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Wildfire, national park visitation, and changes in regional economic activity

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ABSTRACT

The visibility, safety, and health effects of seasonal wildfires may affect recreational visits to national parks (NPs), even if fires occur outside of park boundaries. This study statistically quantifies the effect of nearby wildfire on tourist flows to each of Utah's five NPs (Arches, Bryce Canyon, Canyonlands, Capitol Reef, and Zion). Using monthly data from May 1993 to December 2015, we empirically link wildfire activities (measured as monthly area burned within 80 km, 160 km, and 320 km radii) to monthly visits to each national park. Results show that wildfire has negative and statistically significant effects on visitation in four of the five NPs. Aggregate annual visitation losses at each park are between 0.5% and 1.5% during a typical (mean) fire year. The negative regional economic impacts of seasonal wildfire at all national parks in Utah are estimated to be between \$2.7 and \$4.5 million, with an associated loss of between 31 and 53 jobs depending on the extent of area burned. Economic impacts of reduced visitor expenditures are distributed unequally, with proportionately greater negative effects occurring in tourism-dependent rural economies.

Management implications

- Visitation at national parks is sensitive to wildfires, even if wildfires occur outside of park boundaries.
- Sensitivity to wildfire differs by park, but visitation losses over an average fire year are roughly between 0.50% and 1.5%.
- The proportional economic impact of visitor expenditure losses is greater in rural, tourism-dependent counties than for parks located within larger, more diversified economies.
- Managers of rural national parks may target wildfire suppression and risk reduction activities on nearby public lands to reduce risk not just to property, but also the livelihoods of rural residents.

1. Introduction

On June 17, 2017, a man burning weeds on private property near the Brian Head ski resort in mountains of southern Utah ignited a fire that quickly grew out of control. Within a week the fire had grown to over 16,000 ha. Mountain communities were evacuated, and roads accessing the ski area, Cedar Breaks National Monument (NM), and adjacent public land administered by US Forest Service were closed to all traffic. It took another week for the fire to be controlled, and another two weeks before cessation of fire suppression activities; by then, the fire had burned almost 29,000 ha (NWCG 2017). With access to Cedar Breaks NM eliminated by road closures, June and July visitation fell by nearly 15% relative to the same months in 2016 (USNPS 2018). More surprising was the effect of the Brian Head fire on visitation at Bryce Canyon National Park (NP), located 60 km east of Brian Head. Although the fire never came close to park boundaries, park visitation fell by almost 1% in June, the month during which the fire grew rapidly and unpredictably (USNPS 2018).

National parks, especially those located in rural regions, are important drivers of economic activity (Gabe, 2016; Wilkerson, 2003). The visibility, safety, and health effects of seasonal wildfire can affect recreational visits to national parks and elsewhere (Thapa, Cahyanto, Holland, & Absher, 2013). Fires within a park can lead to road and campground closures, create smoke that damages health and reduces visibility, and change the park's landscape (Duffield, Neher, Patterson, & Deskins, 2013). As the Brian Head fire illustrates, potential visitors may believe that travel to and time spent visiting a national park with nearby wildfire activity may be dangerous or may affect trip quality, even if roads to the park are not closed and the fire is not burning within park boundaries (Thapa et al., 2013).

Our study tests two hypotheses. First, we test whether wildfires in proximity to national parks negatively affect the flow of tourists to that park. This is important because, while the tourism literature has focused on the micro-level effects of natural disasters on tourism destination choices, few researchers have examined wildfire in detail (Karl & Schmude, 2017). To the degree that wildfire has been studied, the bulk of the literature has examined post-fire effects on the number of trips

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demanded and the change in trip quality at the individual (micro) level, with little focus on contemporaneous effects of wildfire on aggregate (macro) visitation (Bawa, 2017).

Secondly, as Duffield et al. (2013) and Wilkerson (2003) note, reduced total visitation means that tourism expenditures will fall, resulting in a cascade of employment and income effects throughout the regional economy. The second objective of this study is to measure the economic effects of wildfire as they differ according to the economic structure of the local economies within which they occur. We expect the economic losses associated with wildfires occurring within diversified local economies to be proportionally smaller than similar wildfires occurring in local economies that are more heavily dependent upon tourism. If wildfire has differing proportional economic effects, fire management officials may wish to consider these effects when deciding how to allocate wildfire preparedness and suppression efforts.

2. Literature review

We are not the first to hypothesize an effect of natural disasters on recreation and tourism, and a deep literature has evolved. Karl and Schmude (2017) provide an overview and synthesis of studies regarding the role of risk perceptions in tourists' destination choices at both the micro (individual tourist) and macro (aggregate tourism flows) levels. In addition to natural disasters such as wildfire, tsunamis, hurricanes, and earthquakes, the broader literature has also considered health risks, crime, political instability, and terrorism. Tourists can be exposed to many kinds of risk, but the key risk exposure pathways related to our wildfire study are *functional* (the possibility of mechanical, equipment, or organizational problems while traveling), *physical/health* (the possibility of physical danger or harm), and *financial* (the possibility that a recreational trip will not provide good value). All of these risk factors, and others that are less relevant to natural disasters, can influence destination choice both immediately and over time.

For example, Rittichainuwat, Nelson, and Rahmafitria (2018) recently examined the effect of the perceived probability of a tsunami on tourism in Southeast Asian countries that had endured the major Indian Ocean tsunami of 2004. The authors found that visitors incorporated tsunami risk into travel destination decisions, that perceived risk was site specific, and that the risk of a tsunami at the selected beach during the trip was perceived to be quite low. People's perceived risk of tsunamis declined over time, as well. As another micro-level example, Sarman, Scagnolari, and Maggi (2016) looked at four sources of risk associated with international tourism (terrorism, political insurgencies, natural disasters, and health epidemics) and gauged the effect on possible tourism to Southeast Asia. Their stated choice experiment found that higher levels of risk resulted in all trips (of any length) being less likely, but the effect on destination choice became smaller as length of trip (a proxy for exposure to risk) becomes shorter. Thus, the risk of natural catastrophes can affect where, when, and how long people will choose to recreate.

Thapa et al. (2013) conducted a related study of perceived wildfire risk and tourism in Florida. The authors found that tourists could be separated into three groups according to wildfire risk perceptions: *Cautious* travelers (25% of the sample) were the most averse to wildfire conditions, whereas *Conscious* (42%) and *Courageous* (33%) travelers were less responsive to dangerous wildfire conditions. Across a variety of wildfire outcomes such as wildfire-caused traffic backups, accidents, road closures, smoke on site, smoke-related health effects, and media attention, courageous travelers were least likely to cancel a trip, change trip destination, or change recreation activities. Cautious travelers were most likely to modify their recreation trips in response to smoke on site, high fire risk, multiple fires burning elsewhere in the state, prescribed fire, and any wildfire receiving negative media attention.

