Long Term Effects of Large Wildfires on Tourism Spending in Colorado

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Abstract

Over the past 30 years, wildfires in the western United States have become larger and more frequent, significantly impacting local economies. In Colorado, the most extreme fires, those in the top 10% by area burned, account for 86% of total burned acreage. This paper examines the economic consequences of these "mega-fires" on Colorado economies using county-level tourism spending data from 1996 to 2019. I use a staggered difference-in-differences approach, defining large wildfire events from 1996 to 2018 as treatment events. Estimates from this analysis indicate that mega-fires of 30,000 acres or more significantly reduce tourism expenditures and related county tax receipts, with negative effects persisting for several years after the fire. Results indicate that these reductions are primarily driven by reductions in spending on commercial lodging. The largest fires cause the most substantial economic disruptions, underscoring the need for policymakers to invest in wildfire mitigation strategies and long-term economic support for affected communities.

1 Introduction

Wildfires in the Western United States have become more frequent and more severe between the 1980s and the 2020s (Bayham et al., 2022). They have become a more salient part of life in western states and have resulted in humanitarian crises several times in the last decade. The 2018 Camp Fire in Northern California resulted in the destruction of over 18,000 structures, burned over 150,000 acres of land, caused over $15 billion in damages, displaced over 50,000 people, and resulted in 85 fatalities (California Air Resources Board, 2020). The 2023 Maui wildfires were similarly destructive, destroying over 2000 structures, killing over 100 people, and causing $5.5 billion dollars in damages (U.S. Fire Administration, 2024). In 2025, a series of wildfires across Southern California displaced over 200,000 people destroyed over 18,000 structures, and resulted in the deaths of 29 people (Los Angeles County Economic Development Corporation, 2025). These examples are reflective of a growing trend in wildfires across the West, as climate change and extreme drought conditions have resulted in larger, more severe wildfires than those seen in the past.

While the economic and social consequences of wildfires are wide ranging, they are uniquely problematic for local communities reliant on tourism and outdoor recreation. Wildfires typically occur on public land, and 'wildfire season' coincides with peak outdoor recreation season. The conflict between tourism and wildfire is acutely problematic for Western states like California, Colorado, Utah, Oregon, and Washington as the forest amenities that attract tourists to the region (e.g. scenic forest trails, remote cabins, campgrounds) are becoming increasingly likely to go up in flames. The goal of this paper is to isolate the effects of large wildfires on local tourism spending. Specifically, I address the research question: how do wildfires affect regional tourism-related economic activity, and what are the long-term economic consequences for local communities?

This research contributes to a growing literature on the economic impacts of wildfires by addressing two notable gaps. Botzen et al. (2019) identify a major shortcoming of most previous studies on natural hazards, which is their failure to account for regional economic impacts. Furthermore, Bayham et al. (2022) notes that there is sparse research on the impact of wildfire on recreational activities, and that most existing studies rely on survey data in relatively small selected locations. I address those gaps in two key ways. First, I estimate the average regional effects of large wildfires on tourism spending across Colorado from 1996 to 2019, rather than focusing on the impacts of individual fires in a specific region or location. Second, using data from the Colorado Office of Tourism on county-level tourism expenditure, this paper provides a more robust analysis than studies that rely solely on survey data from a single location impacted by a wildfire.

This research is pertinent to rural communities that are reliant on tourism spending to maintain a healthy economy, as peak wildfire season often coincides in the summer months with peak tourism season. I hypothesize that counties affected by large wildfires should experience decreases in tourism spending and in tax revenue due to the loss of tourist-attracting forest amenities and recreation opportunities. I use a staggered difference-in-difference approach to estimate the average treatment effects of a county being affected by different sized wildfires. Our findings indicate that the occurrence of a "mega-fire" of at least 30,000 acres has significant and persistent negative effects on tourism-generated tax revenue and overall visitor spending. I find that the negative impacts are most pronounced for counties affected by the largest fires.

2 Literature Review

Wildfires have long played a critical role in shaping ecosystems, with some plant species even evolving to depend on fire for regeneration (Pausas and Keeley, 2019). Unlike many natural disasters, not all wildfires are harmful; low-intensity fires can support ecological health and biodiversity. However, the growing scale and frequency of wildfires across the western U.S. have made their economic and social costs increasingly severe (Bayham et al., 2022).

These costs include direct damage to property, declines in nearby home values (Mueller et al., 2009), and significant health impacts linked to smoke exposure (Chen et al., 2024; Du et al., 2024). Suppression costs alone exceed \$3.5 billion annually (U.S. Congress Joint Economic Committee Democrats, 2023), with subsidies and insurance market inefficiencies often masking the full economic burden in high-risk areas (Baylis and Boomhower, 2019). In addition, wildfires can destabilize ecosystems, increasing risks of erosion, flooding, and long-term degradation of ecosystem services (Pereira et al., 2021; Bayham et al., 2022).

Our paper contributes to a growing body of literature specifically exploring the impacts of wildfires on tourism. Gellman et al. (2022) find that a wildfire occurring within 20 kilometers of a campground in the Western United States results in a decrease of 6.4% in occupancy rates and that cancellation rates more than double after a wildfire. Furthermore, Lee et al. (2023) find that wildfire has a lasting negative effect on campground visits, persisting up to 6 years after the initial burn.

Otrachshenko and Nunes (2022) analyzes wildfire occurrences across Portugal between 2000-2016 and find a significant and persistent negative impact of burned areas on tourist arrivals. The authors estimate that wildfire will cost the Portuguese economy between \$17-24 million in lost tourism revenue in 2030. Meier et al. (2023) estimates the effects of wildfire on GDP growth in southern Spain and find an annual decrease of 0.11-0.18% in affected areas, with large decreases in employment growth across tourism-related industries. However, such studies may be underestimating the full economic impacts on tourism, for example Molina et al. (2019) finds that traditional cost methods of estimating the welfare impacts of wildfires underestimate their estimates by omitting incidental costs of visiting a national park such as food, lodging, retail shopping, gasoline, and more. The dataset used in this paper avoids this problem by accounting for total tourism related spending, which is then broken down into its individual components and analyzed separately.

Large wildfires lead to increases in other environmental hazards such as soil destabilization, landslides, and flash flood events (Bayham et al., 2022). Pereira et al. (2021) finds that large wildfires are especially harmful and have substantial negative effects on most ecosystem services in the short-run and long-run. This affects the tourism sector by degrading the quality of local streams and decimating local fish populations that attract angling related tourism (Wibbenmeyer et al., 2023). This is in part due to the fact that large wildfires are typically hotter and more intense than smaller fires which can negate the positive effects of most wildfires because ecosystems struggle to recover as effectively from high-intensity burns. This is backed up by the researchers' finding that prescribed fires generally have positive impacts on ecosystem services in both the short and long-term.

While there is a relatively small body of literature examining the average effects of wildfire on tourism activity, there is a large gray literature of government reports, nonprofit studies, and industry analyses that document the impact of wildfires on tourism. While these studies are limited in scale and often focus on analyzing one or a small number of wildfires, they provide valuable context for this study.

In 2017, the Cariboo Chilcotin Coast Tourism Association in British Columbia commissioned a report evaluating the effects of wildfire on local tourism operators. The study found that many businesses experienced sharp declines in visitation and revenue due to evacuation orders and sustained fire activity (Cariboo Chilcotin Coast Tourism Association, 2017). Similarly, a case study prepared for the Ashland Oregon Chamber of Commerce found that wildfire smoke led to cancellations and reduced tourist activity, impacting businesses reliant on summer tourism (Sumic et al., 2013). A report prepared for the Sierra Nevada Conservancy also documented significant revenue losses in small, tourism-dependent towns following major wildfires in the Sierra Nevada region (Sierra Business Council, 2020).

Headwaters Economics analyzed the economic consequences of wildfires through five case studies across the American West, categorizing impacts into immediate costs and longer-term damages. Among the most persistent long-term effects were losses in tourism revenue and business activity, illustrating how wildfires can trigger lasting economic disruptions in affected communities (Headwaters Economics, 2018). Finally a 2022 report by the Western Forest Leadership Coalition notes that while wildfires pose a significant threat to recreation and tourism reliant areas, that studies looking at the long-term economic impacts on tourism remain scarce (Western Forestry Leadership Coalition, 2022).

While each of these studies focuses on specific regions and events, they provide valuable context and consistent evidence that wildfires impose both immediate and enduring costs on tourism economies. The findings from these case studies motivate this paper by reinforcing the idea that large wildfires can cause persistent reductions in tourism spending, particularly in communities that rely heavily on this sector for local revenue and economic stability.

3 Background

In Colorado, the threat of wildfires on tourism is especially acute for three reasons. First, wildfires across the state have become increasingly frequent, destructive, and expansive over the past three decades, driven in part by prolonged drought, higher temperatures, and increased development in wildland-urban interface areas. Second, Colorado's tourism sector has experienced substantial growth and now accounts for a significant share of both state and local tax revenues. County governments, in particular, rely heavily on tourism-generated tax receipts to fund essential public services. Third, the vulnerability of local communities dependent on tourism to wildfires is amplified by the geographic overlap between fire-prone landscapes and tourism-intensive regions. Many of the state's most tourism-dependent counties are located in heavily forested areas of the Rocky Mountains, where the risk of large wildfires is especially high.

3.1 Wildfire Trends in Colorado

Several studies have found that the size and intensity of a fire greatly affects the long-term consequences for affected regions. Strauss et al. (1989) find that the largest amount of area burned by wildfires in the western United States occurs under extreme conditions, with a small percentage of fires (1-2%) responsible for burning the vast majority of the cumulative burned area (90-99%). The authors also note that suppression methods are largely ineffective in these extreme cases. Furthermore, large wildfires can severely hinder an ecosystem's ability to recover, which may delay or even permanently prevent the return of natural amenities that attract tourism to the area (Crowley et al., 2023).

Tavor (2024) finds that wildfire characteristics including size, play a crucial role in determining the magnitude of the economic impacts and that these impacts can be heterogeneous across sectors of the economy. Similarly Wang and Lewis (2024) reveals that very large fires ($\geq$ 5000 hectares) near timberland have a more pronounced negative impact on timberland values compared to smaller fires.

The data used in this study, covering wildfires in Colorado from 1996 to 2019, reveals trends consistent with previous research. Drawing on data from the National Interagency Fire Center, I identify 1,176 wildfire occurrences during this period. While the median burn area was just 82.30 acres, the distribution is highly skewed, with a standard deviation of 7,788.03 acres and the largest fire burning nearly 138,395 acres. The long right tail of the distribution indicates that the vast majority of total burned area is caused by a relatively small number of fires. The distribution of total area burned are shown in Figure 2.

Table 1 presents wildfire statistics aggregated across all decades, while Table 2 provides a decade-by-decade breakdown. In Colorado, the number of fires per year has increased dramatically, rising from approximately 16 fires per year in the 1990s to over 60 fires per year in the 2010s, and 70 fires per year in the 2020s. The annual mean of total burned area has also grown over time, albeit more modestly, increasing from 1,500 acres per fire in the 1990s and 2000s to nearly 1800 acres per fire in the 2020s. Additionally, the variance in wildfire size has grown considerably in recent decades, with the standard deviation of burned area rising from approximately 2,300 acres in the 1990s to 4,300 acres in the 2000s, and reaching nearly 9,000 acres in the 2020s. These trends suggest that wildfires in Colorado have grown in frequency, size, and unpredictability. The growing scale of the problem is also shown in Figure 1, which maps the boundaries of each wildfire, broken down by decade.

Statistic (Acres)	Count	Mean	Median	SD	Min	Max
Wildfire Size	1,176	1,683.38	82.29	7,788.03	0.07	128,395.8

Table 1: Summary Statistics for Wildfire Sizes (All Fires)

Decade	Annual Fires	Acreage per Fire	SD	Max	Min
1990s	13.00	1099.41	1912.39	16,572.9	0.17
2000s	48.80	1328.89	4333.95	138,395.8	0.08
2010s	62.50	1645.75	5668.09	108,131.3	0.07
2020s	72.00	1772.69	8731.53	208,913.1	0.00

Table 2: Summary Statistics of Wildfires by Decade

In our sample, the top 10% of wildfires by area are responsible for 86.58% of total burned area, the top 5% were responsible for over 73.5%, and the top 1% of wildfires were responsible for 39% of total burned area. In other words, the vast majority of total burned area was the result of a relatively small number of fires. This study focuses on the economic consequences of these largest fires. I do this for two reasons. First, previous studies (Bayham et al., 2022; Pereira et al., 2021) note that small wildfires are not only beneficial but necessary to maintaining healthy forest ecosystems. It is therefore unlikely that these smaller fires would have a substantial negative impact on tourist behavior, since they maintain the very ecosystems which attract tourists in the first place. Second, large fires are known to cause long-lasting damage to ecosystems, and by focusing on these events, I can also examine the prolonged effects on tourism spending behavior in affected counties.

The distribution of wildfire sizes and their associated burned area is further illustrated in Figure 2. As shown in Figure 2a, the vast majority of wildfires burn fewer than 1,000 acres. However, a small number of exceptionally large fires account for nearly all of the total area burned (Figure 2b). Fires in the top quartile by size, those exceeding 475 acres, are responsible for 96.3% of the cumulative burned area. It is the impact of these infrequent but exceptionally large and destructive fires that is the focus of this study.

Figures 3 show the total number of wildfires and total acreage burned across times. Both measures of wildfire frequency and impact show positive trends across this time period, again underpinning the importance of understanding the long-term impacts of these increasingly frequent and destructive wildfires.

