaining mines soak up many of the workers displaced from the mines that shut down. This within-industry heterogeneity can explain the flat employment estimates at the industry level.

Figure 14 looks at farming income. There is no evidence of clear negative effects - if anything, income shows an increase following NP designation (though most coefficients are not statistically significant). An increase in farm income would be consistent with more tourists creating higher demand for farm products. Some increase might also come from farms selling inventory, e.g., cattle farms reducing their stock as grazing on public land becomes more difficult. Results using the USDA Census of Agriculture do not rule out these explanations: although imprecise, the point estimates show an increase in the sale of farm products along with a reduction in cattle inventories, cattle farms, and the total number of farms (Appendix Figure A.30).[56]

Finally, we investigate the forestry sector. We find no effect of either NP designation or park opening on forestry income (Figure A.31). The former could be because logging was already restricted by the Park Service before a park acquired NP designation. Alternatively,

[55]The increase in mining also cannot be explained by the booms and busts of coal mining in the 1970s and 80s documented in Black et al. (2005). Using the mine-level data, we checked which counties had any coal mining (as of 1983, the earliest year available). Only 3 of the treated parks did, and 2 of those acquired NP designation after 1999. The documented cycles in coal mining are therefore not correlated with NP designations.

[56]Estimates for farming employment are on Figure A.31, and Figure A.32 estimates further lagged effects for both employment and income. None of these show evidence of large declines for the farming industry as a whole.

heterogenous impacts within industry are a possibility, as demand for forestry management services might increase while logging declines. As discussed in Appendix 6, results on our third treatment, the impact of park expansions, are consistent with such an interpretation.

Overall, we do not find any clear negative effects from either NP designation or park openings on industry level outcomes for the three sectors that are most likely to lose from increased conservation. At the same time, there is evidence of within-industry heterogeneity and adjustments that is likely to reflect negative effects on some parts of these sectors.

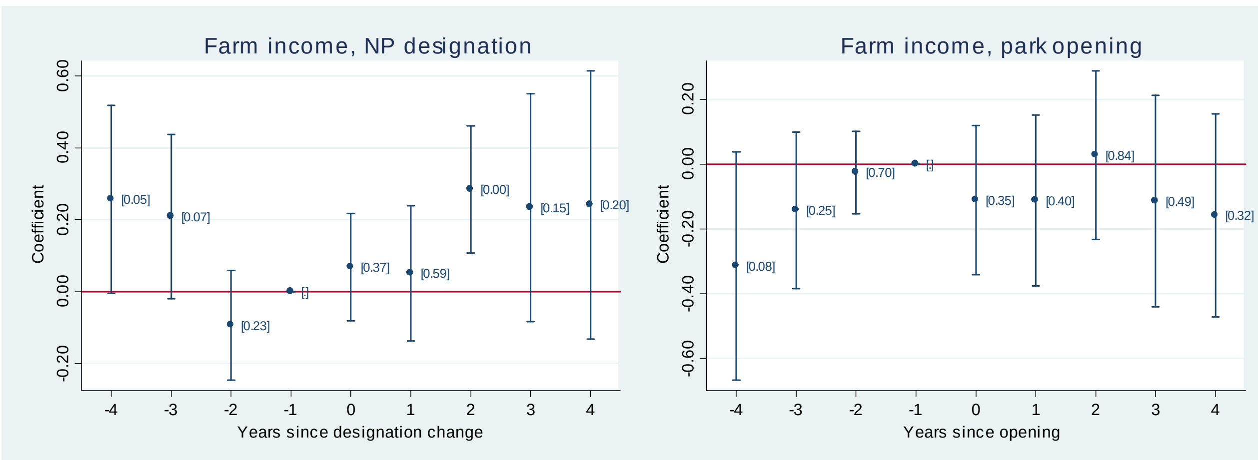

Figure 14: The impact of parks on farm income

Event study coefficient estimates for the impact of NP designation or park opening on log farming income. Estimates are relative to the year before the designation change. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. N = 8297, 116990.

