Assessing the financial impact of the 2019-2020 bushfires on the Australian stock market

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ABSTRACT,
This study investigates the financial consequences of the 2019-2020 bushfires on the Australian stock market. This thesis adopts an event study approach in order to calculate the Cumulative Abnormal Returns (CAR) for both directly- and indirectly-affected industries based on an industry-classification used in similarly conducted previous studies. I use stock market data of the ASX-300 companies and use regression analysis to establish how capital markets react to a significant natural disaster like the 2019-2020 Australian Bushfires. A distinction is made between short-term and long-term effects based on two different event windows. Results show no significant long-term effects because of the fires on either directly- or indirectly-affected industries. In the short-term the indirectly- affected industries showed a significant positive effect on market returns. Where previous literature tends to focus on local impacts, I discuss a nation-wide financial impact of the 2019-2020 Bushfires.

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Bushfires, Wildfires, Australia, capital markets, abnormal returns, financial impacts

During the preparation of this work, the author used no artificial intelligence tools.

1. INTRODUCTION

Climate change is increasingly becoming more relevant to the survival of the human race. The scientific community agreed decades ago change is needed in human operations on our planet in order to make sure we do not change our planet to such an extent that it becomes irreversible.

Environmental risks, particularly those stemming from natural disasters, have become an ever increasing risk not just for people, but businesses as well. Experts predict that as the global surface temperature keeps rising this will ultimately lead to an increase in natural disasters, (see for example (Coumou & Rahmstorf, 2012)). The frequency and severity of natural disasters like floods, hurricanes and wildfires are increasing and intensifying. This poses a threat to populations around the world which means businesses are also increasingly subject to the effects of these disasters.

One such country where the devastating effects of natural disasters can be seen clearly is Australia. Between the start of the 20th century and 2011 reports and data have shown that at least 825 civilians and firefighters lost their lives across over 260 fires that took place (Blanchi et al., 2013). Thus, even decades before the changes in the global climate, Australia already suffered from severe wildfires, which I will refer to as bushfires in this document since previous literature uses this term as well (see (Yang et al., 2023) and (Blanchi et al., 2013) for examples). In 2019, around the beginning of September, the largest bushfires in recorded history took place in Australia, likely as a result of climate change. Record breaking average temperatures were measured across the entire landmass of Australia which in December resulted in an average temperature of over 40 degrees Celsius(Mulhern, 2020). The WWF(World Wildlife Fund) reported around 12.6 million hectares(Australia, 2018a) of forest and bushland destroyed as a result of the bushfires with around 3 billion mammals, reptiles, birds and frogs killed or displaced by the event(Australia, 2018b).

Whereas decades ago climate change and environmental risk may have looked unimportant or a secondary issue, companies in today's business climate have to seriously implement measures in their business' strategic decision making processes(see for example (Haasnoot et al., 2013)). It has become a vital area for risk management and financial performance, but also for the general development of a country. The United Nations have reported that when looking at natural disasters, "the risk of losing wealth in weather-related disasters is now outstripping the rate at which the wealth itself is being created" (Unisdr, 2012) Understanding how and to what extent these risks affect firm performance is vital for businesses.

Numerous studies like (Worthington & Valadkhani, 2004) and (Malik et al., 2020) exist regarding economic impacts of natural disasters. However, these often have been inconclusive and various effects of natural disasters are reported. Curiously, a lot of the studies either look at the stock market as one entity or they look at individual companies and see how they react to a disaster event. Hardly any studies investigate how different industries within the stock market might react differently to natural disasters, especially not on a country-wide scale regarding Australia. This is where a knowledge gap exists since various industries are definitely affected differently. Think of a storm that destroys many peoples' homes. Insurance companies will have to pay out a lot of money to help rebuild the lost homes. This would cost insurance companies a lot of money whereas parts of the construction industry might be affected positively since the demand for many new homes will go up.

To address this knowledge gap mentioned above, I will estimate financial impact of the 2019-2020 bushfires by looking at Australia's biggest listed firms and see their market reactions. A distinction will be made between directly- and indirectly-impacted industries and a short-term and long-term window will be used to see if short-term effects vary from long-term effects. The main research question therefore is:

How did the 2019-2020 Australian bushfires impact the stock performance of the affected industries?

The commonly used event-study methodology (Brown & Warner, 1985) and (MacKinlay, 1997) is used to calculate the abnormal returns for all ASX 300 companies to produce various results. Previous studies later mentioned in the literature review and/or methodology section is adopted in order to classify industries into indirectly- and directly affected industries. See appendix 2 for a list showing the industries and their classification. Previous literature is also adopted to justify a short- and long- term event window to calculate the abnormal returns.

Based on the criteria mentioned above,

some sub-questions could be formed to answer the research question:

1. What was the effect of the bushfires on stock prices of firms directly affected by the fires?
2. What was the effect of bushfires on stock prices of firms indirectly affected by the fires?
3. Is the impact on directly affected industries (significantly) different from those indirectly affected by the fires?
4. How does the stock performance of affected industries recover or deteriorate over time, and how does this contrast with the immediate market reaction?