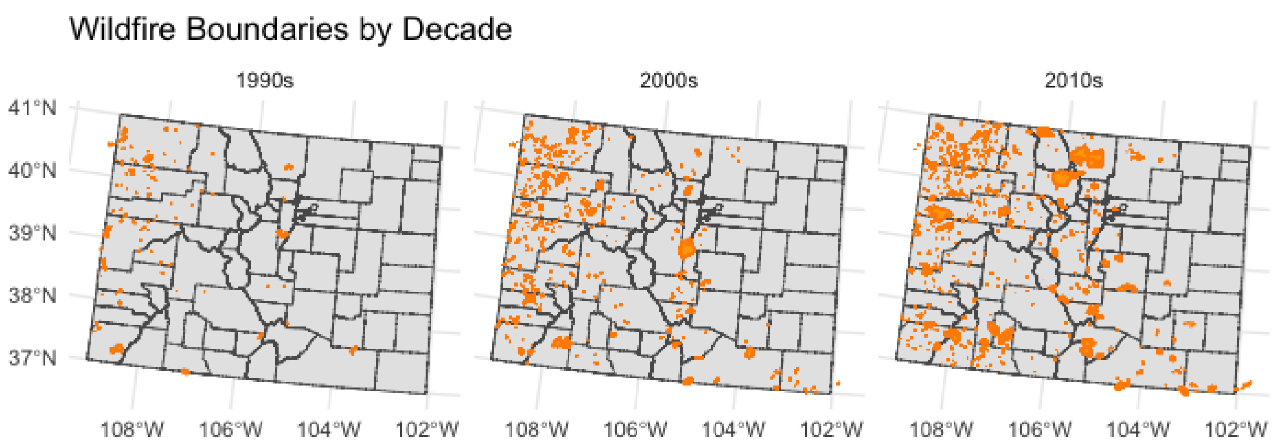
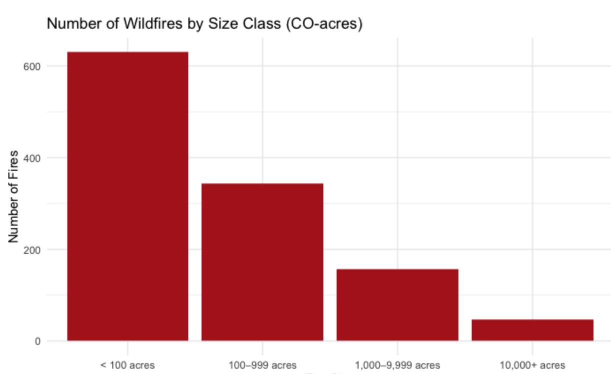
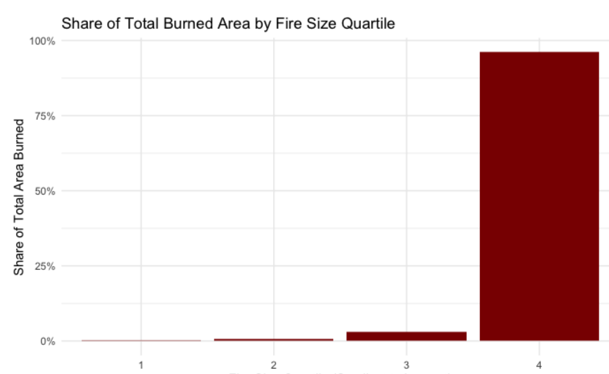


Figure 1: Wildfire Boundaries by Decade

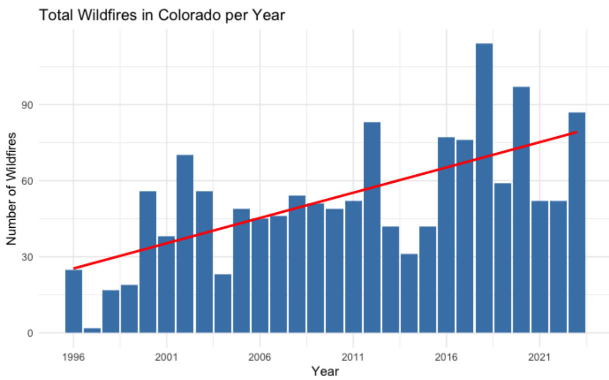


(a) Wildfire Count by Burn Area

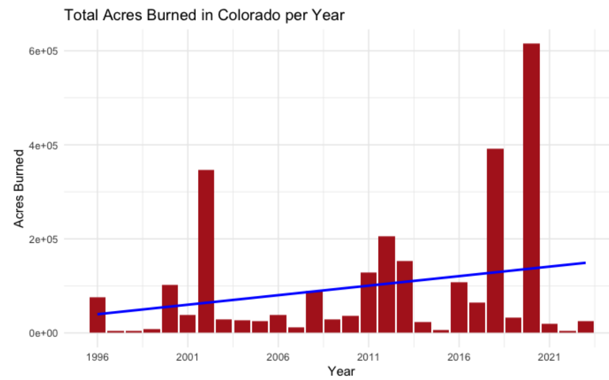


(b) Burn Share by Size Quartile

Figure 2: Distribution of Wildfire Burn Patterns



(a) Wildfires Per Year



(b) Acres Burned Per Year

Figure 3: Trends in Colorado Wildfires

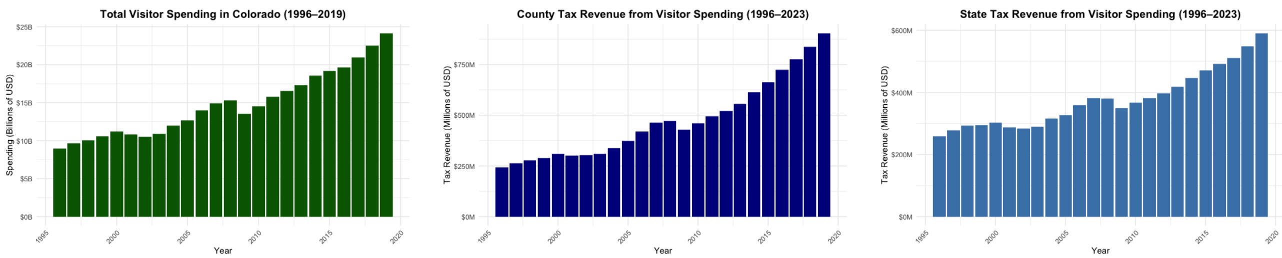
3.2 Economic Impact of Tourism in Colorado

Tourism plays a critical role in shaping Colorado's economy, contributing to job growth at a faster pace than any other sector (Colorado Tourism Office, 2024). It generates substantial business income and tax revenues that help fund public services (including education, infrastructure, and local government operations) through tourism-supported programs and initiatives. Understanding the long-term impacts of large wildfires on regional tourism spending is especially pertinent to residents and policymakers in Colorado as tourism plays a critical role in mountain communities who are acutely at risk of experiencing a large wildfire.

Colorado's tourism sector expanded substantially between 1996 and 2019. Over this period, nominal visitor spending rose from approximately $9 billion to nearly $25 billion, reflecting an average annual growth rate of 4.35%. Revenues from tourism-related taxes followed a similar trajectory. County-level tax receipts climbed from $243 million in 1996 to more than $900 million by 2019, growing at an average annual rate of 5.82%. State-level tax revenues also saw steady gains, increasing from $258 million to $591 million over the same period, corresponding to a 3.76% average annual growth rate. Trends in tourism spending and the tax revenue generated from tourism spending can be seen in Figure 4.

The physical impacts of wildfire are concentrated to certain regions; so too are the economic activities most vulnerable to these disruptions. In Colorado, tourism is not only a major economic driver but also largely localized in high fire risk, forested counties. Understanding the geography of tourism provides critical context for interpreting the economic consequences of mega-fires.

The economic reliance on tourism varies substantially across Colorado counties, as shown in Figure



(a) Visitor Spending **(b)** County Tax Receipts **(c)** State Tax Receipts

Figure 4: Trends in Visitor Spending and Tourism-Generated Tax Revenues in Colorado, 1996–2019

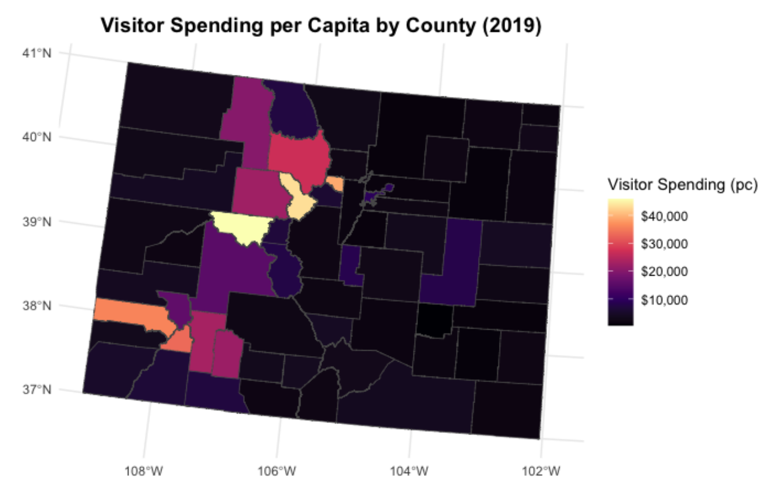
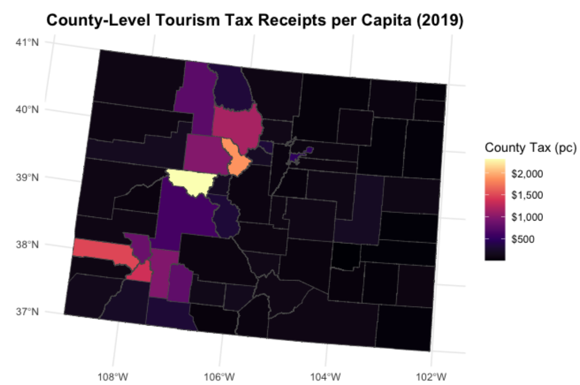
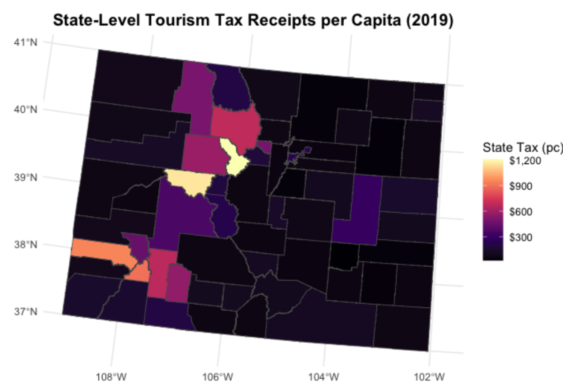


Figure 5: Total Tourism Spending per Capita

5, which maps tourism spending per capita in 2019. Counties such as Pitkin and Summit, home to major resort destinations like Aspen and Breckenridge, exhibit exceptionally high levels of tourism expenditures relative to their resident populations, with per capita spending in the tens of thousands of dollars. In contrast, more populous counties along the Front Range and less tourism-intensive areas on the Western Slope display significantly lower per capita tourism revenues. It is readily apparent that most counties that have relatively high levels of tourism spending per capita are located in mountainous, forested areas, more likely to experience a large wildfire in a given year. Similar trends can be seen in total county and state tax dollars generated from tourism spending, seen in Figure 6.



(a) County Tax Receipts Generated from Tourism Spending



(b) State Tax Receipts Generated by Tourism Spending

Figure 6: State and County Tax Receipts Generated by Tourism Spending

Between 1996 and 2019, Colorado saw substantial growth in both wildfire activity and tourism-related spending. Many of the counties most dependent on tourism revenues to sustain their local economies and fund public services are located in areas of relatively high wildfire risk. As wildfire risk continues to escalate, it is increasingly likely that fires will have larger and more persistent effects on tourism. Understanding the long-term impacts of wildfire on tourism spending is therefore particularly important for policymakers and land managers in Colorado, as well as in other heavily forested states across the American West.

4 Methods

One key feature of this research design is the heterogeneous timing of mega-fires across counties. Between 1996 and 2019, different counties experienced a local mega-fire in various years. Because tourism spending is observed annually over that time span, the effects of the fire are staggered, and some counties are treated earlier than others, while several counties are never treated.

The approach to analyzing the impact of mega-fires on local tourism considers these singular large-scale events as treatments that impact county-level tourism expenditures. The first mega-fire event qualifying as a treatment occurred in 2002, allowing for a substantial pre-treatment period for all counties. To estimate the impact of large wildfires on tourism spending, I employ the Callaway and Sant'Anna (2021) staggered difference-in-differences (staggered DiD) estimation strategy, in which treated counties are compared against a group of 'never-treated' counties that provide a control group for the analysis. I restrict the time frame of the study to pre-2020, as the COVID-19 pandemic had substantial impacts on tourism spending that were not directly related to the occurrences of large wildfires.

The staggered DiD approach is well-suited for this context due to the quasi-random occurrence of historically unprecedented mega-fires in specific counties and years. It allows for the estimation of group-time average treatment effects, $ATT(g,t)$, defined as the average treatment effect in period t for the group of counties first treated in period g. This method is preferred over the traditional two-way fixed effects model because it allows for the estimation of effects based on the length of exposure to the treatment, and avoids biases that arise when treatments are staggered across time periods. I implement this using the `att_gt` function from Callaway and Sant'Anna (2021) in the `did` package in R, using a doubly robust specification combining outcome regression and inverse probability weighting. The estimator accommodates variation in treatment timing and yields group-specific effects $\mathrm{ATT}(g,t)$ that are subsequently aggregated into overall average treatment effects across groups and time.

Following the framework of Callaway and Sant'Anna (2021), the target parameter is the group–time average treatment effect (ATT) shown in Equation 1:

$$ATT(g,t) = \mathbb{E}[\,Y_{it}(1) - Y_{it}(0)\,|\,G_i = g,\ t\,]\,, \tag{1}$$

where $ATT(g,t)$ represents the average treatment effect at time t for the group of counties first treated in period g. The estimator compares each treated cohort to never-treated counties that serve as a control group.

The outcome variable Y_{it} denotes a tourism-related measure for county i in year t, normalized to per capita values. Outcomes include total visitor spending, county and state tax revenues from tourism, and sector-specific expenditures such as hotel/motel and campground spending.

The staggered DiD approach accounts for variation in treatment timing and avoids potential biases that arise from negative weighting in a traditional two-way fixed effects (TWFE) model (Roth et al., 2023). In a TWFE specification, counties treated earlier in the sample can be inappropriately used as controls for counties treated later, even in years when the earlier-treated counties are already treated. For example, a county that experienced a wildfire in 2002 may be used as a control for a county first affected in 2012 during the years 2003 to 2011, despite already being treated throughout that period. As shown by Sun and Abraham (2021), such "forbidden comparisons" are more likely to occur for early-treated units, which can lead to biased estimates and, in some cases, negative weights in the aggregation of treatment effects. The estimator proposed by Callaway and Sant'Anna (2021) avoids these issues by comparing each treated group only to never-treated units and by aggregating treatment effects using non-negative, policy-relevant weights.