7 Potential negative externalities

The above analysis has focused on some of the economic impacts of the NPS. Clearly, conservation efforts such as this will have a variety of additional impacts, both on society and on the natural environment. Over the years observers have expressed concerns regarding externalities such as increased traffic and pollution. These are potentially important effects but we are not aware of any empirical estimates. We use the available data to look at three types of negative externalities: traffic accidents and pollution due to motor vehicle traffic, and the increased extraction of relatively less protected resources. Because the time series of these variables begin later, in the main text we focus on park openings to leverage more variation. We present corresponding estimates for NP designation in the Appendix.

7.1 Motor vehicle traffic

In this section we use the available data to look at the relationship between parks and two measures related to traffic: motor vehicle fatalities and air pollution. A priori, this relationship is ambiguous. More tourism means more vehicle traffic, which could increase accidents and pollution. This has been one of the concerns of critics of the NPS mission of increasing public access to natural areas since at least the 1950s. On the other hand, increased tourist traffic could be accompanied by reduced commuter or commercial traffic (e.g., if the park will restrict such traffic on some existing roads). Furthermore, any effects may be attenuated by avoidance behavior - for example, tourist traffic in parks may decrease when pollution is higher (Keiser et al., 2018).

Traffic fatalities. We use data on the log number of motor vehicle accidents involving a fatality, as well as the log number of fatalities. Event study estimates of the impact of park opening are on Figure 15. Estimates following a park opening are mostly positive and some are statistically significant. Accidents and fatalities appear to increase by approximately 10% 3-4 years after the opening of a new park. Given that fatalities are a rare event but the value of a statistical life is large, even relatively imprecise estimates may indicate substantial costs. For the median park about to open, the 90% confidence interval in year 3 is $[0.34, 6.01]$ extra fatalities. We also checked if the effects differ based on parks' proximity to urban areas (Figure A.42). The estimates suggest that parks more than 50 miles from a metropolitan area with a population of at least 1 million create more accidents, while for parks close to urban areas accidents actually show a short-run decline before returning to their pre-treatment levels. The latter may reflect a reduction in commuter traffic in these areas.

Corresponding estimates for the impact of NP designation on accidents yield imprecise results (Figure A.43).

Air pollution. To measure air pollution, we look at county level nitrogen dioxide (NO_2) and ozone concentration. Of the various compounds linked to pollution from vehicles, these are the most consistently available during our period of study.[57] NO_2 is considered a primary pollutant, while ozone is a secondary pollutant created when the emitted NO_2 is exposed to sunlight (see NPS (1999) for a discussion of the importance of these and other pollutants for the National Park System). The EPA publishes data on NO_2 and ozone for the period 1980-2017.

The estimates for park openings are always small and statistically insignificant (Figure

[57] We also considered using two additional compounds, carbon monoxide and suspended particles. Unfortunately, there are very few observations for carbon monoxide, and for suspended particles, what is being measured varies over time as air quality standards change. Note that there are also other ways parks could impact air quality, such as through increased forest cover and the resulting sequestration of greenhouse gases.