The Rittichainuwat et al. (2018), Sarman et al. (2016), and Thapa et al. (2013) studies centered on what Karl and Schmude (2017) term the *functional* and *physical/health* risk factors associated with tourism. Wildfire can influence not only these factors but also the quality of a recreation trip—what Karl and Schmude call the *financial* risk factor and what economists would term as *changes in net economic value*. Bawa (2017) recently completed a comprehensive review of this literature, ranking studies by quality and summarizing changes in consumer welfare and trip demand by ecoregion and outdoor activity. Nearly all of the studies reviewed by Bawa (2017) examined the response of visitors to onsite landscape changes after a wildfire had *already occurred*. Vaux, Gardner, and Miller (1984), Englin, Loomis, and Gonzalez-Caban (2001), and Hesseln et al. (2003) all used photographs of burned areas and hypothetical visitation questions to measure behavioral responses to wildfire. In contrast, Love and Watson (1992), Englin et al. (1996), Hesseln et al. (2004), and Boxall and Englin (2008) used actual visitation (revealed preferences) to examine visitation patterns immediately after a wildfire. None of these studies examined the contemporaneous effects of wildfire on recreation trips at either the micro- or macro-levels.

The only contemporaneous wildfire-related tourism flow study we can find is that of Duffield et al. (2013), who used an econometric model to examine the effects of current monthly wildfire and lagged monthly wildfire on visitation to Yellowstone NP. Wildfire effects were measured by the total area of fires burning within 50 miles (80.5 km), 100 miles (160.9 km), and 200 miles (321.9 km) of the park center during the month of visitation, as well as the preceding month. The authors found a statistically significant and negative effect of fire and lagged fire on monthly park visitation over the 1986–2011 study time frame. The loss in visitation for a mean fire year was 1.3% of the annual average visitation; during a median fire year the loss is about 0.2% of annual visitation (Duffield et al., 2013).

3. Regional setting, data, and methods

3.1. Economic and physiographic setting

Utah's five national parks stretch across the spectacular red rock country of six counties in the southern half of the state. Some 80% of the nearly 200,000 people residing in the six-county region live in Washington county, home to Zion National Park's main entrance (a small portion of Zion NP is in Iron county, which we do not include in our study region.) Relative to other counties in the study region, Washington county, at 24.7 persons per km^2, is relatively densely populated (U.S. Census Bureau 2018). Its economy is also highly diversified, with only 17.5% of the county's total private employment in the leisure and hospitality sector (Leaver, 2017). The story is quite different in the remainder of the region, however. Population density in the 60,600 km^2 area covered by Garfield, Grand, Kane, San Juan and Wayne counties is 0.66 persons/km^2 (U.S. Census Bureau 2018). The federal government is, by far, the dominant landowner: less than 7% of the land area in these counties is privately-owned (Banner, Baldwin, & Leydsman McGinty, 2009). The leisure and hospitality industries of Garfield (56%), Grand (45.7%), and Kane (43.4%) all provide the largest share of total private employment in each county (Leaver, 2017). The industry is also important in Wayne county (36.2%); only San Juan county (21.6%) has a relatively low reliance on the leisure and hospitality industry (Leaver, 2017).

Four of the five parks (Arches, Canyonlands, Capitol Reef, and Zion) are located in a Level III Ecoregion called the Colorado Plateau (Woods et al., 2001). At semi-arid higher elevations, vegetation on the Colorado Plateau is composed primarily of pinyon-juniper woodlands while its arid lowlands have saltbush-greasewood and blackbrush. Utah's only park outside of the Colorado Plateau ecoregion is Bryce Canyon NP, which is associated with the Level III Wasatch and Uinta Mountains Ecoregion. The Level IV ecoregion around Bryce Canyon (High Plateaus) is subalpine, and features firs, spruce, Douglas fir, and aspen. Ponderosa pine may be found at lower elevations. The woodlands of these Ecoregions once supported a thriving timber industry in Garfield

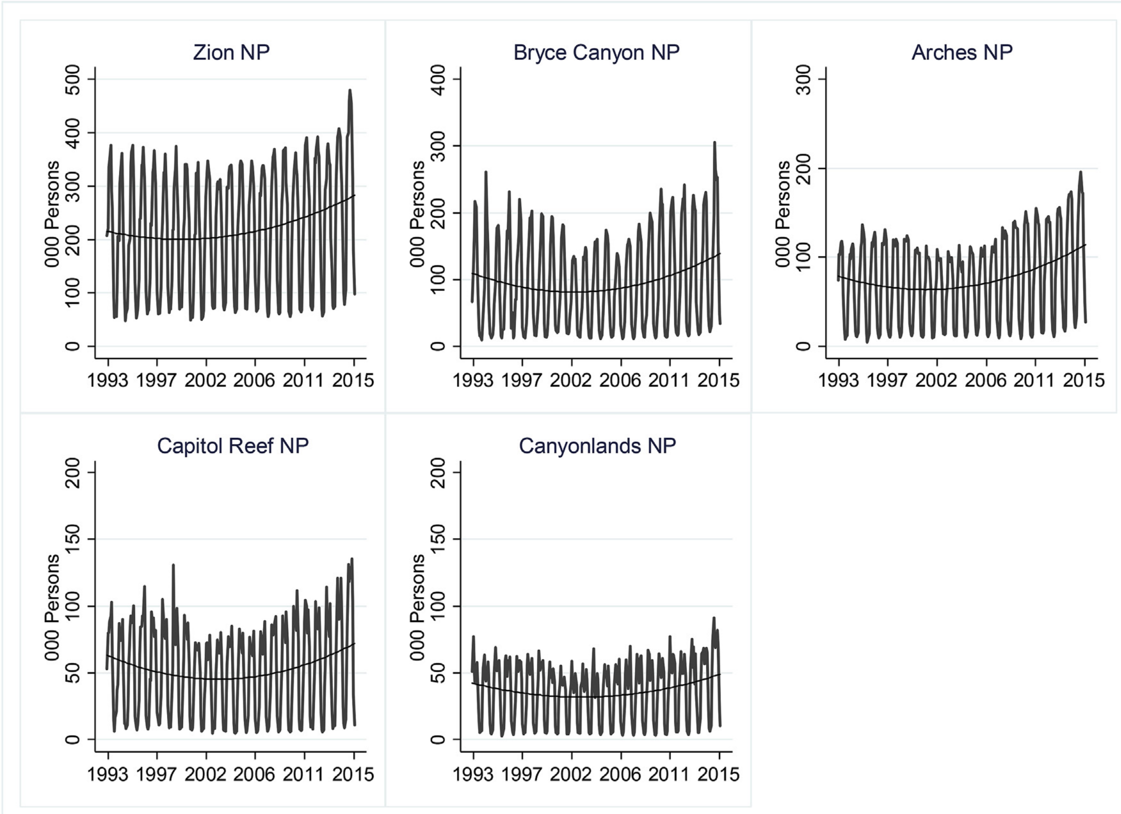

Fig. 1. Monthly Visitation to National Parks in Utah, May 1993 through December 2015 (‘000 visitors).
Source: National Park Service (2018).

and Kane counties. However, US Forest Service policies reduced harvest in these counties by nearly 89% between 2002 and 2012; reductions in harvest have been accompanied by increased stand density and risk of catastrophic wildfire (Sorensen et al., 2016; Werstak et al., 2016).

3.2. Data

The National Park Service maintains historical data about the monthly number of visitors to each national park (USNPS, 2018). Data were collected for the five national parks for all months between May 1993 and December 2015 (273 monthly observations for each park) (see Fig. 1). The USNPS (2016) also conducts surveys at each park unit to examine per visitor spending patterns and spending totals; these data were collected for use in the regional economic impact modeling.