4.1 Data

The data used in this analysis come from a variety of government agencies. Wildfire data was sourced from the National Interagency Fire Center, which is the primary coordinating body for wildland firefighting in the U.S. The Center is composed of representatives from several key agencies including the Bureau of Land Management, U.S. Forest Service, National Park Service, Bureau of Indian Affairs, the National Weather Service and other agencies. More information can be found on their website. They provide data on wildfire occurrences across North America, including the date, size, and shapefile of every recorded fire dating back to the early 20th century.

Data on tourism is sourced from the Colorado Tourism Office in partnership with Dean Runyan Associates, a private data collector that specializes in travel and recreation data collection. Using a combination of public and private data, they provide annual county-level travel impact reports that detail tourism spending by accommodation type (e.g., hotels, camping, second homes) and commodity category (e.g., lodging, transportation, food). These reports also include information on tax receipts generated from tourism spending, as well as industry earnings and employment supported by tourism activity. I leverage the data from these annual reports for the period between 1996-2019. Additional population data was attained from the Colorado State Demography Office.

To classify whether a county was affected by a wildfire in a given year, I use wildfire boundary shapefiles and identify overlaps with county boundaries. A county is considered treated if a wildfire occurs entirely within its borders or intersects its borders, with all counties sharing any portion of the wildfire's area classified as affected.

4.2 Defining the Treatment Group

In using these Colorado wildfire and tourism data to estimate Equation 1, definition of the treatment group is critical, as the vast majority of the total area burned is attributable to a small number of extremely large fires. As discussed in Section 3.1, in Colorado between 1996-2019, the distribution of wildfire sizes is highly skewed. the top 10% of wildfires by area are responsible for 86.58% of total burned area during this period, the top 5% were responsible for over 73.5%, and the top 1% of wildfires were responsible for 39% of total burned area. This concentration of burned area among a small number of large fires suggests that most wildfires in the dataset are not substantial enough to be considered a meaningful treatment.

To address this, I establish three percentile-based thresholds to determine which wildfires qualify as treatments for a given county in a given year. I classify wildfires as treatments if they fall within the top 10% ($\geq$ 2555 acres), top 5% ($\geq$ 7100 acres), top 1% ($\geq$ 30,000 acres), or top 0.5% ($\geq$ 50,000 acres) of wildfires by area. This tiered approach enables an examination of whether the magnitude of a wildfire influences its impact on tourism spending, providing a more nuanced understanding of wildfire effects across different levels of severity. While the ATT estimates for all treatment cutoffs were negative, they were only significant at the 1% and 0.5% cutoff levels. ATT estimates for the 5% and 10% treatment cutoffs are found in Table 6.

The summary statistics for per capita spending in treated and untreated counties in Table 3 for the 1% treatment cutoff, only considering the largest fires as sizable enough to be defined as a treatment. At this cutoff, there are 18 treated counties and 46 counties in the control group. This results in a total of 259 treated county-years, and 1274 untreated county-years. Counties in both the control and treatment group show similar levels of taxes generated from tourism spending. Counties in the control group average slightly higher levels of total tourism spending and hotel/motel spending than treated counties, but treated counties average significantly more campground spending per capita than those in the control group. Balance tables across wildfire size thresholds are found in Table 9 in Appendix 6.1.

One of the outcomes examined in this analysis is state tax revenue generated from tourism activity within each county. Although these revenues are collected at the state level, they are attributed to the county where the economic activity occurred. As a result, the estimates should be interpreted as the effect of wildfire on tax revenue originating in the affected county, not on statewide tax collections.

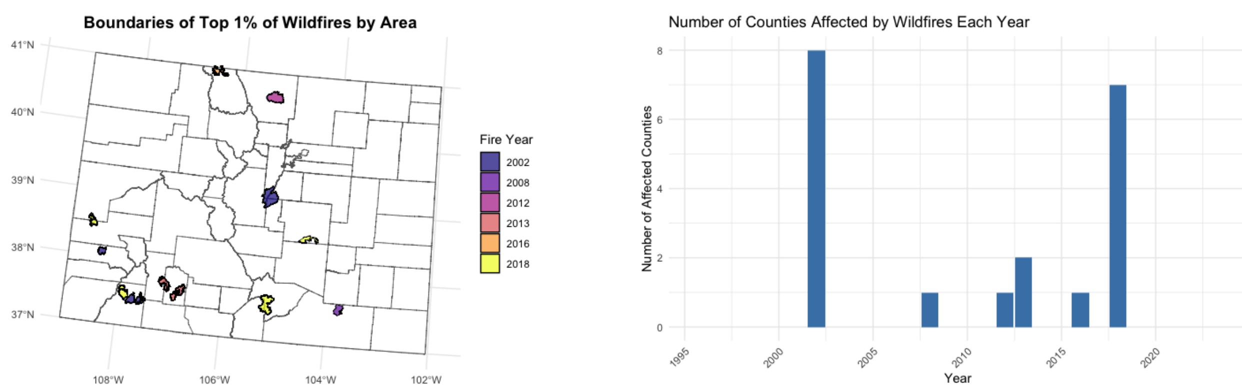
Variable	**Never-Treated**				**Treated**			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
State Tax (pc)	159.71	211.49	0.00	1386.32	151.86	196.68	19.99	1399.61
County Tax (pc)	191.50	357.25	0.00	3092.45	189.63	314.86	5.12	2593.59
Visitor Spending (pc)	5980.43	9223.48	0.00	51163.41	5583.98	7520.93	407.14	51138.91
Campground Spending (pc)	374.87	762.45	0.00	6024.55	708.10	1396.13	4.66	5713.49
Hotel/Motel Spending (pc)	3643.44	6496.04	0.00	38194.30	3005.52	4405.57	0.00	32524.55

Table 3: Balance Table for Treatment Groups

The Callaway and Sant'Anna (2021) approach provides a flexible framework for estimating treatment effects in difference-in-differences (DiD) settings with staggered treatment adoption. Unlike traditional two-way fixed effects (TWFE) models, which can produce biased estimates when treatment effects vary over time or across groups, this method estimates group-time average treatment effects, $ATT(g, t)$. This allows for heterogeneous treatment effects by explicitly accounting for the timing of treatment and enabling comparisons between treated and untreated groups at each period.

Additionally, the approach allows for event-study analyses, allowing for an examination of dynamic treatment effects over time. It also provides robust inference through doubly robust estimation techniques, ensuring greater reliability of the estimated treatment effects even in the presence of potential model misspecification.

The staggered timing of wildfire treatments across Colorado is illustrated in Figures 7a and 7b. Figure 7a displays the location and shape of each wildfire included in the sample, with darker shades indicating fires that occurred earlier in the study period. Figure 7b highlights that no counties experienced the largest mega-fires until 2002, when seven counties were affected. Between 1996 and 2019, mega-fires occurred in six different years, each impacting between 1-7 counties.



(a) Top 1% of Wildfires Boundaries

(b) Affected Counties Per Year

Figure 7: Occurrence of mega-fires Across Time

5 Results

This section presents the main results across three key tourism-related outcomes: county tax revenue generated from tourism, state tax revenue generated from tourism, and total visitor spending. To further investigate the main avenues through which spending is affected, I also report the ATT estimates for campground spending and hotel/motel spending. The results highlight consistent negative impacts following large wildfires across all outcome variables. Significant drops in tourism spending and associated tax receipts are observed at the 1% and 0.5% cutoff and are the focus of the proceeding two sections.

Table 4 lists the average treatment effects of a wildfire on tourism spending per capita.

Outcome	**ATT**	**Std. Error**	**95% CI**	**Sig**
County Tax (pc)	-49.25	20.47	[-89.37, -9.13]	*
State Tax (pc)	-19.65	9.49	[-38.25, -1.04]	*
Total Spending (pc)	-776.93	335.71	[-1434.90, -118.95]	*
Campground Spending (pc)	-32.33	26.15	[-83.58, 18.92]	
Hotel/Motel Spending (pc)	-647.78	324.59	[-1283.96, -11.60]	*

Table 4: Average Treatment Effects on Tourism-Related Outcomes for Smaller, Rural Counties. All specifications include fixed effects for county and year. Asterisks (*) indicate statistical significance at the 5% level.

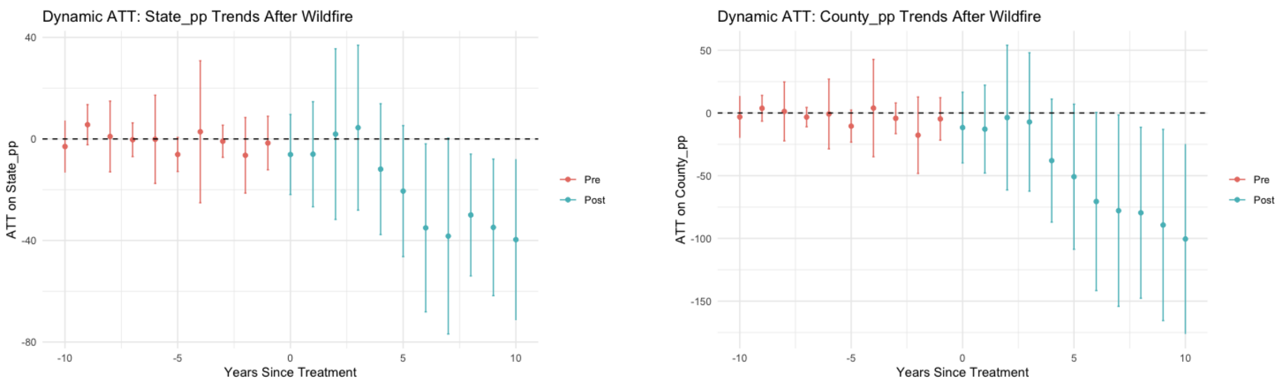
Our analysis reveals that the largest wildfires have significant and long-lasting negative effects on tourism spending in affected counties. Specifically, the occurrence of a mega-fire leads to substantial declines in overall visitor spending, as well as reductions in county and state tax revenues generated from tourism. These negative impacts are statistically significant a decade after the initial fire. The decreases in visitor spending are primarily driven by reductions in hotel/motel spending. Importantly, these effects emerge only when applying the most stringent treatment definition, where only the top 1% of wildfires by area are classified as treatments. Negative spending effects persist when the analysis is restricted to rural counties, which are more prone to wildfire exposure and are generally more economically dependent on tourism.

The estimated average treatment effects (ATT) reveal significant and economically meaningful impacts of large wildfires on tourism-related economic outcomes. For county tax revenue, the occurrence of a mega-fire reduces per capita county tax receipts by approximately $49.25, with a 95% confidence interval ranging from -$9.13 to -$89.87. State tax revenue shows a similar pattern, declining by about -$19.65 per capita, also statistically significant, with a confidence interval between -$1.04 and -$38.25. Total visitor spending per capita shows a significant decline, falling by roughly -$776 following a mega-fire, albeit with a wide 95% confidence interval of -$118.95 to -$1,434.90.

The negative impacts are only significant when the treatment definition is restricted to fires larger than 30,000 acres, corresponding to the 12 largest fires (top 1% by area burned) in the sample. While the top 5% cutoff shows similar trends to the 1% threshold, the estimates are not statistically significant. In contrast, the top 10% cutoff yields null results across all outcomes, suggesting that many fires within this broader category are too small to have lasting economic effects on tourism spending. The complete results of the DID analysis at the 5% and 10% thresholds can be found in 6.1.

Although the ATT estimate for per capita campground spending is -$32.33 following a major wildfire, this estimate is not statistically significant. In contrast, hotel and motel spending exhibits a statistically significant average treatment effect of -$647.78 per capita. The magnitude and significance of the latter suggest that the economic impact of wildfires is more pronounced among visitors who rely on commercial lodging than those who choose to camp. This discrepancy implies that wildfire events may deter higher-spending, hotel-dependent tourists more than those engaging in lower-cost recreational activities such as camping, although more study is needed on this topic.

To further explore the dynamics of tourism spending around wildfire events, Figures 8a and 8b present event study plots illustrating pre- and post-treatment trends. These graphs display the estimated coefficients for each period relative to the wildfire event, along with 95% confidence intervals.



(a) State Tax Receipts

(b) County Tax Receipts

Figure 8: Event Study: Tax Receipts Generated from Tourism Spending

Figures 8 show the time dynamics that the length of exposure to treatment has on state and county tax receipts generated from tourism spending. The full tables listing the ATT estimates, standard errors, and the confidence intervals can be found in Appendix 6.1. The event-study graphs provide evidence that parallel trends hold, as all pre-treatment periods return coefficients statically insignificant from zero. Secondly, they show that the negative effects of wildfire on tax receipts increase in length of exposure to the treatment. That is to say a wildfire exhibits a persistent negative effect on tax receipts a decade later.

The long-term effects of large wildfires on tourism spending intensify in the years following the initial event. In the fifth year after a wildfire, county tax receipts per capita decline by an average of $50.80. This effect deepens over time, with average spending reductions rising to $70.55 per capita by year six and $77.87 by year seven. A decade after the initial event, affected counties experience a decrease in county tax revenue generated by tourism of over $100 per capita on average.