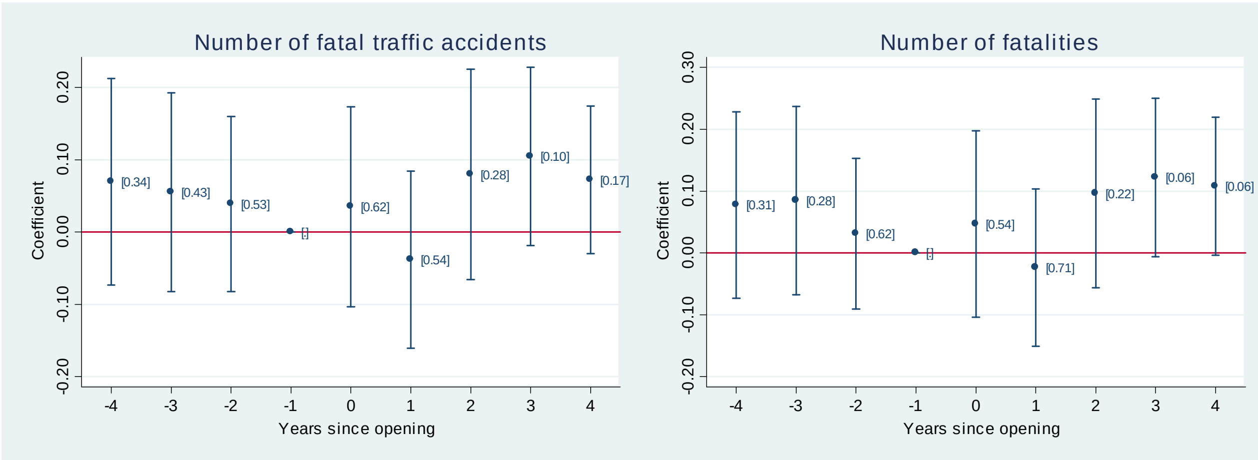

Figure 15: The impact of park opening on traffic fatalities

Event study estimates of park opening on log number of fatal accidents and log number of traffic fatalities. Estimates are relative to the year before opening. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. Years 1975-2017. N = 116,229.

A.44 in the Appendix). For NO_2, the point estimates are often negative, and the upper end of the 95% confidence interval is 6 parts per billion (ppb). By comparison, the mean and median concentration in our sample are both 25 ppb, and the EPA air quality standard is 53 ppb. The conclusions regarding ozone are similar: the point estimates vary in sign and the upper end of the 95% confidence interval is 3ppb. The latter is small both relative to the sample mean or median (both 52 ppb), and relative to the EPA standard (70 ppb). Our findings from the available data suggest no adverse air quality effects from park openings.

Estimates for NP designation are consistently negative (an improvement in air quality) (Figure A.45 in the Appendix). These sometimes reach statistical significance, but concentration levels for both NO_2 and ozone are trending downwards prior to the treatment, so it is unclear if the designation change contributes to the improvement in air quality. We again do not find any large negative effects on air quality in this data.

7.2 Increased extraction of relatively less protected resources

Simple economic logic dictates that mandating the conservation of one resource will create incentives for the increased extraction of resources that are substitutes and, on the margin, relatively less protected.[58] In this section we ask whether this might be the case in response

[58] See Pfaff and Robalino (2017) for a review of the literature on the various spillover effects of conservation programs.

to an area's inclusion in the NPS. Specifically, we ask whether the opening of a park led to increased timber harvesting in adjacent US national forests.

National forests are federal lands managed by the US Forest Service. Unlike the National Park Service, which is part of the Department of the Interior, the Forest Service is part of the Department of Agriculture, and the two systems operate independently. Whereas the Park Service's mandate is focused on conservation, the Forest Service's mandate emphasizes the "management" of natural resources. When a park is included in the NPS, reducing the availability of timber in the area, timber extraction in national forests could increase in response.[59]

To study whether this is the case, we obtain the annual volume of timber cut from each unit ("forest" from now on) managed by the Forest Service. This data is available starting in 1977, and there are 123 forests from which timber is cut at any point. We restrict attention to parks that are adjacent to one or more forests, where we call two areas "adjacent" if they share a county. In our sample, 96 parks in the NPS are adjacent to a national forest, and 13 of these parks were included in the NPS after 1973. For each park, we calculate the total volume of timber cut annually in all adjacent forests (this is measured in 1000 board feet, and we take logs). We also include in the regressions 21 forests that are not adjacent to any park as part of the comparison group.[60]

Figure 16 shows event study estimates of including a park in the NPS on annual volume of timber cut in adjacent national forests. We find clear positive effects: the volume of timber cut jumps by 20% in the year of opening, and continues to increase for at least the next 5 years. Corresponding estimates for NP designation are also positive but not statistically significant (Figure A.46 in the Appendix).