USFS wildfire occurrence data were downloaded directly from the Forest Service Research Data Archive (Short et al., 2017). Selecting only fires greater than 2 ha and occurring between May 1993 and December 2015, geo-location coordinates allowed us to calculate the distance between the fire origin and the visitor center of each NP. Choosing the size of the wildfire zone of influence is rather arbitrary, so we followed Duffield et al. (2013) by using radii of 80 km, 160 km, and 320 km. Any wildfire igniting outside a 320 km radius of all national park visitor centers was dropped, leaving 8,787 wildfires as possibly influencing visitation at one or more national park. Fig. 2 presents wildfire activity within 160 km zone of any National Park in Utah. Dots are orgins of wildfire in Fig. 2. The ignition dates for all fires were known but the containment dates of 824 fires (9%) were unknown. Thus, we assign the total burned area of a fire to the month the fire started. Amongst fires with known containment dates, some 95% were contained within 30 days, and 98% were contained within 60 days. We cannot model individual fires because many fires may be burning simultaneously in a given month. Instead, for each park and for each month, the area of all fires within a given radius are summed to create a variable measuring monthly fire activity in or adjacent to national parks. Some months had zero wildfire area; we added 1 ha to the wildfire area for all months so that a log-log visitation model could be estimated.

The monthly gasoline price for the Rocky Mountain region was obtained from U.S. Energy Information Administration (EIA 2018) and adjusted for inflation to a 2015 constant (real) dollars. Following the Duffield et al. (2013) model specification, we divide the real gasoline price by real per capita personal income. The influence of economic recessions is captured by an indicator variable that takes a value of one during times of recession and zero otherwise. Two recessions occurred during our time frame; beginning and ending dates of recessions are reported in the Federal Reserve Economic Database (FRED, 2018).

The Utah Office of Tourism began a marketing campaign focusing on the five National Parks in Utah in April 2013; the campaign has promoted out-of-state visitation to Utah's parks through integrated communications, marketing, and travel trade initiatives. The “Mighty 5” campaign has been considered highly successful in bringing more visitors to Utah's National Parks. A dummy variable for the advertising campaign takes a value of one beginning in April 2013 and a value of zero before that date.

3.3. Analytic strategy

3.3.1. Econometric approach

We estimate linear regression models of visitation to each of five national parks in Utah using the general specification shown in Equation (1):

$$v_t = f\,(wf_t,\ wf_{lagged},\ p_t^{gas},\ Recession,\ Mighty\ Five,\ Time\ Trends) + \varepsilon_t, \tag{1}$$

where v_t is the number of visitors in month t, wf_t and wf_{lagged} are hectares

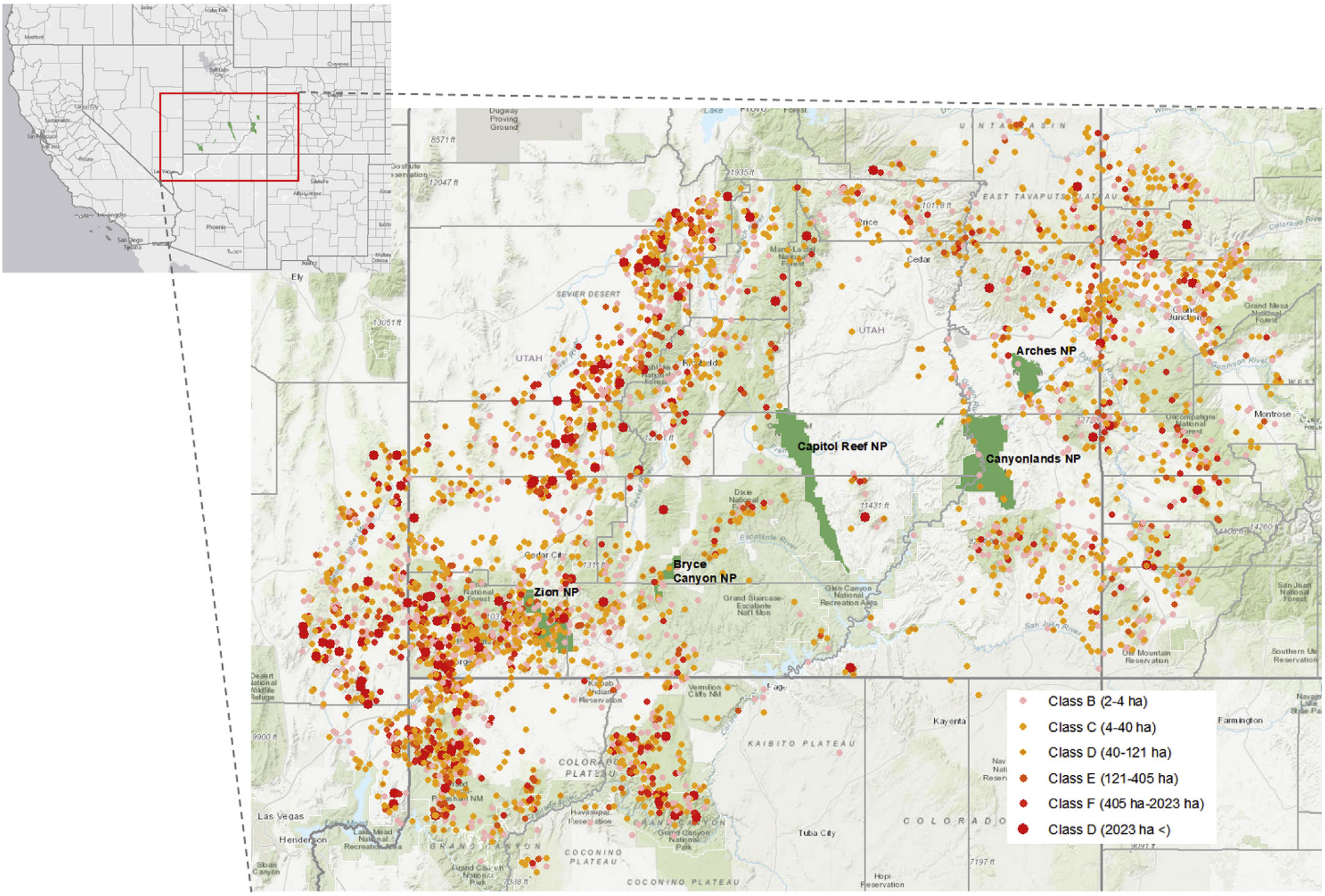

Fig. 2. Wildfire Activity within 160 km zone of any National Park in Utah, May 1993–December 2015.
Dots are origins of wildfires. Darker colors indicate larger wildfires. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

burned by wildfire within a defined wildfire zone (with radius of 80 km, 160 km, or 320 km) during months t and a lagged effect (with structure to be determined), p_t^{gas} is the real gas price (a proxy for travel cost), economic recessions, the Mighty 5 advertising campaign, fixed time effects, and the error term, ε_t. Coefficients for any given specification of the model were estimated using ordinary least squares (OLS) regression.

Monthly tourism data can exhibit strong seasonality, which can cause two econometric problems. First, one can anticipate correlation of a monthly time series with its own past and future values. A Breusch-Pagan test can be used to assess serial correlation and then, if necessary, one may adjust the variance-covariance matrix to obtain estimated standard errors with desirable properties (Newey & West, 1987). Secondly, seasonal variation in visitation variable can cause heteroscedasticity, *i.e.*, the variance of the regression is non-constant and the estimated variance-covariance matrix is biased. Post-regression tests, such as the White test (White, 1978), can be used to determine if heteroscedasticity is present. If the variance is non-constant, an often effective remedy is to transform the dependent variable its natural log, as in equation (2):

$$\ln v_t = f\,(wf_t,\ wf_{lagged},\ p_t^{gas},\ Recession,\ Mighty\ Five,\ Time\ Trends) + \varepsilon_t, \tag{2}$$

where $\ln v_t$ is now the natural log of visitation in month t. This functional form also has the added advantage of allowing for non-linear marginal effects of wildfire.