The impact of large wildfires on total visitor spending also intensifies over time. In the first three

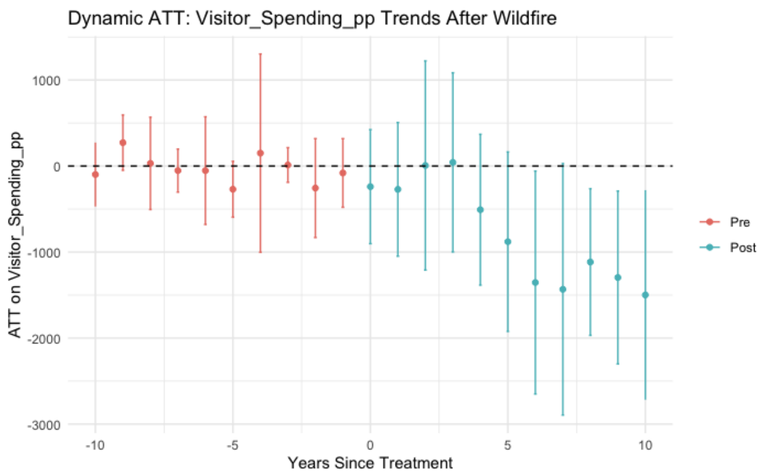


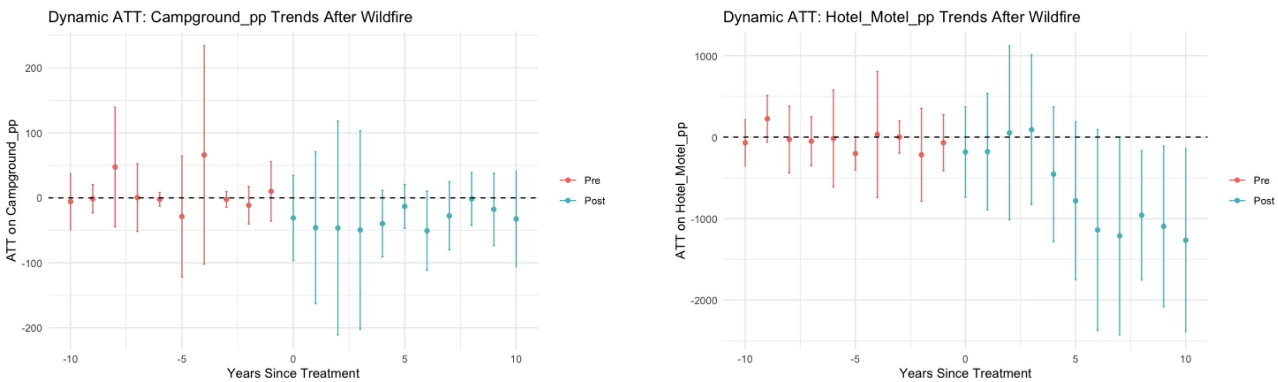
Figure 9: Total Visitor Spending

years after a wildfire, spending declines are modest and statistically insignificant. By year four, the reduction deepens to \$507.73 per capita, increasing to \$879.48 by year five, though these effects remain statistically insignificant.

From year six onward, declines in visitor spending become substantial and statistically significant. Spending drops by \$1354.15 per capita in year five, intensifying to \$1,623.12 in year six and \$1,433.23 in year seven. The largest reduction occurs a decade after the wildfire, with spending down \$1498.55 per capita and a 95% confidence interval ranging from \$280.41 to \$2,716.70.

These results suggest that the negative economic consequences of large wildfires not only persist but intensify over time. The most pronounced reductions occur several years after the initial event, potentially reflecting prolonged disruptions in tourism infrastructure, permanent damages inflicted on the local ecosystem, changes in visitor perceptions of wildfire-prone areas, or broader regional economic adjustments. This pattern may also reflect the fact that ecosystems struggle to recover after mega-fires due to their above average temperatures and the vastness of the burn scar Pausas and Keeley (2019). The delayed nadir in spending reductions highlights the importance of considering long-term recovery strategies when assessing the economic consequences of large-scale wildfires. The wide confidence intervals on these estimates also underscore the importance of further research with more granular data obtain more precise estimates on these long-term economic impacts.

Finally, I estimate the effects of mega-fires on campground spending and hotel/motel spending. While the estimated effect on hotel/motel spending is negative and statistically significant, I find no significant impact on campground spending. These results suggest that the response to wildfire events may vary by accommodation type, with commercial lodging more affected than lower-cost options like camping. Event study estimates for these spending categories are presented in Figure 10.



(a) Campground Spending per Capita

(b) Hotel/Motel Spending per Capita

Figure 10: Event Study: Tax Receipts Generated from Tourism Spending

5.1 Results at 0.5% Mega-Fire Cutoff

To ensure that the analysis isolates the economic consequences of only the most extreme wildfire events, I re-estimate the staggered DiD models using a treatment threshold corresponding to the top 0.5% of wildfires by burned area within Colorado, only including the seven biggest fires in the sample as treatments. These included fires exceeding approximately 50,000 acres. This stricter definition captures exceptionally large, high-intensity events that are most likely to disrupt regional tourism infrastructure, degrade air quality, and alter visitor behavior. The 0.5% cutoff reduces the number of treated counties but provides a clearer distinction between typical wildfire activity and truly catastrophic events.

Table 5 reports the estimated average treatment effects (ATT) on per-capita tourism outcomes under this specification. The results indicate statistically significant declines in total visitor spending, county lodging tax revenues, state tourism tax revenues, and hotel/motel spending in the years following a mega-fire. Although campground spending also decreases on average, this effect is not statistically significant at conventional levels. The magnitudes imply that a single mega-fire event is associated with reductions of nearly \$934 in total visitor spending per resident, \$47 in county tax revenue per capita, and \$22 in state tax revenue per capita, relative to never-treated counties. Event-study estimates (Figure 11) show that these effects persist for several years after the fire, with no evidence of pre-treatment divergence.

Outcome	ATT	Std. Error	95% CI	Sig.
Total Visitor Spending (pc)	-933.70	286.22	[-1494.68, -372.73]	*
County Tax (pc)	-47.46	16.65	[-80.10, -14.83]	*
State Tax (pc)	-22.13	7.88	[-37.58, -6.69]	*
Campground Spending (pc)	-90.23	55.59	[-199.18, 18.73]	
Hotel/Motel Spending (pc)	-768.06	267.34	[-1292.03, -244.09]	*

Table 5: Average Treatment Effects of Mega-Fires (Top 0.5% by Burned Area)

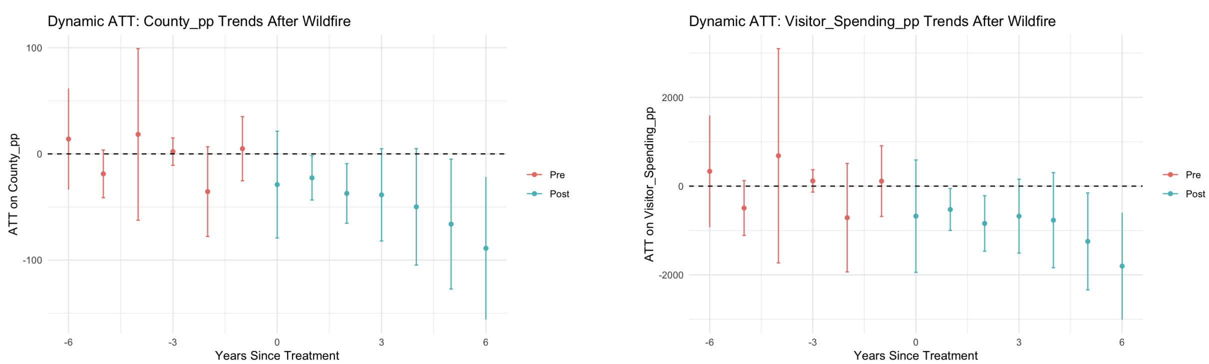


Figure 11: Event-study estimates of the dynamic effects of mega-fires (top 0.5% cutoff) on county tax receipts and total visitor spending.

The dynamic event-study estimates in Figure 11 reveal that the negative effects of mega-fires on tourism spending emerge immediately following the year of the mega-fire. The first post-treatment period shows a pronounced decline in visitor spending and tax revenues, suggesting that the very largest wildfires have the most immediate and severe impacts on local tourism activity. Similar to baseline results, there are no signs of recovery and that reductions in visitor spending are significantly reduced six years after the initial burn.

5.2 Comparison Across Wildfire Size Cutoffs

To assess whether the estimated economic impacts depend on the severity of the wildfire event, I compare ATT estimates across alternative treatment thresholds corresponding to the top 10%, 5%, 1%, and 0.5% of fires by burned area. As shown in Table 6, the magnitude and statistical significance of the estimated effects increase as the cutoff becomes more restrictive. When all large fires (top 10%) are included, reductions in tourism spending and tax receipts are small and statistically insignificant.

In contrast, as the definition narrows to the top 1% and 0.5% of fires, the estimated declines in visitor spending, lodging tax revenues, and hotel/motel expenditures grow sharply in magnitude and become statistically significant at the 5% level.

This pattern suggests that the size of the wildfire is a key driver of the observed impacts rather than unobserved confounding factors common to all fire years. The results imply that only the very largest, most destructive wildfires generate persistent and measurable reductions in local tourism activity, and that the observed reductions in visitor spending are driven by the size of the wildfire. Full event-study graphs across all specifications can be found in Appendix 6.1.

Table 6: Comparison of Average Treatment Effects Across Wildfire Size Cutoffs

	0.5% Cutoff		1% Cutoff		5% Cutoff		10% Cutoff	
Outcome	**ATT**	**SE**	**ATT**	**SE**	**ATT**	**SE**	**ATT**	**SE**
Visitor Total	**-933.70***	(286.22)	**-776.93***	(335.71)	**-381.34**	(315.58)	**-357.18**	(300.13)
County Tax	**-47.46***	(16.65)	**-49.25***	(20.47)	**-20.02**	(18.87)	**-27.14**	(19.43)
State Tax	**-22.13***	(7.88)	**-19.65***	(9.49)	**-11.37**	(7.83)	**-11.24**	(6.90)
Campground	**-90.23**	(55.59)	**-32.33**	(26.15)	**-9.99**	(20.46)	**1.55**	(17.11)
Hotel/Motel	**-768.06***	(267.34)	**-647.78***	(324.59)	**-327.67**	(252.96)	**-327.91**	(239.71)

Notes: ATT estimates from Callaway–Sant'Anna staggered DiD models. All outcomes are expressed in per capita terms. Asterisks (*) indicate statistical significance at the 5% level.

5.3 Spillover Effects

To test whether wildfire impacts extend beyond directly affected counties, I examine potential spatial spillovers by constructing buffers of varying distances around each county and rerunning the analysis. I generate zones of 10, 25, and 50 miles around each county. Counties with buffers that intersect any wildfire are reclassified as treated in that buffer specification. For instance, a county whose border lies within 10 miles of a wildfire is treated as affected at the 10-mile cutoff, while those beyond 10 miles remain untreated. I use this approach at the 1% treatment cutoff as a robustness check as a method to check for spillover effects. The model is then re-estimated using the same staggered difference-in-differences framework and intersection-based treatment assignment.

Table 7 reports the average treatment effects across buffer distances. The magnitude and statistical significance of the estimated impacts decline as the buffer distance increases, indicating that proximity plays a key role in determining the severity of economic disruption. At the 10-mile cutoff, I find significant reductions in county tax revenues and negative but imprecisely estimated effects for total visitor spending and state tax receipts. At 25 and 50 miles, the estimates become smaller in magnitude and lose statistical significance, suggesting that the adverse economic effects of wildfires are geographically concentrated and dissipate with distance from the burn perimeter.

Table 7: Spillover Robustness: Buffer Zones Around Wildfire Boundaries

Buffer Distance	**Total Spending**	**County Tax**	**State Tax**
10 miles	-634.7 (383.1)	-45.1* (21.6)	-16.6 (9.1)
25 miles	-429.3 (647.9)	-29.2 (37.3)	-13.2 (16.4)
50 miles	-269.8 (675.4)	-29.4 (55.0)	-5.3 (17.3)

Notes: Coefficients reported with robust standard errors in parentheses. $^{*}p < 0.05$. All results reported in per capita terms.

These results provide evidence of localized spillover effects: economic disruptions to tourism are strongest within roughly 10 miles of the burn perimeter but fade quickly with distance. This pattern is consistent with short-range channels such as road closures, smoke intrusion, and perceived fire risk that directly affect neighboring communities, while more distant areas remain largely unaffected. These results provide evidence that the negative effects of mega-fires on tourism spending are largely localized to areas closest to the burn scar, with some evidence of spillovers to the closest counties. Event study graphs at different buffer thresholds are found in Appendix 6.1.

5.4 Alternative Specifications

To assess the robustness of the main findings, I estimate two alternative model specifications. First, I restrict the sample to smaller, rural counties, excluding the more densely populated Front Range. This isolates effects in less urbanized regions where tourism activity is more directly linked to natural amenities. Second, I exclude La Plata County, which experienced two mega-fires during the sample period, to ensure that repeated exposure does not drive the results.

Across these specifications, the estimated average treatment effects remain negative and broadly similar in magnitude to the baseline results, though standard errors increase and estimates become less precise. In the model excluding Front Range counties, the ATT estimates lose statistical significance, suggesting that declines in tourism spending may be more pronounced for counties along the Front Range that experience a mega-fire. Even so, several group–year estimates remain significantly negative across both specifications, indicating that large wildfires continue to depress visitor spending and tax receipts across alternative samples. Full ATT estimates are presented in Table 8, and corresponding event-study plots are provided in Appendix 6.1.

Outcome	ATT	Std. Error	95% CI	Sig.
Main Specification				
County Tax	-49.25	20.47	[-89.37, -9.13]	*
State Tax	-19.65	9.49	[-38.25, -1.04]	*
Total Visitor Spending	-776.93	335.71	[-1434.90, -118.95]	*
Campground Spending	-32.33	26.15	[-83.58, 18.92]	
Hotel/Motel Spending	-647.78	324.59	[-1283.96, -11.60]	*
Excluding Front Range Counties				
County Tax	-46.34	21.03	[-87.57, -5.10]	*
State Tax	-17.65	10.05	[-36.72, -2.68]	
Total Visitor Spending	-684.85	369.55	[-1409.17, 39.46]	
Campground Spending	-35.15	39.44	[-112.45, 42.16]	
Hotel/Motel Spending	-565.34	324.64	[-1189.07, 59.22]	
Excluding Twice-Treated Counties				
County Tax	-49.25	21.15	[-90.72, -7.78]	*
State Tax	-19.65	9.63	[-38.52, -0.77]	*
Total Visitor Spending	-776.93	370.80	[-1503.68, -50.17]	*
Campground Spending	-35.14	39.70	[-87.79, 23.14]	
Hotel/Motel Spending	-565.34	331.45	[-1214.96, 84.29]	

Table 8: Average Treatment Effects on tourism-related outcomes across model specifications. All ATT estimates are measured in per capita terms for county i. All specifications include fixed effects for county and year. Asterisks (*) indicate statistical significance at the 5% level.

The persistence of negative effects across specifications supports the conclusion that observed declines in tourism-related spending are causally attributable to the occurrence of mega-fires rather than to sample composition or outlier events.

