Journal of Forest Economics 33 (2018) 1–7

Contents lists available at ScienceDirect

Journal of Forest Economics

journal homepage: www.elsevier.com/locate/jfe

The effect of natural disasters on housing prices: An examination of the Fourmile Canyon fire

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ARTICLE INFO

JEL classification:
Q54
R11
R21

Keywords:
Disasters
Forest fires
Housing
Climate change

ABSTRACT

In September 2010, the Fourmile-Lefthand Canyon forest fire burned 6181 acres, destroyed 169 homes, and caused $217 million in property damages making it by far the most expensive fire in Colorado history at the time. This paper examines how the fire affected housing prices in vulnerable neighboring areas that were not directly impacted by the fire, controlling for the property's level of risk. This damaging fire may have increased home owners' perceptions about the risk of living in forested areas subject to wildfires to a significant degree adding to the total direct economic losses from the fire. Utilizing a unique fire risk data set and a difference-in-difference approach, we test whether buyers of houses in areas with different risk levels prior to the fire adjust expectations differently. We find buyers in the highest risk area are most likely to change their perceptions in response to a fire with houses in these areas experiencing a statistically significant 21.7% decline in sale price compared to houses in non-risky areas.

Introduction

In September 2010, the Fourmile Canyon forest fire burned 6181 acres, destroyed 169 homes, and caused $217 million in property damages in the mountains directly west of Boulder, Colorado. At the time, the Fourmile fire was the most damaging in Colorado history with insured losses five times larger than the next most expensive recorded forest fire in the state's history and over twice as large as the losses from the next ten most damaging Colorado fires combined. (See Table 1). It also burned more houses than any previous Colorado wildfire, and its location just five miles west of downtown Boulder, a major urban center, served to focus significant local and national media attention on the event.

The damage caused by the Fourmile Canyon fire was a magnitude greater than anything seen in Colorado previously, but within two years, its destruction was exceeded by the High Park fire in Larimer Country west of Fort Collins and the Waldo Canyon fire in the outskirts of Colorado Springs. In June 2012, the High Park fire burned 87,250 acres (the second largest fire in Colorado history), destroyed 256 homes (exceeding the record set by the Fourmile fire), and caused $113.7 million in insured damages. With the High Park fire not yet fully contained, the Waldo Canyon fire erupted west of Colorado Springs. It eventually consumed 18,247 acres, destroyed 347 homes, and caused $453.7 million in insured property damages, breaking the records set by the Fourmile Canyon fire. The Colorado Springs area was hit again in 2013 when the Black Forest fire consumed more than 14,000 acres and destroyed 489 homes worth $420.5 million, eclipsing the Waldo Canyon fire in terms of homes destroyed.

While wildfires are nothing new to Colorado, it is evident that the severity of damages associated with forest fires has risen dramatically in just the past few years. In the thirty years between 1976 and 2006, 387 homes across the state were lost to forest fires, while over 1326 were destroyed in just the three years between 2010 and 2013. At least four root causes can serve to explain the increase in fire damages. First, fire suppression techniques and forest management over the past century have led to an increase in damaging fires across the country. Second, climate change is contributing to weather and forest conditions that favor fires. According to the National Research Council (2011), the mountains and foothills west of the major population centers in Colorado can expect a 656% percent "increase in burned areas… for a 1.8 °F increase in global average temperatures relative to the median area burned during 1950–2003." Third, invasive species of plants and insects can increase the frequency and intensity of fires. Since climate change can also impact the spread and longevity of invasive species, the impacts can be intensified. Finally, Colorado has experienced a large increase in the population living in areas at high risk for wildfires. In 2010, 1.1 million Coloradans lived is a so-called "red-zone," an increase of 29 percent since 1990 (Kodas and Hubbard, 2012).

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https://doi.org/10.1016/j.jfe.2018.09.002
Received 2 August 2017; Accepted 7 September 2018
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Table 1
Most damaging wildfires in Colorado.
(Source: Rocky Mountain Insurance Information Association, 2018)

Fire	County	Year	Houses	Insurance Costs/ Damages (rank) Million $	Acreage (rank)
Black Forest	El Paso	2013	489	$420.5 (2)	14,280 (15)
Waldo Canyon	El Paso	2012	347	$453.7 (1)	18,247 (12)
High Park	Larimer	2012	256	$113.7 (4)	87,250 (3)
Fourmile	**Boulder**	**2010**	**169**	**$217.0 (3)**	6181 **(25)**
Hayman	El Paso	2002	133	$ 38.7 (5)	137,760 (1)
Iron Mountain	Fremont	2002	100	$ 7.5 (10)	4439 (29)
Missionary Ridge	La Plata	2002	56	$ 17.7 (7)	71,739 (4)
Hi-Meadow	Park	2000	51	$ 18.5 (6)	10,800 (20)
Black Tiger Gulch	Boulder	1989	44	$ 10.0 (9)	1778 (38)
Coal Seam	Garfield	2002	29	$ 6.4 (11)	12,209 (17)
Lower North Fork	Jefferson	2012	27	$ 11.0 (8)	3790 (31)

Fremont County includes Cañon City.
Garfield County includes Glenwood Springs.
La Plata County includes Durango.
Park County includes Bailey (but the fire may have been primarily in Jefferson).