When modeling wildfire effects on visitation, one could consider wildfire zones of any radius, specifications that include linear, quadratic or logged measures of wildfire; and any number of monthly lags to capture the lingering effects of wildfire. The number of modeling options is in effect infinite, but we do not wish to engage in a wide-ranging specification search to find a preferred model for any given park (Caudill & Holcombe, 1999). Instead, we consider wildfire zones with radii of 80 km, 160 km, and 320 km, which allows us to compare our results to those of Duffield et al. (2013). Secondly, we follow Thapa et al.'s (2013) analysis of contemporaneous wildfire effects on tourism, specifically the decision to make a trip or not, which is equivalent to changes in our total trips measure. Thus, we keep the number of time lags to just one month or three months. This permits us to account for changes in visitation as linked to wildfire for up to four months (one current month and three previous months.) This approach also has the advantage of capturing, in a single model, the amount of wildfire occurring during the months of greatest visitation (May, June, July, and August). Third, we model wildfire by considering models that have linear, quadratic and logged measures of wildfire size on the right-hand side. We then rely upon the corrected Akaike Information Criterion and associated evidence ratios to select the best relative model (Burnham, Anderson, & Huyvaert, 2011).

3.3.2. Simulating regional economic impacts

Our regression model empirically estimates the change in visitation in response to wildfire, which will result in reduced tourism expenditures in the region. Changes in expenditures, also known as changes in final demand, can be entered into an input-output model to estimate multiplier effects (see Poudel, Munn, & Henderson, 2017 for a description of the input-output approach). One complication in this study is the great variation in the timing, size, and geographic distribution of wildfires within and across years. We capture these distributional effects by using a multi-step bootstrap approach that simulates both magnitude and timing of wildfire:

1. Simulate wildfires within the wildfire zone for each national park based on the historical spatial distribution, timing, and size of wildfires. An intertemporal correlation among months is considered in the random draws.
2. For each park and its monthly wildfires for a simulated fire year, calculate the effect of wildfire area on the number of visitors using estimated model coefficients. All other model variables are fixed at their 2015 values.
3. Calculate "visitor loss" as the difference between the number of monthly visitors with wildfire (step 2) and the predicted visitors assuming zero wildfires in that month. Monthly visitor losses are summed to derive an annual measure of visitor losses.
4. Repeat steps one through three 1,000 times (1000 simulated fire years for each park) to generate an empirical distribution of wildfire-induced visitation loss at each park.

The empirical distribution of reduced visitation is then combined with park-specific visitor expenditure profiles (USNPS 2016) and the IMPLAN input-output model to measure the economic impact on local economies of wildfire. Expenditures affect the local and regional economy through the inter-relationships among different sectors or industries, so that different spending profiles result in different multiplier effects. Multipliers can be described through the following definitions:

- Direct effects (or direct expenditures) are the changes sales by industries associated with visitors' expenditures. Park visitors have direct expenditures for lodging or camping, groceries, restaurant meals, gasoline or local transportation (bus, shuttles), equipment rentals, etc.
- Indirect effects are backward links to goods and service suppliers as retail firms respond to direct expenditures by park visitors.
- Induced effects are created as income changes in response to direct and indirect effects.
- Total economic effect is the sum of direct, indirect, and induced effects. The multiplier is the ratio of the total effect to the direct effect.

The direct, indirect, induced, and total effects are based upon IMPLAN software for the year 2013, where the six contiguous counties that encompass the bulk of southern Utah—Garfield, Grand, Kane, San Juan, Washington, and Wayne—are treated as a single economic region that is home to all of Utah's national parks (IMPLAN Group LLC, 2018, p. 28078).

4. Results

4.1. Visitation and wildfire data

Fig. 1 presents a time plot of visitation to each national park during the sample period; descriptive statistics are reported in Table 1. Using 2015 visitation as a reference, the annual number of visitors was 1.40 million for Arches NP, 1.75 million for Bryce Canyon NP, 0.63 million for Canyonlands NP, 0.94 million for Capitol Reef NP, and 3.65 million for Zion NP, respectively. In 2015, the total number of visitors to all five national parks was 8.37 million.

The average wildfire size for all 8,787 fires occurring within a 320 km radius of at least one national park was 342 ha, with an average length of 5.7 days. The largest fire was the 144,500 ha Milford Flat fire (July 2007), which was within the 160 km zone for Bryce Canyon NP, Capitol Reef NP, and Zion NP, and within the 320 km wildfire zone for all five parks. Aggregate monthly median and mean wildfire burned area within each of the three wildfire zones are also shown in Table 1.

The distribution of wildfire size is highly skewed because most fires are relatively small. Some 79% of all wildfires burned less than 100 ha, whereas only 5.4% all wildfires within 320 km of a national park burned more than 1000 ha. The distribution of aggregate (total) area burned within a given wildfire zone is also skewed. For example, the 80 km zone for Arches NP—where the 35,600 ha Diamond Creek fire burned in June 2002 just 63 km east of the park—has a mean fire size of 2,187 ha whereas the median fire size was just 47 ha (Table 1). We characterize a typical fire season by referencing both the median and mean burned area.

4.2. Visitation modeling

The White test rejects the null hypothesis of homoscedasticity for a linear specification of every national park model whereas the same test for the semi-log specification fails to reject the null hypothesis of homoscedasticity for four of the five parks; Zion NP, with $P = 0.08$, was the exception. Further, the Breusch-Godfrey test confirms our suspicion of serial correlation: the error in predicting visitation in one month was correlated with the error for the same month in the previous year. We correct this problem by using Newey-West (1987) robust standard errors with 12 lags.

We estimate three general functional forms for our model: a semi-log form that is linear in wildfire size, a semi-log form that is quadratic in wildfire, and a log-log form that uses the natural log of wildfire. Specifications are further varied by wildfire zone width (80 km, 160 km, and 320 km zones) and time lag structure (one monthly lag and three monthly lags). Thus, we estimated 18 empirical models for each of five national parks. Models were selected on the basis of *AICc* values and relative evidence ratios. Table 2 shows *AICc* and evidence ratios for each park for the single-lag specifications. We do not report results for models with multiple lag models because these were never identified as the best relative models; however, empirical results for all 90 park-level model specifications, *AICc* values, and evidence ratios may be found in an online Statistical Appendix.

The semi-log, linear model was the best relative specification for Arches, Bryce Canyon, Canyonlands, and Capitol Reef NPs; the log-log model was preferred for the Zion NP. Evidence ratios are quite strong in favor of semi-log, linear 160 km models for Arches, Bryce Canyon, and Canyonlands NPs (Table 2). For Capitol Reef NP, the semi-log linear, 80 km and log-log, 80 km models were virtually identical in strength; similarly, the semi-log, linear 80 km and the log-log, 320 km models were essentially equal for Zion NP.