6 Discussion & Policy Implications

The findings of this study demonstrate that large wildfires have significant and persistent negative effects on tourism spending, with the most severe impacts occurring several years after a fire. These results suggest that the economic consequences of wildfires extend well beyond the immediate aftermath, underscoring the need for long-term recovery strategies and proactive policy interventions. Wildfires pose a threat not only to local ecosystems and public health, but also to long-term tourism spending and the public goods and services that rely on revenues generated by that economic activity.

ATT estimates show that wildfires significantly reduce hotel and motel spending, but not campground spending, suggesting that different types of tourists may respond differently to wildfire events. Visitors who rely on commercial lodging may be more sensitive to wildfire-related disruptions, either because they tend to book further in advance, incur higher costs, or have lower tolerance for risk and uncertainty. In contrast, campers may be more flexible in their travel plans or less deterred by the presence of recent fire activity. This potential heterogeneity in behavioral responses is important for future research and could have implications for how local governments and tourism agencies design recovery strategies and allocate resources after a wildfire.

A growing body of literature highlights the economic link between water quality and recreation-based tourism. Wibbenmeyer et al. (2023) suggest that diminished water quality can reduce visitation to recreation sites, indirectly impacting local economies through lost tourism revenue. Holmes (1988) similarly notes that degraded water quality can impair aquatic ecosystems, leading to declines in recreational and commercial fishing activity. Olmstead (2010) reinforces this connection by documenting that much of the economic value attributed to water quality in the United States stems from its effect on recreation. Together, these findings suggest that wildfire-related degradation of water quality may help explain the long-term decline in tourism spending observed in affected counties. If a major wildfire significantly impacts local fish populations for several years, tourists who travel to these areas for recreational fishing may choose to visit alternative destinations instead, potentially leading to a lasting shift in travel and spending patterns.

One key implication of these findings is the importance of sustained support for tourism-dependent communities. Given that tourism spending continues to decline for up to a decade following a mega-fire, local and state governments should consider developing long-term recovery programs for affected communities. These could include marketing campaigns aimed at restoring visitor confidence, investments in rebuilding tourism infrastructure, and targeted policies to support local businesses most affected by declines in tourism activity.

It is important to interpret the ATT estimates in the context of their per capita scale. Because the results are expressed on a per resident basis, the total economic impact of a mega-fire will vary substantially depending on the population of the affected county. For instance, a wildfire affecting Mineral County, which has a population of just 794, would result in a relatively modest aggregate reduction in county tax revenue compared to a similar event in Summit County, home to over 31,000 residents. Applying the ATT estimates from Table 4, a mega-fire in Mineral County in 2025 would lead to an average annual loss of approximately $39,000 in county tax revenue and $616,100 in total visitor spending over the following decade. In contrast, the same per capita effects in Summit County would translate to a loss of roughly $1.5 million in county tax revenue and $24 million in annual visitor spending.

This distinction is critical for policymakers evaluating regional vulnerability. While smaller counties may incur lower aggregate revenue losses, the relative impact can be substantial due to their limited fiscal capacity and dependence on tourism as a key economic sector. Even modest declines in revenue or visitor spending can strain public services and hinder long-term recovery in these communities. Mineral County, for example, had a fund of approximately $400,000 in the beginning of 2024 according to their county budget public records. An annual average loss of $39,000 in tourism-generated tax revenue, representing almost 10% of the county fund, would have substantial impacts on the county's ability to fund public services and respond to environmental or economic shocks in the region.

While mega-fires' effects on campground spending are not statistically significant, hotel and motel spending shows a significant decline, as illustrated in Figure 10b. These results suggest that the economic impact of wildfires may vary across segments of the tourism industry, with commercial lodging appearing more vulnerable than lower-cost accommodations such as campgrounds. The heterogeneous nature of these effects highlights the need for further analysis into sector-specific responses to wildfire events in order to better understand the distributional impacts within the tourism economy.

6.1 Mitigating Large Wildfires

In addition to recovery-focused policies, these results underscore the importance of wildfire prevention and mitigation strategies to reduce the risk of large fires. Previous studies have found investments in fuel management, prescribed burning, and improved firefighting capacity can decrease the likelihood and severity of destructive wildfires. Given the substantial economic costs associated with mega-fires, such investments are likely to yield high returns by preventing long-term disruptions to local economies. Accordingly, it is critical for policymakers to identify which mitigation strategies are most cost-effective at reducing the risk of mega-fire occurrence in a given region.

A small but growing literature has examined the relative efficacy of various mitigation strategies, though many of these studies originate from fields outside of economics. The cost-effectiveness of wildfire mitigation remains an underexplored area within the wildfire economics literature.

One widely supported strategy is proactive fuel management (Bayham et al., 2022; Michetti and Pinar, 2019; Pereira et al., 2021). Historically, western forests experienced frequent, low-severity fires that naturally reduced surface and ladder fuels, thereby lowering the risk of high-intensity crown fires (Shafran, 2008). Prescribed burning can replicate these natural processes, reducing fuel accumulation and, consequently, the probability of severe wildfires (Kaval et al., 2007; Pereira et al., 2021). Mechanical fuel treatments, such as thinning or mastication, also interrupt fuel continuity and reduce stand density, although studies suggest they are often more costly and labor-intensive than prescribed burns (Amacher et al., 2005; Halbritter et al., 2020). Enhanced forest monitoring and early detection systems and novel machine learning techniques can further shift the focus from emergency response to prevention (Michetti and Pinar, 2019). In addition, fire-conscious silvicultural practices, such as cultivating less flammable tree species, can reduce the potential intensity of future fires (Michetti and Pinar, 2019).

In terms of targeting mitigation strategies to minimize the risk of wildfire risk, individual property owners and community organizers can create and maintain a defensible space around high value property, minimizing the number of structures affected by a wildfire (Gritzo, 2024; Meldrum et al., 2014; Shafran, 2008). This involves clearing nearby vegetation to reduce the risk of fire reaching structures. Research has emphasized that defensible space is a primary means for wildfire risk reduction on private property (Meldrum et al., 2014, 2018). Changing building codes to mandate the use of non-flammable materials in the construction of new structures is another avenue through which policymakers can reduce wildfire risk in their community, though these changes take effect over a longer time horizon.

Dale and Barrett (2023) is one of the few studies that examine the alignment between the effectiveness of wildfire risk reduction policies and their funding levels. They find that strategies such as home hardening and the implementation of mandatory building codes are among the most effective in mitigating community wildfire risks, yet they are significantly underfunded. Conversely, wildfire suppression efforts, which receive substantial funding, are less effective in reducing long-term community risk. This misalignment suggests a need to reevaluate funding priorities to enhance the efficacy of wildfire mitigation efforts.

Finally, these findings have broader implications in the context of climate change. A changing climate, characterized by rising temperatures and altered precipitation patterns creates environments more conducive to both ignition and the rapid spread of wildfires (Abatzoglou and Williams, 2016). Climate models predict that rising global temperatures and reduced precipitation will lead to longer and more intense fire seasons, with some projections indicating a significant increase in acreage burned for every degree Celsius of warming (Borgschulte et al., 2024). As wildfires become more frequent and severe, the economic risks to tourism-dependent regions will continue to grow. Policymakers should incorporate these elevated risks into broader climate adaptation strategies, ensuring that tourism sectors in wildfire-prone areas are equipped to respond to and recover from future fire events. This may include diversifying local economies to reduce reliance on tourism, promoting year-round tourism activities to offset seasonal vulnerabilities, and improving communication strategies to manage visitor perceptions of wildfire risk.

Overall, this analysis underscores the need for comprehensive wildfire management policies that address both the immediate and long-term economic impacts of large fires. By implementing targeted recovery programs, investing in prevention, and developing climate-resilient tourism strategies, policymakers can help mitigate the lasting economic consequences of wildfires on tourism-dependent communities.

References

Abatzoglou, J. T. and Williams, A. P. (2016). Impact of anthropogenic climate change on wildfire across western us forests. *Proceedings of the National Academy of sciences*, 113(42):11770–11775.

Amacher, G. S., Malik, A. S., and Haight, R. G. (2005). Not getting burned: the importance of fire prevention in forest management. *Land Economics*, 81(2):284–302.

Bayham, J., Yoder, J. K., Champ, P. A., and Calkin, D. E. (2022). The economics of wildfire in the united states. *Annual Review of Resource Economics*, 14(1):379–401.

Baylis, P. and Boomhower, J. (2019). Moral hazard, wildfires, and the economic incidence of natural disasters. Technical report, National Bureau of Economic Research.

Borgschulte, M., Molitor, D., and Zou, E. Y. (2024). Air pollution and the labor market: Evidence from wildfire smoke. *Review of Economics and Statistics*, 106(6):1558–1575.

Botzen, W. W., Deschenes, O., and Sanders, M. (2019). The economic impacts of natural disasters: A review of models and empirical studies. *Review of Environmental Economics and Policy*.

California Air Resources Board (2020). Camp fire air quality data analysis. Accessed: 2025-04-24.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of econometrics*, 225(2):200–230.

Cariboo Chilcotin Coast Tourism Association (2017). Wildfire impacts on tourism in the cariboo chilcotin coast region. Accessed April 2025.

Chen, G., Guo, Y., Yue, X., Xu, R., Yu, W., Ye, T., Tong, S., Gasparrini, A., Bell, M. L., Armstrong, B., et al. (2024). All-cause, cardiovascular, and respiratory mortality and wildfire-related ozone: a multicountry two-stage time series analysis. *The Lancet Planetary Health*, 8(7):e452–e462.

Colorado Tourism Office (2024). Colorado tourism office overview. Accessed: 2025-04-21.

Crowley, C., Miller, A., Richardson, R., and Malcom, J. (2023). Increasing damages from wildfires warrant investment in wildland fire management. *US Department of Interior, May*, 25.

Dale, L. A. and Barrett, K. (2023). Missing the mark: Effectiveness and funding in community wildfire risk reduction. Technical report, Headwaters Economics.

Du, R., Liu, K., Zhao, D., and Fang, Q. (2024). Climate disaster and cognitive ability: Evidence from wildfire. *International Journal of Public Health*, 69:1607128.

Gellman, J., Walls, M., and Wibbenmeyer, M. (2022). Wildfire, smoke, and outdoor recreation in the western united states. *Forest Policy and Economics*, 134:102619.

Gritzo, L. A. L. (2024). Mitigating social and economic impact of wildfires. *Applications in Energy and Combustion Science*, 20:100285.

Halbritter, A., Deegen, P., and Susaeta, A. (2020). An economic analysis of thinnings and rotation lengths in the presence of natural risks in even-aged forest stands. *Forest Policy and Economics*, 118:102223.

Headwaters Economics (2018). The full community costs of wildfire. Technical report, Headwaters Economics. Accessed April 2025.

Holmes, T. P. (1988). The offsite impact of soil erosion on the water treatment industry. *Land economics*, 64(4):356–366.

Kaval, P., Loomis, J., and Seidl, A. (2007). Willingness-to-pay for prescribed fire in the colorado (usa) wildland urban interface. *Forest Policy and Economics*, 9(8):928–937.

Lee, M. C., Suter, J. F., and Bayham, J. (2023). Reductions in national forest campground reservation demand from wildfire. *Journal of Agricultural and Resource Economics*, 48(3):483–499.

Los Angeles County Economic Development Corporation (2025). Impact of 2025 los angeles wildfires and comparative study. Accessed: 2025-04-24.

Meier, S., Strobl, E., Elliott, R. J., and Kettridge, N. (2023). Cross-country risk quantification of extreme wildfires in mediterranean europe. *Risk analysis*, 43(9):1745–1762.

Meldrum, J. R., Brenkert-Smith, H., Champ, P. A., Falk, L., Wilson, P., and Barth, C. M. (2018). Wildland–urban interface residents' relationships with wildfire: variation within and across communities. *Society & Natural Resources*, 31(10):1132–1148.

Meldrum, J. R., Champ, P. A., Warziniack, T., Brenkert-Smith, H., Barth, C. M., and Falk, L. C. (2014). Cost shared wildfire risk mitigation in log hill mesa, colorado: survey evidence on participation and willingness to pay. *International journal of wildland fire*, 23(4):567–576.

Michetti, M. and Pinar, M. (2019). Forest fires across italian regions and implications for climate change: a panel data analysis. *Environmental and Resource Economics*, 72:207–246.

Molina, J. R., González-Cabán, A., and y Silva, F. R. (2019). Wildfires impact on the economic susceptibility of recreation activities: Application in a mediterranean protected area. *Journal of environmental management*, 245:454–463.

Mueller, J., Loomis, J., and González-Cabán, A. (2009). Do repeated wildfires change homebuyers' demand for homes in high-risk areas? a hedonic analysis of the short and long-term effects of repeated wildfires on house prices in southern california. *The Journal of Real Estate Finance and Economics*, 38:155–172.

Olmstead, S. M. (2010). The economics of water quality. *Review of Environmental Economics and Policy*.

Otrachshenko, V. and Nunes, L. C. (2022). Fire takes no vacation: Impact of fires on tourism. *Environment and Development Economics*, 27(1):86–101.

Pausas, J. G. and Keeley, J. E. (2019). Wildfires as an ecosystem service. *Frontiers in Ecology and the Environment*, 17(5):289–295.

Pereira, P., Bogunovic, I., Zhao, W., and Barcelo, D. (2021). Short-term effect of wildfires and prescribed fires on ecosystem services. *Current Opinion in Environmental Science & Health*, 22:100266.

Roth, J., Sant'Anna, P. H., Bilinski, A., and Poe, J. (2023). What's trending in difference-in-differences? a synthesis of the recent econometrics literature. *Journal of Econometrics*, 235(2):2218–2244.

Shafran, A. P. (2008). Risk externalities and the problem of wildfire risk. *Journal of urban economics*, 64(2):488–495.

Sierra Business Council (2020). The impact of wildfires on the tourism economy in the sierra nevada region. Technical report, Sierra Business Council. Accessed April 2025.

Strauss, D., Bednar, L., and Mees, R. (1989). Do one percent of the forest fires cause ninety-nine percent of the damage? *Forest science*, 35(2):319–328.

Sumic, N., Sirohi, S., and Lipinski, M. (2013). Economic impact of wildfire smoke on the ashland tourism industry. Accessed April 2025.

Sun, L. and Abraham, S. (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of econometrics*, 225(2):175–199.