While the damage directly caused by wildfires is clear, this paper seeks to examine the effect of wildfires on home prices in at-risk but unaffected areas. While natural disaster risk is clearly incorporated in the price of any housing unit, a fire of the magnitude of the Fourmile, Black Forest, High Park, or Waldo Canyon fires may serve to change public perceptions of risk in a measurable way. By estimating the impact on house values for areas that were not directly impacted, we can more fully understand the economic effect of these fires. Using the difference-in-differences approach allows us to look at homes before and after the fire, controlling for a variety of housing and neighborhood characteristics. In addition, our work allows us to consider whether owners of homes that are exposed to different risk levels change perceptions in different ways after a fire takes place.

Literature review

The existing literature on the economic effect of natural disasters on housing prices has often addressed the issue of risk. Bin and Polasky (2004), Chivers and Flores (2002), and Atreya et al. (2013) all examine the effect of major floods on housing prices in flood plains, i.e. areas at high risk for flood damages. All three papers note that local housing values in flood plains are observed to fall immediately after flooding events, but the decrease in prices tends to be short-lived.

Donovan et al. (2007) examine home prices in the wilderness-urban interface in El Paso County, Colorado, the location of the Waldo Canyon fire, both before and after the Colorado Springs Fire Department rated the wildfire risk of 35,000 local housing parcels in 2000 in an effort to increase awareness of risk. Prior to the on-line publication of the wildfire risk data, fire risk was positively correlated to housing prices (presumably due to the amenity aspects of solitude and the proximity of natural beauty) while after the publication of the risk assessment the "benefits" of owning a home prone to fire risk were significantly reduced. It is worth noting that Donovan et al. (2007) specifically mention the potential for large fires to affect housing values but do not test specifically for this possibility. To wit,

> There is one other factor to consider when evaluating the effectiveness of this educational campaign. In June 2002, the Hayman fire burned 138,000 acres mostly on the Pike National Forest (17,000 acres were on the Pikes Peak Ranger District); it destroyed 132 homes and came within 20 miles of Colorado Springs. Although homeowners in the study area were not directly threatened by the Hayman fire, some of the observed effect on the housing market may be attributable to this fire. We cannot determine how much of the observed effect on the housing market was due to the educational campaign and how much was due to the Hayman fire. (Donovan et al., 2007, pg. 232)

Stetler et al. (2010) study 18,785 housing sales in Montana from June 1996 to January 2007. Their model includes neighborhood characteristics such as distance to the nearest golf course, and environmental variables such as distance to major lakes and rivers. Their wildfire variables included distance to the nearest wildfire perimeter in the previous seven years, and if the area burned could be seen from the home. They find home prices in the northwest portion of the state less than 5 km and between 5 km and 10 km from a wildfire burn area were 13.7% ($33,232) and 7.6% ($18,924) lower, respectively, than equivalent homes at least 20 km from a fire. Homes with views of burn areas decreased in value even further. In this work the authors control for distance from a fire, but not explicitly for risk. It may be that distance and risk are correlated, but their results do not provide direct evidence of impact of a change in risk.

Loomis et al. (2009) examine prices of homes within 1.75 miles of a series of three fires that took place between 1989 and 2003 in Southern California near the Angeles National Forest. They find that home prices respond to repeated fires by falling significantly. While housing prices fell only 9.7% after one fire, they dropped an additional 22.7% after the second wildfire. Their model, however, only controls for distance to the center of each wildfire; there is no control for the level of risk to which each house is exposed.

Loomis (2004) examines 134 properties sales before and over 300 sales after the Buffalo Creek wildfire in 1996 that burned 12,000 acres and destroyed 10 homes near the community of Pine, Colorado. The study finds a 15% decrease in home values in the neighboring community after the fire, a result that the author suggests is due to a revised attitude of homebuyers regarding the perceived wildfire risk of the area or a loss in forest amenities in the community. While house characteristics are included in the regression, there is no measure of distance from the fire, nor is there any control for the level of risk each house is subject to. The results do suggest that buyers adjust their perceptions after a wildfire.

Xu and van Kooten (2013) also identify a decrease in property values associated with forest fires. Most directly related to the research here is the fact that they find more significant reductions in property values associated with larger fires. Thus, if their results are applicable in Colorado, a fire the magnitude of the Fourmile fire should have the most significant effects on property values for data prior to the High Park and Waldo Canyon fires which were larger.

The paper closest to this research is a recent working paper by McCoy and Walsh (2014). Using a data set that covers house sales in eight counties over thirteen years, they ask whether large fires in Colorado lead to changes in risk perception. In particular, they test a model where the occurrence of fires leads people to put a larger weight on the risk of fire. Using a difference-in-differences estimation strategy, they also find that risk perceptions are impacted by distance to the fire as well as the level of risk assigned to the house's location. The level of risk is measured at the end of the time frame covered by their data set, and may have changed over the period studied.

Data and model

Data for 9630 single family housing sales that occurred between January 2009 and April 2012 in Boulder County, where the Fourmile Canyon fire occurred, were purchased from the Warren Group. This time period represents roughly 18 months before and after the Fourmile Canyon fire, and the data end two months prior to the even larger High Park and Waldo Canyon fires. The data include sales date and price,

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