Table 3 shows the coefficients for the best relative specifications (minimum *AICc*). As is common with time series models, the models explain a large proportion of total variation in visitation ($0.957 < R^2 < 0.977$ for all models). Before turning to the wildfire coefficients, we first discuss the ancillary factors hypothesized to affect park visitation, but whose influence did not vary across model specifications. The positive coefficient on the Mighty 5 dummy indicates a successful marketing campaign for all parks in all specifications ($P < 0.10$). Independent of the Mighty 5 campaign, the positive coefficient on the time trend shows a slight increasing trend in national park visitation over time for Arches NP and Zion NP ($P < 0.01$ for both). The estimated parameter for recession reveals that, all else equal, a nationwide recession results reduces visitation to Zion NP only ($P < 0.05$). Finally, the income adjusted real price of gasoline is not statistically significant in any model.

We now focus exclusively on the estimated effects of wildfire. Contemporaneous and lagged wildfire coefficients were negative and statistically significant ($P < 0.05$) for Arches, Bryce Canyon, and Capitol Reef NPs. For Canyonlands, the contemporaneous wildfire coefficient was negative and significant at $P < 0.08$, whereas lagged wildfire was negative and significant at $P < 0.01$. Neither wildfire coefficient was significant in the best relative model for Zion NP;

Table 1
Visitation and wildfire data, by National Park and radius of wildfire zone, May 1993 through December 2015.

	Arches	Bryce Canyon	Canyonlands	Capitol Reef	Zion
Monthly Visitation					
Mean	76,437	96,576	36,672	52,967	221,152
Median	77,963	82,038	43,078	58,850	230,959
Min	5,009	9,535	2,792	4,604	47,283
Max	195,748	305,465	91,284	135,543	479,538
80 km Radius					
Total # of wildfires	307	287	202	117	729
Wildfire size, mean (median)[a]	243 (11)	195 (9)	107 (7)	228 (17)	238 (12)
Summed monthly fire (ha)					
May, mean (median)	160 (12)	867 (2)	164 (0)	79 (0)	277 (5)
Jun, mean (median)	2,187 (47)	560 (19)	353 (14)	224 (0)	3,262 (488)
Jul, mean (median)	732 (177)	750 (235)	295 (13)	731 (51)	3,135 (244)
Aug, mean (median)	130 (19)	135 (32)	92 (11)	71 (3)	693 (341)
Sep, mean (median)	11 (2)	50 (0)	10 (0)	15 (0)	116 (34)
160 km Radius					
Total # of wildfires	1,138	1,520	949	1,047	2,049
Wildfire size, mean (median)	172 (10)	428 (14)	178 (10)	543 (12)	546 (17)
Summed monthly fire (ha)					
May, mean (median)	516 (50)	1,522 (34)	500 (39)	915 (10)	2,018 (85)
Jun, mean (median)	3,566 (526)	7,433 (1,768)	2,896 (605)	5,206 (742)	21,146 (2,713)
Jul, mean (median)	3,450 (1,311)	15,588 (6,891)	3,194 (970)	13,172 (3,291)	20,588 (9,843)
Aug, mean (median)	730 (397)	2,689 (1,044)	605 (180)	4,705 (778)	3,890 (1,930)
Sep, mean (median)	139 (39)	836 (315)	81 (21)	569 (62)	764 (353)
320 km Radius					
Total # of wildfires	5,009	5,586	5,242	6,094	4,916
Wildfire size, mean (median)	282 (11)	411 (13)	282 (11)	345 (13)	439 (14)
Summed monthly fire (ha)					
May, mean (median)	2,073 (182)	3,599 (1,087)	2,510 (259)	2,967 (899)	3,485 (1,619)
Jun, mean (median)	18,275 (2,918)	40,831 (9,354)	20,885 (3,516)	30,989 (7,464)	38,635 (7,475)
Jul, mean (median)	26,284 (15,633)	37,687 (26,966)	26,328 (16,397)	37,955 (26,466)	36,822 (25,930)
Aug, mean (median)	11,978 (6,331)	14,488 (9,455)	11,627 (5,487)	15,734 (7,558)	12,417 (6,458)
Sep, mean (median)	1,739 (1,109)	2,301 (1,569)	2,016 (1,628)	2,712 (1,904)	1,782 (1,274)

[a] Wildfire size measured in hectares.

indeed, regardless of specification, no wildfire coefficient was ever significant in any of the 18 model specifications for Zion NP.

One could also estimate a panel model that explicitly holds the contemporaneous and lagged effects of wildfire constant across all parks. The only statistically significant effects were found with the semi-log linear, single time lag park-level with 80 km or 160 km models, so Table 4 reports the analogous pooled times-series cross-section estimation results, where each park is treated as a fixed effect. The contemporaneous and lagged wildfire parameters in the pooled 80 km model statistically differ from zero ($P < 0.07$ and $P < 0.09$, respectively); the wildfire parameters for the pooled 160 km model are not significantly different from zero. The contemporaneous and lagged wildfire coefficients reported for the preferred specifications for Arches ($P = 0.02$ and $P = 0.06$, respectively), Bryce ($P = 0.10$ and $P = 0.10$), and Canyonlands NPs ($P = 0.13$ and $P = 0.01$) are significantly different from the contemporaneous and lagged parameters estimated for

Table 2
Corrected Akaike Information Criterions (*AICc*) statistics and Evidence Ratios for visitation models, by wildfire zone.[a].

Wildfire Zone, Time Lag	Arches	Bryce	Canyon-lands	Capitol Reef	Zion	Functional Form
AICc Values						
80 km, 1 lag	−263.176	−74.656	−211.036	**−117.756**	−381.716	semi-log, linear
	−260.893	−70.853	−207.753	−113.193	−377.153	semi-log, quadratic
	−262.096	−73.956	−210.456	−117.696	−380.956	log-log
160 km, 1 lag	**−264.856**	**−76.596**	**−214.596**	−116.116	−381.196	semi-log, linear
	−260.513	−73.053	−210.053	−112.373	−376.653	semi-log, quadratic
	−262.936	−75.916	−211.616	−116.616	−381.376	log-log
320 km, 1 lag	−261.436	−73.096	−208.556	−116.296	−380.956	semi-log, linear
	−257.133	−68.653	−204.653	−111.813	−376.633	semi-log, quadratic
	−261.476	−73.496	−208.476	−116.716	**−381.816**	log-log
Evidence Ratios						
80 km, 1 lag	2.32	2.64	5.93	**1.00**	1.05	semi-log, linear
	7.25	17.66	30.62	9.79	10.29	semi-log, quadratic
	3.97	3.74	7.92	1.03	1.54	log-log
160 km, 1 lag	**1.00**	**1.00**	**1.00**	2.27	1.36	semi-log, linear
	8.77	5.88	9.69	14.75	13.22	semi-log, quadratic
	2.61	1.40	4.44	1.77	1.25	log-log
320 km, 1 lag	5.53	5.75	20.49	2.08	1.54	semi-log, linear
	47.54	53.07	144.25	19.52	13.35	semi-log, quadratic
	5.42	4.71	21.33	1.68	**1.00**	log-log

Bolded values denote the best relative model. Evidence ratios measure relative model strength. The Arches NP 160 km single time lag model is 2.32 times stronger than the 80 km model, and 5.53 times as strong as the 320 km model.

Table 3
Best relative National Parks visitation models as indicated by *AICc* and evidence ratios.