Tavor, T. (2024). Assessing the financial impacts of significant wildfires on us capital markets: sectoral analysis. *Empirical Economics*, pages 1–34.

U.S. Congress Joint Economic Committee Democrats (2023). Climate-exacerbated wildfires cost the u.s. between $394 to $893 billion each year in economic costs and damages. Accessed: 2025-02-18.

U.S. Fire Administration (2024). Preliminary after-action report on the 2023 maui wildfire. Accessed: 2025-04-24.

Wang, Y. and Lewis, D. J. (2024). Wildfires and climate change have lowered the economic value of western us forests by altering risk expectations. *Journal of Environmental Economics and Management*, 123:102894.

Western Forestry Leadership Coalition (2022). The true cost of wildfire in the western u.s. Technical report, Western Forestry Leadership Coalition. Accessed April 2025.

Wibbenmeyer, M., Sloggy, M. R., and Sánchez, J. J. (2023). Economic analysis of wildfire impacts to water quality: a review. *Journal of Forestry*, 121(4):374–382.

Appendix A: Data Sources

Colorado Tourism Office (Dean Runyan Associates). County-level tourism spending data are obtained from the Colorado Tourism Office, which partners with Dean Runyan Associates (DRA) to produce the annual *Colorado Travel Impacts Report*. DRA uses its Regional Travel Impact Model (RTIM), a “bottom-up” framework developed to estimate the economic impacts of visitor activity at fine geographic scales without relying on annual survey sampling. The model integrates a wide array of private and public data sources to estimate visitor spending, employment, earnings, and tax receipts attributable to tourism in each county. Core private data inputs include lodging metrics from Smith Travel Research (STR) and Key Data for hotels, motels, and short-term vacation rentals, as well as occupancy and pricing information from AllStays and the U.S. Forest Service for public and commercial campgrounds. Public data sources include U.S. Bureau of Labor Statistics employment and wage records, Bureau of Economic Analysis industry earnings, U.S. Census Bureau business patterns, second-home inventories, and state and local government finance data.

Expenditures are modeled separately by lodging category (commercial lodging, camping, second homes, and day travel) each calibrated using lodging tax receipts, inventory data, and visitor expenditure profiles. For commercial accommodations, lodging sales derived from tax receipts are multiplied by expenditure distribution shares to generate estimates of total visitor spending across sectors (lodging, food service, retail, recreation, and transportation). Campground impacts are estimated from site inventories, occupancy data, and average party expenditures, while second-home travel spending is derived from census-based housing utilization and expenditure benchmarks. All spending estimates are reconciled with state-level aggregates and cross-validated against independent datasets (e.g., BLS industry employment, STR sales, and Key Data metrics) to ensure internal consistency. The resulting dataset provides annual county-level estimates of total visitor spending, tourism-related employment, and both county and state tax revenues from 1996–2019.

National Interagency Fire Center (NIFC). Wildfire data are obtained from the National Interagency Fire Center (NIFC) through the Wildland Fire Interagency Geospatial Services (WFIGS) Group, which provides authoritative geospatial data products under the interagency Wildland Fire Data Program. The WFIGS database, hosted within the National Interagency Fire Center ArcGIS Online Organization (the NIFC Org), serves as the official repository for national wildfire perimeter data. It integrates records from the Integrated Reporting of Wildland Fire Information (IRWIN) system and includes all incidents categorized as Wildfire (WF) or Prescribed Fire (RX) that are valid, non-quarantined, and publicly accessible. Each perimeter record must meet interagency publication standards—specifically, a *Feature Access* of *Public*, a *Feature Status* of *Approved*, and an *Is Visible* setting of *Yes*.

Perimeters are derived from multiple authoritative federal sources, with internal rules ensuring that the most current or most reliable polygon is retained when overlaps occur. Data are refreshed continuously, with updates propagated every five minutes, though changes in perimeter sources may take up to fifteen minutes to appear. The database is an ongoing project aimed at developing a comprehensive national history of wildland fire perimeters extending indefinitely into the past. While coverage before 2021 remains incomplete, WFIGS represents the best-available spatial record of wildfire activity across the United States.

For this study, annual wildfire shapefiles were downloaded from WFIGS and used to identify the spatial intersection between burn perimeters and county boundaries in Colorado. A county is classified as treated if any portion of its land area intersects a wildfire perimeter meeting the "mega-fire" threshold ($\geq$ 30,000 acres). This spatial overlay approach ensures that treatment assignments reflect the true geographic extent of wildfire exposure rather than administrative or reporting boundaries.

Colorado State Demography Office. Population data are obtained from the Colorado State Demography Office, which provides annual county-level population estimates. These data are used to normalize all monetary variables to a per capita basis, allowing for consistent comparison of tourism spending and tax revenues across counties and over time.

Variable Construction

This subsection defines the key variables used in the analysis and describes their transformations.

- $VisitorSpending_{it}$: total visitor spending per capita in county i and year t.
- $CountyTax_{it}$ and $StateTax_{it}$: county-level and state-level tourism-generated tax revenues per capita in county i and year t.
- $first\_treated\_year_i$: the first year in which county i was exposed to a mega-fire (burn area $\geq$ 30,000 acres for the 1% treatment cutoff).
- Treatment status is defined using wildfire size thresholds corresponding to the top 10%, 5%, and 1% of fires by burned area.

Summary Statistics

Balance tables for different model specifications across treatment cutoffs are found in Table 9

Variable	Never-Treated				Treated			
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Panel A: 0.5% Cutoff								
Visitor Spending	5615.69	6535.23	407.14	27416.38	5921.32	9175.67	0.00	51163.41
County Tax	183.40	256.29	5.12	1168.03	192.55	361.64	0.00	3092.45
State Tax	151.00	172.66	19.99	792.60	158.85	213.95	0.00	1399.61
Campground Spending	1040.63	1693.29	4.66	5713.49	349.77	718.93	0.00	6024.55
Hotel/Motel Spending	2737.97	3293.68	0.00	17308.92	3614.60	6396.93	0.00	38194.30
Panel B: 1% Cutoff								
Visitor Spending	5980.43	9223.48	0.00	51163.41	5583.98	7520.93	407.14	51138.91
State Tax	159.71	211.49	0.00	1386.32	151.86	196.68	19.99	1399.61
County Tax	191.50	357.25	0.00	3092.45	189.63	314.86	5.12	2593.59
Campground Spending	374.87	762.45	0.00	6024.55	708.10	1396.13	4.66	5713.49
Hotel/Motel Spending	3643.44	6496.04	0.00	38194.30	3005.52	4405.57	0.00	32524.55
Panel C: 5% Cutoff								
Visitor Spending	4663.98	6422.02	407.14	51138.91	7078.77	10494.96	0.00	51163.41
County Tax	157.11	270.45	2.97	2593.59	224.99	404.92	0.00	3092.45
State Tax	130.59	165.58	19.99	1399.61	184.52	239.31	0.00	1386.32
Campground Spending	544.30	1079.11	0.00	5713.49	393.00	895.48	0.00	6024.55
Hotel/Motel Spending	2555.36	4026.92	0.00	32524.55	4377.61	7345.73	0.00	38194.30
Panel D: 10% Cutoff								
Visitor Spending	4750.61	6334.67	407.14	51138.91	7408.98	11130.82	0.00	51163.41
County Tax	159.41	264.43	2.97	2593.59	234.46	429.89	0.00	3092.45
State Tax	134.64	163.01	19.99	1399.61	188.98	253.02	0.00	1386.32
Campground Spending	491.45	1012.76	0.00	5713.49	437.77	968.43	0.00	6024.55
Hotel/Motel Spending	2662.99	4050.73	0.00	32524.55	4569.09	7785.76	0.00	38194.30

Table 9: Balance Statistics for Treated and Never-Treated Counties Across Wildfire Size Cutoffs. All estimates are expressed in per capita terms.

Appendix B: Event-Study ATT(g, t) Tables

Each table reports time-specific effects relative to the wildfire year at the 1% wildfire threshold. Full event tables for other wildfire size thresholds are available upon request.

t	ATT	Std. Error	95% CI Lower	95% CI Upper	Signif.
-10	-98.52	161.10	-467.73	270.69	
-9	271.95	147.35	-65.76	609.65	
-8	31.01	228.12	-491.81	553.84	
-7	-52.87	116.10	-318.95	213.20	
-6	-53.20	282.68	-701.07	594.67	
-5	-269.70	132.19	-572.65	33.25	
-4	150.16	513.32	-1026.29	1326.62	
-3	12.24	91.51	-197.49	221.97	
-2	-256.07	249.87	-828.74	316.60	
-1	-80.26	162.51	-452.71	292.19	
0	-239.57	269.55	-857.34	378.20	
1	-270.94	328.77	-1024.45	482.56	
2	6.37	507.57	-1156.91	1169.64	
3	42.86	438.14	-961.30	1047.02	
4	-507.74	366.07	-1346.71	331.23	
5	-879.49	447.56	-1905.23	146.25	
6	-1354.16	561.48	-2640.99	-67.33	*
7	-1433.23	573.10	-2746.70	-119.76	*
8	-1115.84	397.24	-2026.27	-205.41	*
9	-1295.90	447.64	-2321.84	-269.97	*
10	-1498.56	522.11	-2695.17	-301.95	*

Table 10: Event Study ATT Estimates for Total Visitor Spending (Per Capita) at 1% cutoff threshold

t	ATT	Std. Error	95% CI Lower	95% CI Upper	Signif.
-10	-3.13	6.74	-19.29	13.03	
-9	3.76	3.87	-5.52	13.05	
-8	1.25	8.26	-18.56	21.07	
-7	-3.28	3.19	-10.93	4.38	
-6	-0.79	11.56	-28.53	26.94	
-5	-10.46	4.61	-21.53	0.60	
-4	3.92	15.33	-32.84	40.68	
-3	-4.25	4.97	-16.18	7.68	
-2	-17.71	12.82	-48.46	13.04	
-1	-4.72	6.98	-21.47	12.02	
0	-11.63	10.99	-37.99	14.74	
1	-12.86	14.46	-47.54	21.82	
2	-3.65	21.98	-56.37	49.07	
3	-7.14	23.29	-63.00	48.72	
4	-37.95	22.42	-91.71	15.82	
5	-50.81	24.74	-110.14	8.53	
6	-70.55	29.18	-140.54	-0.56	*
7	-77.87	29.92	-149.63	-6.11	*
8	-79.54	25.58	-140.89	-18.20	*
9	-89.30	28.79	-158.35	-20.25	*
10	-100.44	31.86	-176.85	-24.04	*

Table 11: Event Study ATT Estimates for County Tax Receipts (Per Capita) at 1% cutoff threshold

t	ATT	Std. Error	95% CI Lower	95% CI Upper	Signif.
-10	-3.00	4.57	-13.65	7.65	
-9	5.59	3.22	-1.92	13.10	
-8	0.96	5.84	-12.65	14.56	
-7	-0.33	2.90	-7.08	6.43	
-6	-0.16	7.42	-17.46	17.14	
-5	-6.13	3.00	-13.13	0.87	
-4	2.81	11.88	-24.88	30.50	
-3	-0.93	2.64	-7.08	5.23	
-2	-6.46	5.69	-19.72	6.81	
-1	-1.62	4.48	-12.07	8.82	
0	-6.15	6.36	-20.97	8.68	
1	-6.02	8.94	-26.85	14.81	
2	1.90	15.28	-33.71	37.50	
3	4.43	11.86	-23.20	32.06	
4	-11.92	10.50	-36.37	12.53	
5	-20.55	12.26	-49.11	8.00	
6	-35.03	14.41	-68.60	-1.47	*
7	-38.28	15.83	-75.17	-1.40	*
8	-29.97	10.12	-53.56	-6.39	*
9	-34.85	11.12	-60.75	-8.95	*
10	-39.67	14.06	-72.44	-6.91	*

Table 12: Event Study ATT Estimates for State Tax Receipts (Per Capita) at 1% cutoff threshold

t	ATT	Std. Error	95% CI Lower	95% CI Upper	Signif.
-10	-68.61	117.42	-348.44	211.23	
-9	225.71	122.31	-65.77	517.18	
-8	-28.00	147.54	-379.61	323.62	
-7	-50.22	126.28	-351.18	250.73	
-6	-17.23	257.78	-631.56	597.10	
-5	-201.40	82.53	-398.07	-4.73	*
-4	32.97	329.99	-753.47	819.41	
-3	1.70	80.30	-189.68	193.08	
-2	-217.49	219.12	-739.69	304.72	
-1	-68.25	137.23	-395.30	258.81	
0	-183.05	225.50	-720.46	354.36	
1	-178.60	295.28	-882.31	525.10	
2	52.93	414.18	-934.15	1040.02	
3	91.63	366.20	-781.08	964.35	
4	-454.94	323.90	-1226.86	316.98	
5	-780.87	388.93	-1707.77	146.03	
6	-1140.00	443.87	-2197.82	-82.18	*
7	-1211.84	541.98	-2503.47	79.80	
8	-959.21	308.09	-1693.45	-224.96	*
9	-1096.00	364.12	-1963.78	-228.22	*
10	-1265.67	445.07	-2326.37	-204.98	*