This finding should not be used to draw strong conclusions regarding the impact of the NPS on conservation. Even putting aside the fact that conservation is difficult to define (Schuurman et al., 2020), the number of trees left standing is at most one component of conservation. Our result does however illustrate that the simple economic logic that limiting resource extraction in the NPS may lead to more resource extraction elsewhere could be a relevant consideration. Such substitution across resources may partially offset some of the impact of the NPS, and more generally may indicate a weakness of conservation policies that focus only on limited geographic areas and/or specific government agencies.

[59] Whether timber in national forests is a good substitute for parks in the NPS depends on a number of factors we have no data on (e.g., the type of trees in each area). This will make it more difficult to detect a substitution effect in our regressions below.

[60] The results are similar with or without these forests. Because we take logs, observations reporting 0 timber cut are excluded. We get almost identical results if we retain these observations by adding 1 before taking logs.

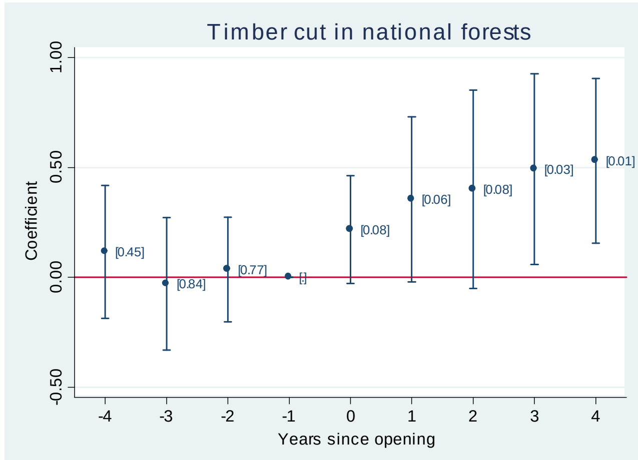

Figure 16: The impact of park opening on timber cut in adjacent national forests
Event study coefficient estimates of park opening. Timber volume is measured in log(1000 board feet). Estimates are relative to the year before opening. Standard errors are clustered at the park level. Bars indicate 95 percent confidence intervals, p-values are in brackets. Years 1977-2017. N = 4522.

8 Conclusion

This paper has presented a comprehensive analysis of the economic impacts of the US National Park System, the largest and best known national conservation entity in the world. We use a detailed dataset on the NPS and county-level information from several sources to investigate the impacts of parks through various channels.

We consistently find large positive effects on local employment and income. These are larger than what can be explained by direct government spending on park budgets, and indicate substantial multiplier effects on the local economy. Comparing different designation changes suggests that increased visitation is a necessary condition for increased employment and incomes.

Economic impacts also extend beyond tourist expenditures. There is clear evidence of positive spillovers to other sectors, such as increased employment and incomes in the construction industry. We find little evidence that the mining, forestry, or farming sectors *overall* experience large losses from NP designations or new park openings. At the same time, there is evidence of heterogenous effects within some of these sectors, such as some mines benefitting when others close following the opening of new parks.

We also investigate several possible negative externalities. Although pollution related to motor vehicles does not seem to rise, there is evidence of increased traffic fatalities following the opening of new parks. When an area becomes part of the NPS, timber extraction in nearby national forests increases, indicating a potential limitation of localized approaches to resource conservation.

Conservation policy in the US government has undergone several changes over the past decade, putting the spotlight on the economic effects of conservation. The National Park System has served as a model for conservation efforts around the world, and the tradeoffs between conservation and development are a particularly salient question in developing countries. Our results provide evidence that may help inform some of these policy discussions. Conservation can lead to economic development as long as the conditions are present for it to increase tourism and have multiplier effects on the local economy. At the same time, complementary policies may need to be put in place to avoid costly externalities - for example due to increased traffic or the extraction less protected resources.

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