	Arches 160 km Semi-log, linear	Bryce 160 km Semi-log, linear	Canyonlands 160 km Semi-log, linear	Capitol Reef 80 km Semi-log, linear	Zion 320 km Log-log
Wildfire[a] hectares within *X* km, month *t*	-3.50×10^{-3} (0.005)[b]	-1.57×10^{-3} (0.013)	-3.28×10^{-3} (0.071)	−0.014 (0.005)	6.85×10^{-3} (0.502)
Wildfire hectares within *X* km, month *t−1*	-3.28×10^{-3} (0.031)	-1.63×10^{-3} (0.030)	-6.79×10^{-3} (0.001)	−0.013 (0.001)	6.67×10^{-3} (0.438)
Mighty 5 Ad Campaign	0.259 (0.001)	0.242 (0.011)	0.303 (0.001)	0.351 (0.001)	0.101 (0.072)
Time trend	1.41×10^{-3} (0.001)	8.0×10^{-4} (0.160)	-4.0×10^{-5} (0.903)	-5.0×10^{-4} (0.229)	1.16×10^{-3} (0.001)
Recession	−0.030 (0.409)	−0.030 (0.467)	−0.033 (0.415)	−0.046 (0.368)	−0.051 (0.049)
Adj. Gas Price	−2.647 (0.318)	−2.752 (0.502)	−0.490 (0.877)	0.091 (0.982)	−2.008 (0.351)
Constant[c]	9.332 (0.001)	9.788 (0.001)	8.502 (0.001)	9.012 (0.001)	10.992 (0.001)
N	272	272	272	272	272
Adjusted R^2	0.9769	0.9572	0.9755	0.9640	0.9704

[a] Wildfire measured in 1000 ha.
[b] Numbers in parentheses are P-values.
[c] Monthly dummy variables are omitted to save space; all 66 monthly coefficients are statistically significant.

Table 4
Fixed effect panel data (pooled) models.

	80 km Semi-log, linear	160 km Semi-log, linear
Wildfire[a] hectares within *X* km, month *t*	-7.51×10^{-3} (0.063)[b]	-5.28×10^{-3} (0.340)
Wildfire hectares within *X* km, month *t−1*	-6.96×10^{-3} (0.084)	-3.91×10^{-3} (0.479)
Mighty 5 Ad Campaign	0.252 (0.001)	0.255 (0.001)
Time trend	5.7×10^{-4} (0.001)	5.5×10^{-4} (0.001)
Recession	−0.039 (0.097)	−0.037 (0.057)
Adj. Gas Price	−1.421 (0.264)	−1.228 (0.291)
Constant[c]	9.523 (0.001)	9.519 (0.001)
N	1,350	1,350
R^2 (within)	0.932	0.931
R^2 (between)	0.928	0.731
R^2 (overall)	0.611	0.612
σ_u	0.748	0.746
σ_e	0.244	0.244
ρ	0.904	0.903

[a] Wildfire measured in 1000 ha.
[b] Numbers in parentheses are P-values.
[c] Monthly dummy variables are omitted to save space; all 66 monthly coefficients are statistically significant.

the 160 km pooled model. The 80 km wildfire parameters for Capital Reef NP (P = 0.21 and P = 0.11) are not different from those of the 80 km pooled model.

4.3. Regional economic impacts

The evidence ratios reveal the semi-log, linear in wildfire, 160 km, single lag models are the best relative models for Arches, Bryce Canyon, and Canyonlands National Parks, with the semi-log, linear in wildfire 80 km, single time-lag model preferred for Capitol Reef NP. The wildfire parameters for Zion NP were never significant at conventional levels for any wildfire zone or time-lag structure, so we conclude that wildfire has not affected tourism flows at Zion. Regional economic impact analysis is based, therefore, on all parks except Zion NP.

Economic impact analysis rests on our original modeling, whose uncertainty we can assess, and park expenditure data and the technical coefficients imbedded in the Implan input-output model. We cannot assess uncertainty introduced from these latter sources. Instead, we have followed standard practice of evaluating economic impacts using final demand vectors that reflect different conditions of analysis. In our case, we present impacts associated with the central tendencies (median and mean) of wildfire distribution during a typical fire year.

4.3.1. Simulating changes in visitation due to wildfire

Our empirical models have different magnitudes for the wildfire parameters, so we should expect different effects of wildfire across parks. The semi-log form of the model allows us to calculate easily the *relative* change in visitation for a given change in wildfire activity by summing the appropriate wildfire parameters. For example, an additional 1000 ha of wildfire within the 160 km wildfire zone of Arches NP would depress current month visitation by 0.350% and the subsequent month's visitation by 0.328%, for a total visitation loss of 0.678% from baseline levels. Similar calculations can be done for Bryce Canyon (160 km, 0.320%), Canyonlands (160 km, 1.007%) and Capitol Reef (80 km, 2.700%). Though Capitol Reef NP has a relatively large percentage response to wildfire, its low baseline visitation (0.94 million visitors in 2015) and low level of wildfire activity (Table 1, 80 km zone) mean that absolute visitation losses will be modest. In contrast, visitors' percentage response to wildfire near Bryce Canyon NP is relatively small, but its baseline visitation (1.75 million visitors) and wildfire activity (Table 1, 160 km zone) are high enough to generate relatively large losses in tourism.

The skewed distribution of wildfire area results in a skewed empirical distribution for visitation losses. Hence, we report visitation losses for the median and mean wildfire areas arising from the 1,000 annual wildfire simulations for each park. Wildfire activity is concentrated in the summer months, so we restrict our analysis to changes in peak season monthly visitation (May through September). Columns 2 (visitation loss during a median fire year) and 4 (visitation loss during a mean fire year) of Table 5 presents the changes (losses) in visitation in each national park for the simulated visitation loss distribution.

The visitation losses follow expected patterns and are a function of the wildfire parameters estimated for each park, the amount of simulated burned hectares, and baseline visitation. Bryce Canyon NP has the largest loss in visitation under either median (−1.07%) or mean (−1.54%) wildfire conditions. These estimated losses, between 13,660 and 19,600 visits each year, comprise about 58%–68% of total wildfire-related visitor losses in Utah's National Parks. Arches NP, Canyonlands NP, and Capital Reef NP lose comparatively fewer tourists under either median or mean wildfire scenarios (Table 5).

4.3.2. Six-county regional economic impacts

NPS expenditure profiles show that per visitor expenditures in 2015 were lowest at Canyonlands NP ($59.72) and highest at Arches NP ($116.15). Further, the types of goods purchased differed across parks. For example, visitors to the more remote, less popular Canyonlands NP and Capitol Reef NP spent a greater proportion of their funds on gasoline and camping services, and a smaller proportion on transport services (i.e., tour busses, airlines) than those choosing to visit the more heavily trafficked Bryce Canyon NP. An economic impact analysis will

Table 5
Visitation and expenditure losses due to wildfire.