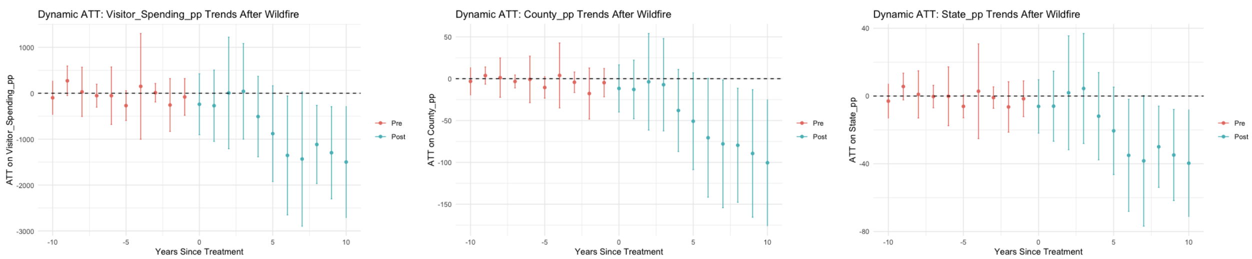
Table 13: Event Study ATT Estimates for Hotel/Motel Spending (Per Capita)

t	ATT	Std. Error	95% CI Lower	95% CI Upper	Signif.
-10	-5.72	21.71	-124.45	113.01	
-9	-1.43	10.76	-60.27	57.42	
-8	47.47	42.73	-186.27	281.21	
-7	0.43	25.42	-138.59	139.45	
-6	-2.26	5.00	-29.60	25.08	
-5	-28.81	44.32	-271.21	213.59	
-4	66.03	78.37	-362.63	494.70	
-3	-2.47	5.68	-33.53	28.60	
-2	-11.42	13.99	-87.94	65.10	
-1	10.08	22.16	-111.15	131.30	
0	-30.89	31.78	-204.72	142.93	
1	-45.92	58.02	-363.30	271.45	
2	-46.35	80.84	-488.51	395.81	
3	-49.43	91.77	-551.43	452.57	
4	-39.62	26.30	-183.49	104.26	
5	-13.20	15.16	-96.14	69.75	
6	-50.72	31.84	-224.90	123.47	
7	-27.59	25.16	-165.20	110.03	
8	-1.70	20.42	-113.40	110.00	
9	-17.63	26.96	-165.11	129.85	
10	-32.55	36.37	-231.50	166.40	

Table 14: Event Study ATT Estimates for Campground Spending (Per Capita) at 1% cutoff threshold

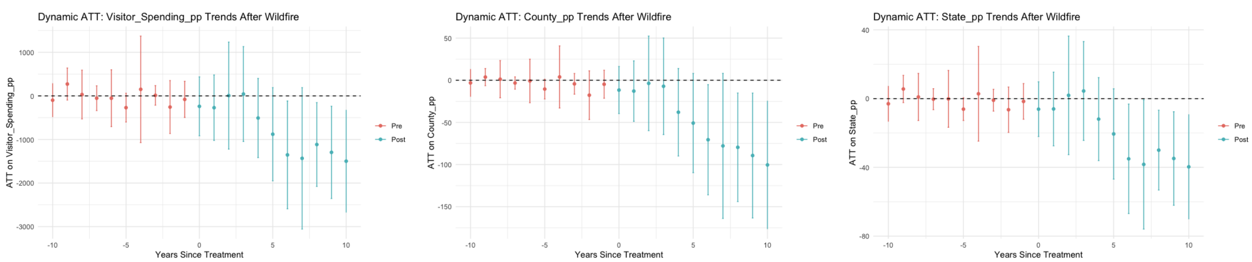
Appendix C. Event Study Figures

1% Cutoff



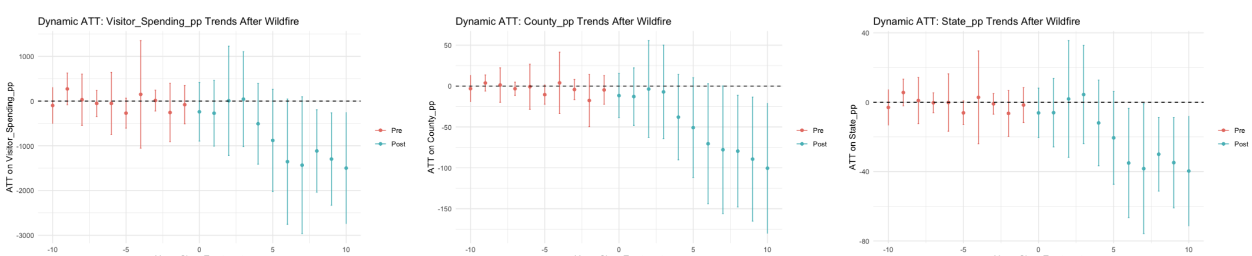
(a) Visitor Spending **(b)** County Tax **(c)** State Tax

Figure 12: Baseline specification: event-study estimates under the 1% wildfire size cutoff.



(a) Visitor Spending **(b)** County Tax **(c)** State Tax

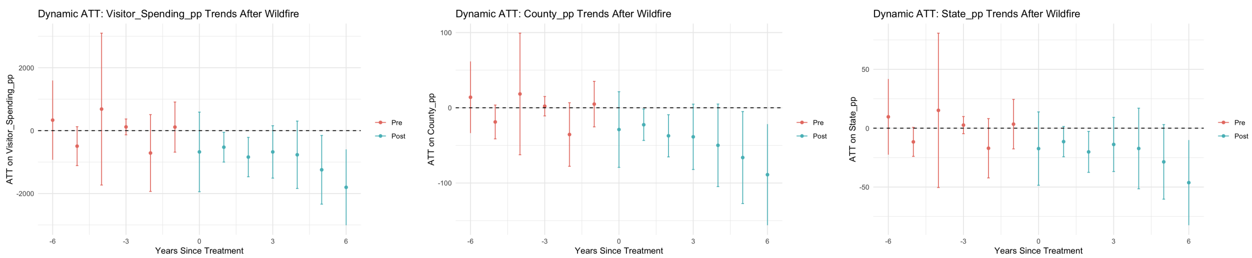
Figure 13: Rural-only specification: event-study estimates under the 1% wildfire size cutoff.



(a) Visitor Spending **(b)** County Tax **(c)** State Tax

Figure 14: Excluding La Plata County: event-study estimates under the 0.5% wildfire size cutoff.

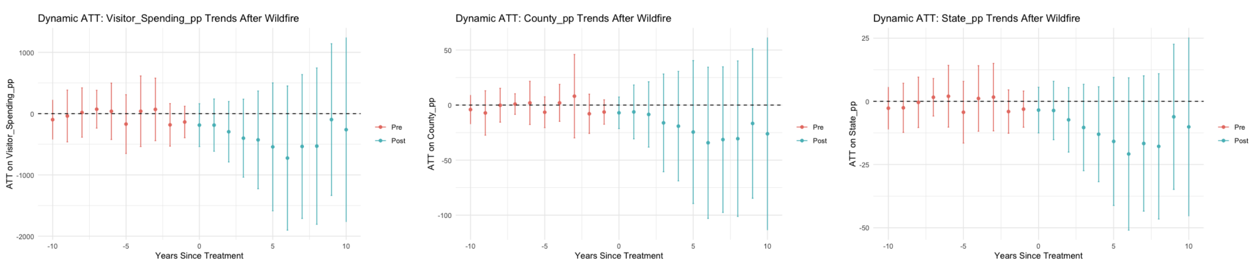
0.5% Cutoff



(a) Visitor Spending **(b)** County Tax **(c)** State Tax

Figure 15: Baseline specification: event-study estimates under the 0.5% wildfire size cutoff.

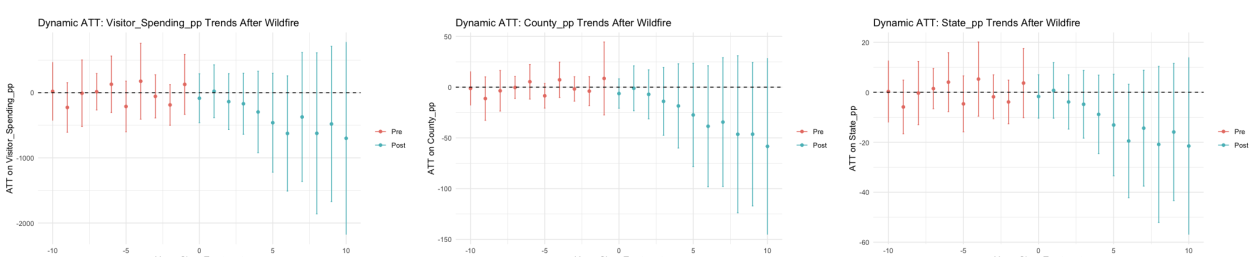
5% Cutoff



(a) Visitor Spending **(b)** County Tax **(c)** State Tax

Figure 16: Baseline specification: event-study estimates under the 5% wildfire size cutoff.

10% Cutoff



(a) Visitor Spending **(b)** County Tax **(c)** State Tax

Figure 17: Baseline specification: event-study estimates under the 10% wildfire size cutoff.

Appendix D. Event-Study Figures for Robustness Checks (1% Cutoff)

Excluding Front Range Counties

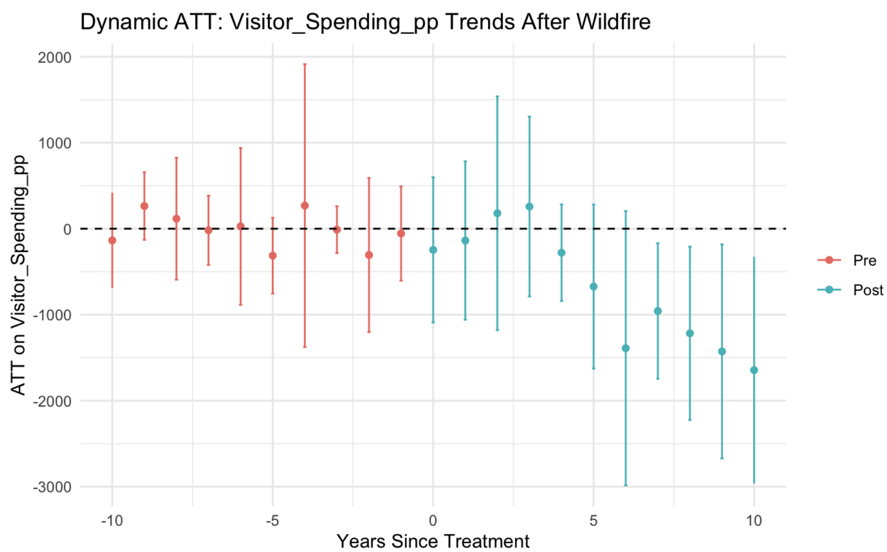


Figure 18: Event-study estimates for total visitor spending (excluding Front Range counties).

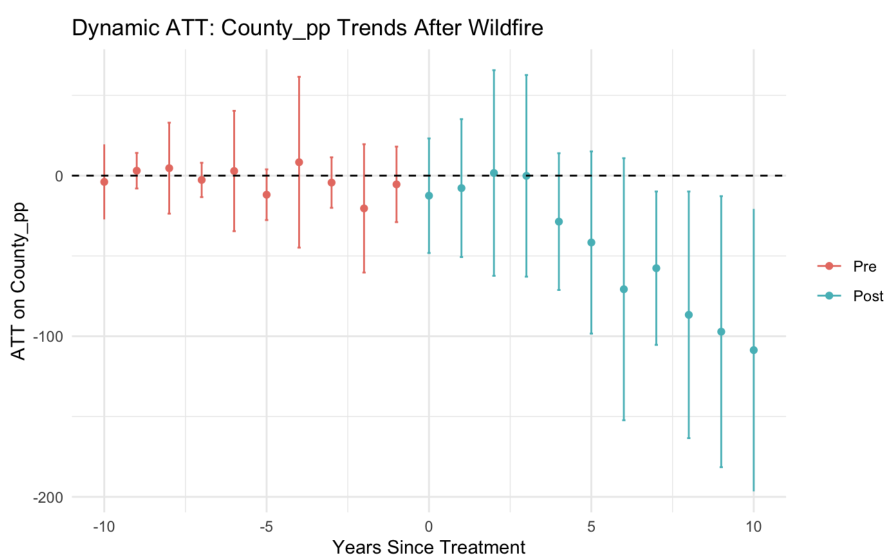


Figure 19: Event-study estimates for county tax receipts (excluding Front Range counties).

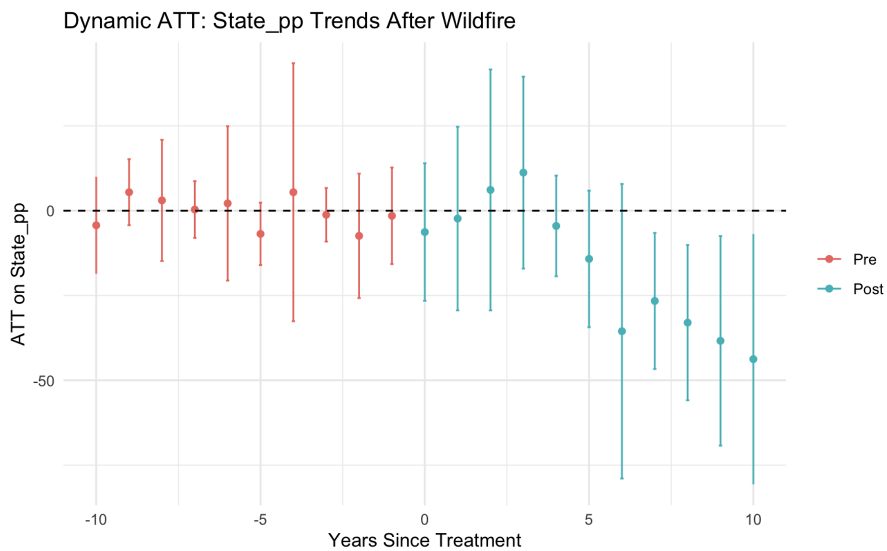


Figure 20: Event-study estimates for state tax receipts (excluding Front Range counties).

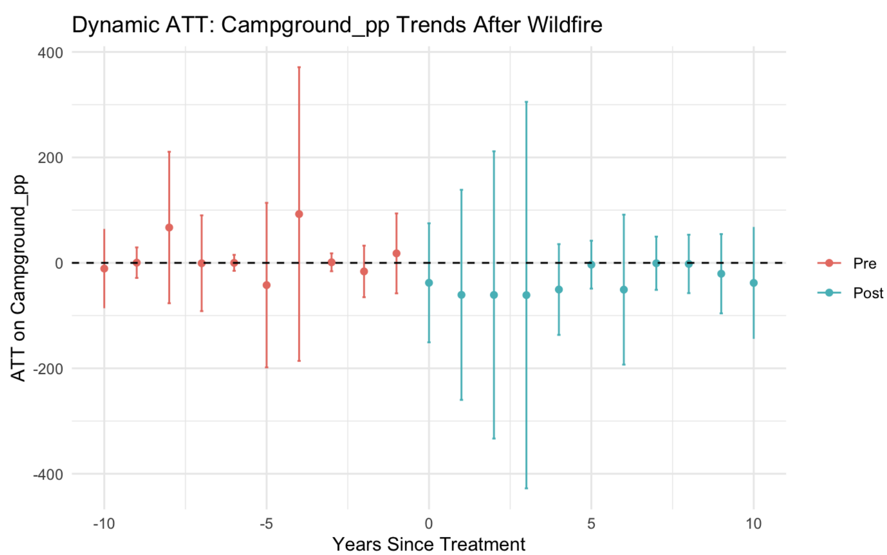


Figure 21: Event-study estimates for campground spending (excluding Front Range counties).

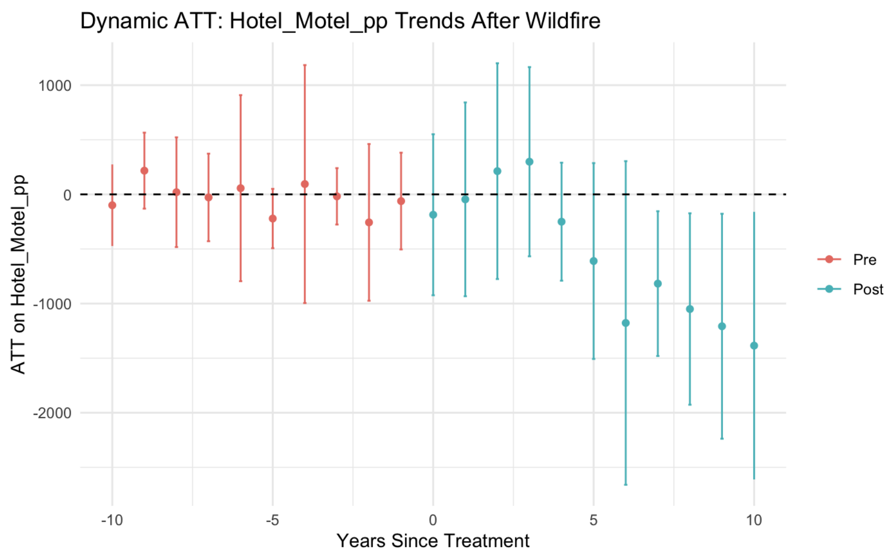


Figure 22: Event-study estimates for hotel and motel spending (excluding Front Range counties).

Excluding Twice Treated Counties (1% cutoff)

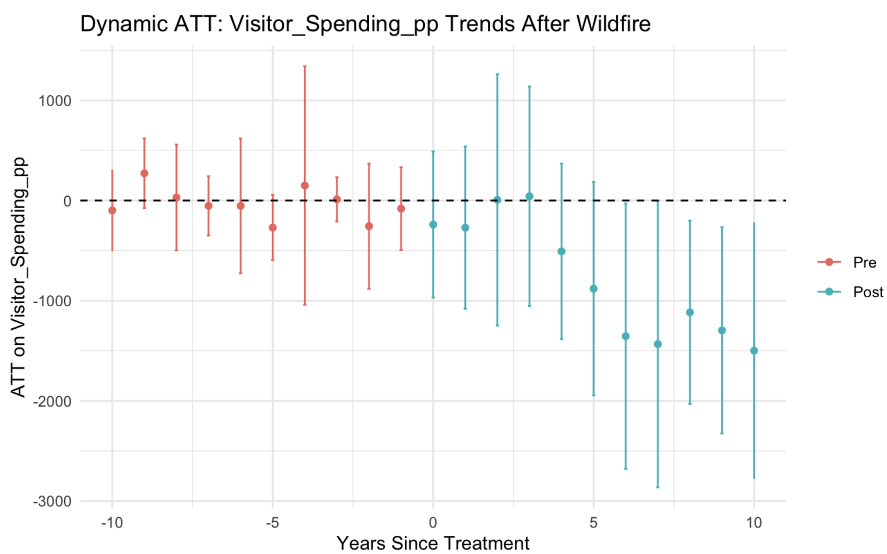


Figure 23: Event-study estimates for total visitor spending (excluding twice-treated counties).

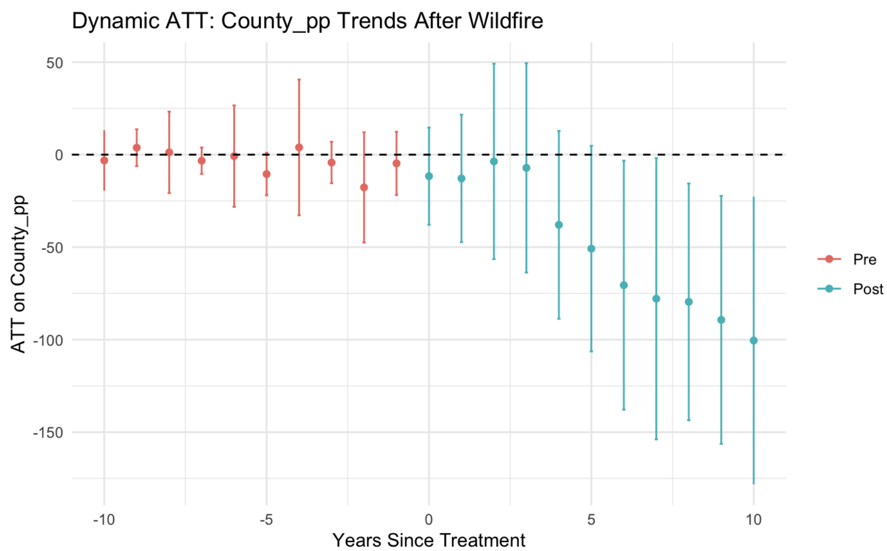


Figure 24: Event-study estimates for county tax receipts (excluding twice-treated counties).

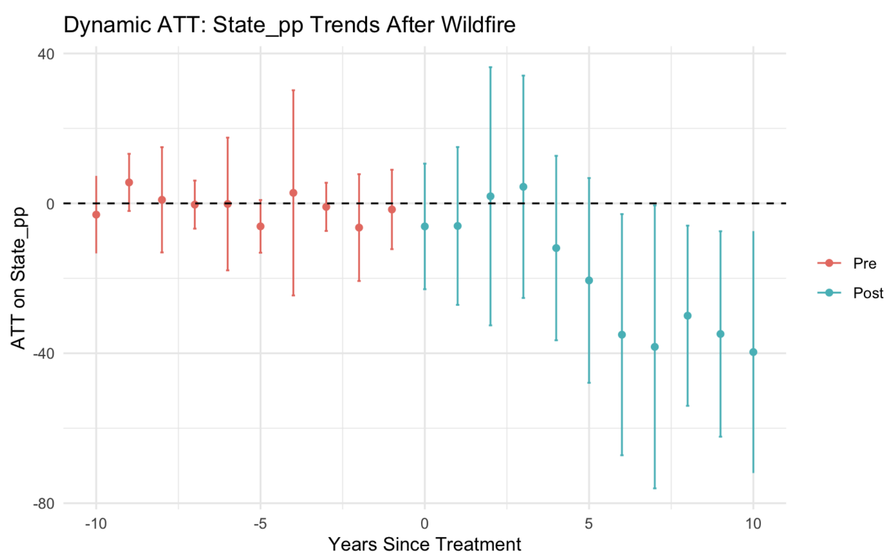


Figure 25: Event-study estimates for state tax receipts (excluding twice-treated counties).

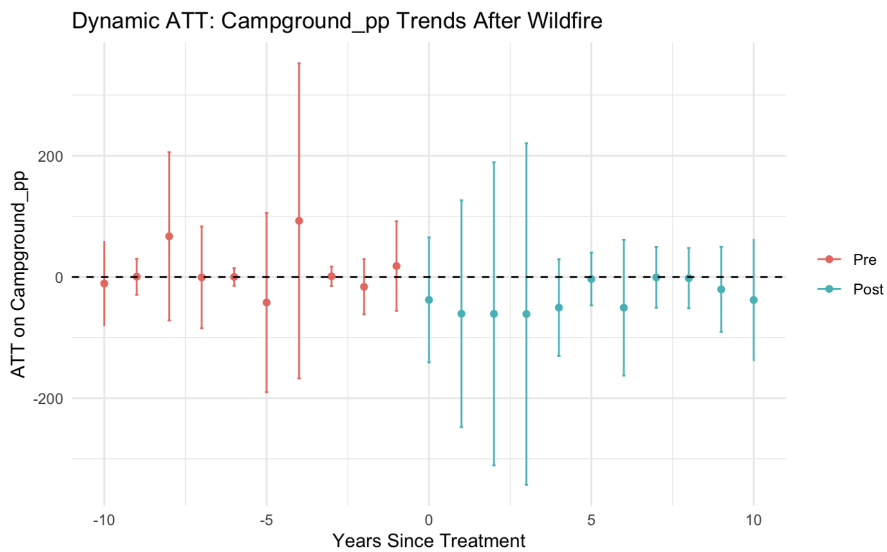


Figure 26: Event-study estimates for campground spending (excluding twice-treated counties).

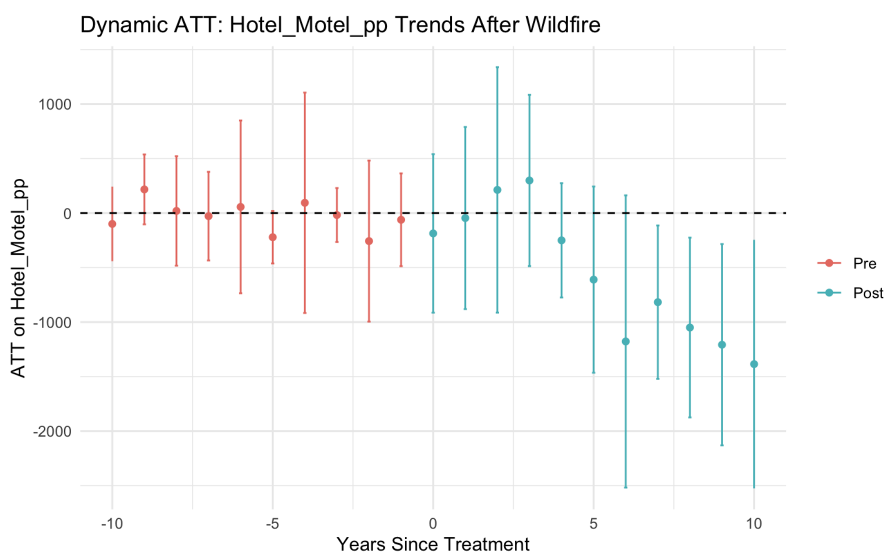
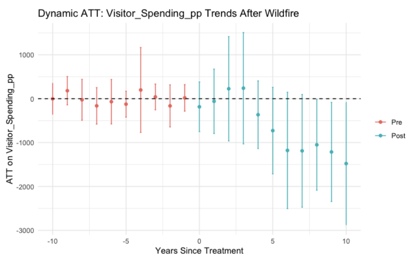
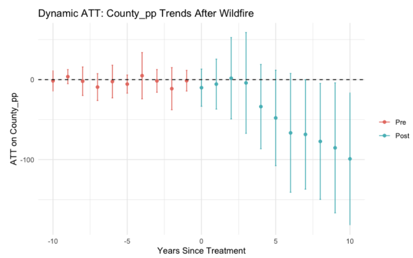


Figure 27: Event-study estimates for hotel and motel spending (excluding twice-treated counties).

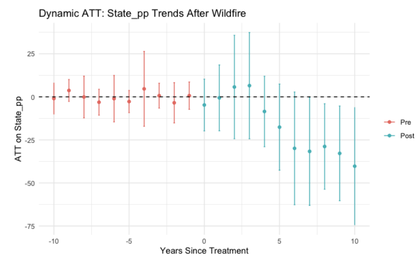
Appendix E. Spillover Event-Study Figures



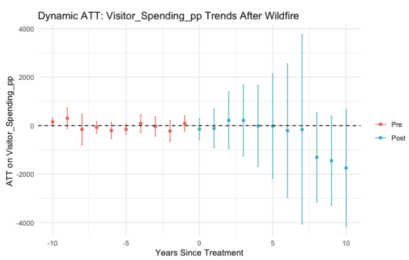
(a) Visitor Spending, 10 miles



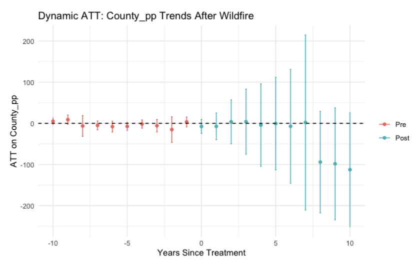
(b) County Tax, 10 miles



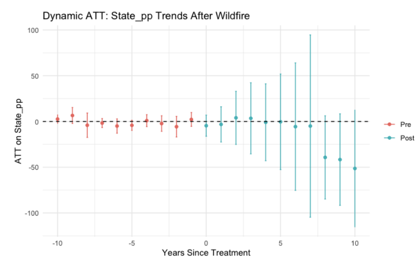
(c) State Tax, 10 miles



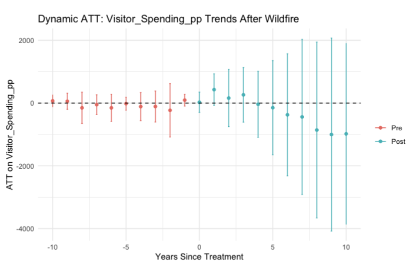
(d) Visitor Spending, 25 miles



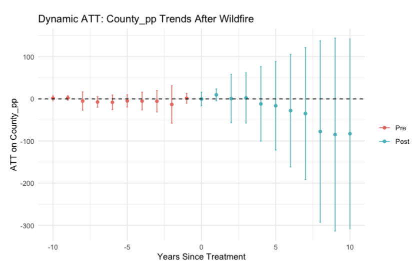
(e) County Tax, 25 miles



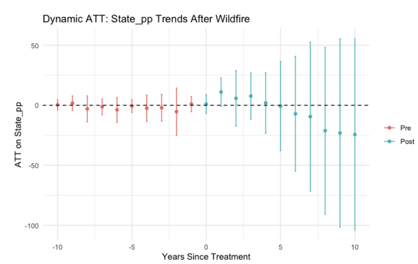
(f) State Tax, 25 miles



(g) Visitor Spending, 50 miles



(h) County Tax, 50 miles



(i) State Tax, 50 miles

Figure 28: Event-study estimates for spillover exposure buffers around wildfire perimeters. Rows vary buffer radius (10/25/50 miles); columns vary outcome (Visitor Spending, County Tax, State Tax).