National Park (wildfire zone radius)	Visitation Loss Based on Median Hectares Burned		Visitation Loss Based on Mean Hectares Burned	
	Reduced Visits (% of peak season)[a]	Loss in Visitor Spending in million $ (% of annual)	Reduced Visits (% of peak season)	Loss in Visitor Spending in million $ (% of annual)
Arches NP (160 km)	3,450 (−0.38%)	$0.40 (−0.25%)	6,690 (−0.74%)	$0.78 (−0.48%)
Bryce NP (160 km)	13,590 (−1.07%)	$1.14 (−0.27%)	19,597 (−1.54%)	$1.64 (−1.12%)
Canyonlands NP (160 km)	1,976 (−0.09%)	$0.12 (−0.31%)	4,119 (−1.05%)	$0.25 (−0.65%)
Capitol Reef (80 km)	735 (−0.12%)	$0.05 (−0.08%)	3,239 (−0.51%)	$0.23 (−0.34%)
Zion NP	Statistically Insignificant Wildfire Parameters			
Sum	19,751 (−0.39%)	$1.71 (−0.28%)	33,645 (−0.66%)	$2.89 (−0.47%)

[a] % change in peak season visitation in 2015 (May through September).

typically distinguish between local and non-local expenditures, but the NPS reports non-local visitation as comprising between 98.3% (Bryce Canyon NP) and 100% (Arches NP) of all visitors; weighting by 2015 visitation, our four parks average 99.1% of all visitation from non-locals. Thus, we make no distinction between the origin of visitors.

The losses in visitor spending in the local economy are shown for each park for the median and mean visitation loss (columns 3 and 5, respectively, in Table 5). For example, Arches NP lost $400,000 in visitor spending under the median wildfire scenario, or about 0.25% of total annual expenditures by visitors to Arches. In the mean wildfire scenario, Arches NP lost $780,000 in visitor spending, or about 0.48% of total annual expenditures. Similar calculations are presented for all national parks under both scenarios. The aggregate loss in visitor spending across all national parks in a typical fire year is estimated to be between $1.71 million (median) and $2.89 million (mean).

The estimated regional economic impact of wildfire-related losses in visitor spending is shown in Table 6. The total loss of industry output associated with decreased expenditures by visitors is between $2.66 million (median visitation loss) and $4.50 million (mean visitation loss). Relative to the gross change in expenditures, losses in output correspond to an effective expenditure multiplier of 1.56, which is reasonable for a relatively small economic region; that is, every dollar spent in the national parks generates $1.56 in total economic output.

The loss in value-added (net regional output) resulting from decreased industry output was estimated to be $1.45 million (median) and $2.46 million (mean), respectively. For perspective, the total value-added for the six county area was $6.1 billion. A portion of the value-added impact is the loss of income accruing to labor: the estimated loss in labor income under median fire conditions is $0.84 million, which includes losses of 31 full- and part-time jobs. Evaluated at mean wildfire levels, losses in labor income were $1.42 million and 53 jobs full and part-time jobs. Tax revenues are also affected; during a median fire year state and local governments could expect to see a decline of $0.21 million whereas the federal government could experience losses of $0.20 million. In case of a mean fire year, the loss of state/local tax revenue is estimated to be $0.36 million; the federal government loses $0.33 million.

Table 6
Economic impacts (losses) associated with average (median and mean) annual wildfire activity near national parks in Utah.

	Median of Visitation Loss	Mean of Visitation Loss
Change in Value of Output	$2.66 million	$4.50 million
Change in Value Added	$1.45 million	$2.46 million
Change in Labor Income	$0.84 million	$1.42 million
Change in Employment	31 jobs	53 Jobs
Change in State and Local Tax Revenue	$0.21 million	$0.36 million
Change in Federal Tax Revenue	$0.20 million	$0.33 million

5. Discussion

Few papers have examined how tourist flows change in response to contemporaneous (or near contemporaneous) wildfire risks, and this study has contributed to that literature (Karl & Schmude, 2017). The modeling approach used in this study yields empirical results that are consistent with those found by Duffield et al. (2013). Those authors measured visitation losses at Yellowstone NP during a mean fire year to be 1.3%. We find mean fire year visitation losses to be between 0.51% (Capitol Reef NP) and 1.54% (Bryce Canyon NP). The greatest absolute tourism losses appear to have occurred in Bryce Canyon NP. Despite relatively low visitor responsiveness to wildfire, this park is simultaneously among those suffering the greatest burned area during a typical fire year and among the most heavily visited.

Evaluating the mean wildfire scenario over the entire six-county region shows the value-added losses in a typical fire year amount to only 0.04% of total regional product (approximately $6.1 billion). This very small proportion ignores the heavy influence of Washington county's contribution to the six-county total value-added (77.7%). Indeed, even if all of the simulated wildfires had been concentrated in Washington county and visitors to Zion NP had been responsive to wildfire, it is unlikely that economic losses would have been felt by more than a relative handful of businesses and people. In contrast, the economic losses associated with wildfire are likely to have greater proportional impact on tourism-dependent rural economies.

Consider, for example, Bryce Canyon NP in Garfield and Kane counties. Bryce Canyon visitors have relatively high expenditures and, in a typical fire year, this park also suffers the greatest absolute visitation losses of any of Utah's other national parks. The combination of these two factors means that tourism expenditures at Bryce Canyon are reduced by $1.64 million in a typical wildfire year (Table 5, mean scenario), or about 56% of total annual wildfire-induced expenditure losses for all five parks. Re-casting our economic impact analysis for these two counties, the loss of expenditures translates to a $1.40 million loss in value-added. Given the $445 million gross regional product of Kane/Garfield economy, wildfires in a typical (mean) year cause losses (0.32%) that are nearly an order of magnitude larger than when wildfire effects are distributed over a wider region. Wildfire thus has uneven economic impacts, with proportionally greater impacts in rural, tourism-dependent counties than in counties with more diversified economies.

Wildfire preparedness and suppression programs will often focus on property and ecosystem services at risk, with little attention paid to the broader economic context within which wildfire management decisions are made. In the United States, for example, suppression decisions are a function of homes at risk, watershed resources at risk, and expected wildfire costs, but these decisions do not consider other economic factors (Calkin, Venn, Wibbenmeyer, & Thompson, 2013). Thus, while wildfire preparedness and suppression decisions include *property* at risk, current protocols do not consider whether people's *jobs and income* are at risk. Our study suggests that those in charge of wildfire preparedness programs adjust decision protocols to consider broader economic concerns of local communities. For example, wildfire managers must choose where, and to what degree, to engage in wildfire risk reduction activities on overstocked or heavily-stocked public lands. All else equal, for a given fuels reduction/wildfire preparedness activity decision makers may choose to reduce the risk of wildfire in regions where wildfire has proportionally greater impact on residents' livelihoods.

Several areas for future research may prove fruitful. By extending this paper to five additional national parks, we have confirmed the suspicion of Duffield et al. (2013) that the effect of wildfire on tourism is heterogeneous across national parks. However, the greatest percentage marginal responses to wildfire were found in semi-arid Capitol Reef NP (2.7% loss in response to 1000 ha burned) and arid Canyonlands NP (1.1%). Large wildfires do not often occur near or in Capitol Reef and Canyonlands, so it is not immediately clear why these parks are more sensitive to wildfire. Both parks are relatively remote and are not located adjacent to heavily commercialized gateway communities; NPS expenditure data confirm that visitors to these parks are relatively self-reliant and do not tend to depend upon commercial services for lodging and meals. This suggests a visitor population that may be considered *courageous* (to use Thapa et al.'s term 2013), at least as far as the decision to camp versus stay in a hotel is concerned. But a willingness to camp outdoors may not extend to a willingness to expose oneself to wildfire risk, where a person who is camping may choose to be *cautious*, especially at a remote NP. Further research may help answer this question.

Finally, wildfire varies greatly in its timing, location, and size, both within and across years, which creates complications in trying to characterize wildfire in an econometric model.[1] First, we do not know if there is a threshold wildfire size to which people respond. Put another way, are some fires small enough to safely ignore because we know that visitor will not have risk concerns? Second, are risk concerns driven more by print, broadcast, and online publicity about wildfire than they are by pure wildfire size? A measure of contemporaneous publicity, especially non-local publicity regarding fires near a National Park that draws from a non-local population, would be a key addition to a visitation model. Third, our model has not distinguished between large catastrophic fires and wildfires of a typical year. We have restricted our analysis to estimating visitation effects (and their corresponding economic impacts) to the central tendencies of the wildfire distribution because the OLS models can predict the effects on visitation of a typical fire year quite well. However, these models do not predict changes in tourism flows well under conditions of a large and catastrophic fire. Future research may wish to focus on predicting the effects of large, potentially catastrophic fires on national park visitation.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jort.2019.03.007.

References

Banner, R. E., Baldwin, B. D., & Leydsman McGinty, E. I. (2009). *Rangeland resources of Utah.* https://extension.usu.edu/rangelands/ou-files/RRU_Final.pdf, Accessed date: 22 September 2018.

Bawa, R. S. (2017). Effects of wildfire on the value of recreation in western North America. *Journal of Sustainable Forestry, 36*(1), 1–17.

Boxall, P., & Englin, J. (2008). Fire and recreation values in fire-prone forests: Exploring an intertemporal amenity function using pooled RP-SP data. *Journal of Agricultural and Resource Economics, 33*, 19–33.

Burnham, K. P., Anderson, D. R., & Huyvaert, K. P. (2011). AIC model selection and multimodel inference in behavioral ecology: Some background, observations, and comparisons. *Behavioral Ecology and Sociobiology, 65*, 23–35.

Calkin, D. E., Venn, T., Wibbenmeyer, M., & Thompson, M. P. (2013). Estimating US federal wildland fire managers' preferences toward completing strategic suppression objectives. *International Journal of Wildland Fire, 22*, 212–222.

Caudill, S. B., & Holcombe, R. G. (1999). Specification search and levels of significance in econometric models. *Eastern Economic Journal, 25*, 289–300.

Duffield, J. W., Neher, C. J., Patterson, D. A., & Deskins, A. M. (2013). Effects of wildfire on national park visitation and the regional economy: A natural experiment in the northern Rockies. *International Journal of Wildland Fire, 22*, 1155–1166.

Energy Information Administration (2018). *Weekly retail gasoline and diesel prices.* https://www.eia.gov/dnav/pet/pet_pri_gnd_a_epmr_pte_dpgal_m.htm, Accessed date: 10 February 2018.

Englin, J., & co-authors, T.hree (1996). Valuing the impacts of forest fires on backcountry forest recreation. *Forest Science, 42*, 450–455.

Englin, J., Loomis, J. B., & Gonzalez-Caban, A. (2001). The dynamic path of recreational values following a forest fire: A comparative analysis of states in the intermountain west. *Canadian Journal of Forest Research, 31*, 1837–1844.

Federal Reserve Economic Data (FRED) (2016). NBER based recession indicators for the United States from the period following the peak through the trough. https://fred.stlouisfed.org/series/USREC, Accessed date: 22 September 2018.

Gabe, T. (2016). Effects of the October 2013 U.S. Federal government shutdown on national park gateway communities: The case of Acadia national park, and Bar harbor, Maine. *Applied Economics Letters, 23*(5), 313–317.

Hesseln, H., & three co-authors (2003). Wildfire effects on hiking and biking demand in New Mexico: A travel cost study. *Journal of Environmental Management, 69*, 359–368.

Hesseln, H., Loomis, J. B., & Gonzalez-Caban, A. (2004). Comparing the economic effects of fire on hiking demand in Montana and Colorado. *Journal of Forest Economics, 10*, 21–35.

IMPLAN Group, L. L. C. (2018). *IMPLAN System (data and software).* NC: Huntersville. www.IMPLAN.com.

Karl, M., & Schmude, J. (2017). Understanding the role of risk (perception) in destination choice: A literature review and synthesis. *Tourism, 65*, 138–155.

Leaver, J. (2017). *The state of Utah's travel and tourism industry.* http://gardner.utah.edu/wp-content/uploads/TravelandTourismRepFinal2017.pdf, Accessed date: 22 September 2018.

Love, T. G., & Watson, A. E. (1992). *Effects of the gates park fire on recreation choices.* Ogden, UT): USDA Forest Service, Intermountain Research Station, Research Note INT-402.

National Wildfire Coordinating Group (2017). *Brian Head fire.* https://inciweb.nwcg.gov/incident/5253/, Accessed date: 10 February 2018.

Newey, W. K., & West, K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica, 55*, 703–708.

Poudel, J., Munn, I. A., & Henderson, J. E. (2017). Economic contributions of wildlife watching recreation expenditures (2006 & 2011) across the U.S. South: An input-output analysis. *Journal of Outdoor Recreation and Tourism, 17*, 93–99.

Rittichainuwat, B., Nelson, R., & Rahmafitria, F. (2018). Applying the perceived probability of risk and bias toward optimism: Implications for travel decisions in the face of natural disasters. *Tourism Management, 66*, 221–232.

Sarman, I., Scagnolari, S., & Maggi, R. (2016). Acceptance of life-threatening hazards among young tourists: A stated choice experiment. *Journal of Travel Research, 55*(8), 979–992.

Short, K. C. (2017). *Spatial wildfire occurrence data for the United States, 1992-2015* (4th ed.). Fort Collins: CO. Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2013-0009.4, Accessed date: 22 September 2018.

Sorenson, C. B., & six coauthors (2016). *The Four Corners timber harvest and forest products industry, 2012. Resource Bulletin RMRS RB-21.* Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Thapa, B., Cahyanto, I., Holland, S. M., & Absher, J. D. (2013). Wildfires and tourist behaviors in Florida. *Tourism Management, 36*, 284–292.

United States Census Bureau (2018). *American FactFinder.* https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src = bkmk.

United States National Park Service (2016). *2015 National park visitor spending effects* Natural Resource Report NPS/NRSS/EQD/NRR-2016/1200 (April).

United States National Park Service (2018). National parks visitor use statistics. Park https://irma.nps.gov/Stats/Reports/, Accessed date: 22 September 2018.

Vaux, H., Jr., Gardner, P. D., & Miller, T. J. (1984). *Methods for assessing the impact of fire on forest recreation*USDA Forest Service, Pacific Southwest Forest and Range Experiment Station General Technical Report PSW-79.

Werstak, C. E., Jr., & 12 co-authors (2016). *Utah's forest resources, 2003-2012. Resource Bulletin RMRS-RB-20.* Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. https://www.fs.usda.gov/treesearch/pubs/50931, Accessed date: 22 September 2018.

White, H. L. (1978). A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica, 48*, 817–838.

Wilkerson, C. (2003). Travel and tourism: An overlooked industry in the U.S. And tenth district. *Federal Reserve Bank of Kansas City Economic Review, 2003(3rd quarter)*, 45–71.

Woods, A. J., Lammers, D. A., Bryce, S. A., Omernik, J. M., Denton, R. L., Domeier, M., et al. (2001). Ecoregions of Utah. ftp://newftp.epa.gov/EPADataCommons/ORD/Ecoregions/ut/ut_eco.pdf, Accessed date: 22 September 2018.

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(*footnote continued*)