My research produces several findings. First of all, the t-test of the short-term cumulative abnormal returns is significant and this gives reason to assume that the bushfires had a significant positive effect on the stock performance of the ASX300 companies. However, the effect of the long-term cumulative abnormal returns shows no significant result and indicates that the bushfires have no effect on the market sentiment in the long term. Reviewing the effect of the indirect and direct industries on the cumulative abnormal return shows that the indirect industries have a significant positive effect on the cumulative abnormal returns. Indicating that indirectly impacted industries have a positive stock performance, where the directly impacted industries have not. However, the coefficient for the directly impacted industries is not significant. For the long term the relationships with the cumulative abnormal return remains the same but both the intercept and the coefficient are insignificant.

With this paper I hope to contribute to the discussion regarding the financial implications of the 2019-2020 Australian bushfires. First an analysis of the empirical link between the ASX300 companies and the bushfires by adopting an event study methodology. Second I develop an empirical model to analyze both short- and long-term effects across both directly- and indirectly- affected industries. In section 2, a literature review is presented explaining how natural disasters can affect stock prices by the efficient market hypothesis, and I review previous literature on the effect of natural disasters on the stock performance. What follows is section 3 discussing the methodology and empirical approach that was adopted in this paper. Next is section 4 discussing the results of the empirical research and finally section 5 provides a discussion section with a critical analysis of the results.

2. LITERATURE REVIEW

2.1 The efficient market hypothesis

In finance the efficient market hypothesis (EMH) is a common theory. The efficient market hypothesis can be used to explain why natural disasters like bushfires tend to affect

companies and their stock market prices. The EMH was developed over 50 years ago and for a long time, until around the start of the 21st century, its validity was widely accepted.
The view of the EMH is that if information appears which is or could be relevant to stock prices, then "news spreads very quickly and is incorporated into the prices of securities without delay" (Malkiel, 2003). Malkiel goes on to explain in this paper that the EMH is often associated with the concept called a "random walk". The author goes on to explain that the reasoning behind the "random walk" idea is that "prices fully reflect all know information, and even uninformed investors buying a diversified portfolio at the tableau of prices given by the market will obtain a rate of return as generous as that achieved by the experts" (Malkiel, 2003). A paper from 2015 also states that the "efficiency" term within the term EMH refers to the fact that "investors have no opportunity of obtaining abnormal profits from capital market transactions as compared to other investors, they cannot beat the market" (Țițan, 2015).

Around the start of the 21st century more papers arose challenging the validity of the theory. In 2015, Țițan explored some of these papers which challenged the commonly accepted EMH model. However the conclusion was that the reason most of the reviewed papers failed to prove the simple in theory EMH model was that the models used to test the EMH are themselves biased. Finally, a paper by (Fama, 1998) states that "market efficiency survives the challenge from the literature on long-term return anomalies"

Thus, the theory seems to still be valid even after attempts to invalidate it in previous literature discussed above. Therefore information about natural disasters, which is relevant information which affects firm value, will cause the market to immediately adjust stock prices accordingly to reflect all the expected financial impacts on the firms affected by the disaster. To conclude, the EMH is a suitable theory to apply to this research. Next I will discuss the literature which already looked into the financial impact of natural disasters, particularly bushfires.

2.2 Financial impact natural disasters

As mentioned before, there are not that many studies investigating the relationship between the stock market and natural disasters. Until the early 2000s almost all data and academic papers were related to the United States of America. One study (Worthington & Valadkhani, 2004) measures the impact of natural disasters from 1989 to 2002 in Australia and this is the some of the earliest papers I could find regarding Australia. They conclude that surprisingly bushfires had an overall positive impact on market returns. The study concludes that bushfires are associated with a positive impact on market returns of between 0.79% and 0.86% on the day that the fires occurred. During the days following the fires, a positive market return between 0.44% and 0.54% was found. A conclusion which I did not expect prior to reading the literature. The same study concludes that other disasters like cyclones and earthquakes negatively impact the stock market returns which might be surprising. Other studies find contradictory findings as well. One study examines the impact of natural disasters in Japan and the USA on insurance sectors as well as on composite stock markets (Wang & Kutan, 2013) . They find that whilst no wealth effects were found in either country's composite stock markets, there was a negative financial impact on the insurance sector in the US whilst it was positive in Japan.

However a different study disputes this. Wang and Kutan used data from 1989 – 2011. A different study investigating over a longer time frame in the US (1960-2015) hypothesized a negative impact on the US insurance sector as well, building on the conclusion from Wang and Kutan. Their data reported differently however, as analysis of the data concluded a positive rather than negative impact for insurance companies, mainly in the pre-disaster period (Malik et al., 2020).

All of the literature above however relates to studies examining either bushfires or other natural disasters and their impact across decades, and thus across different events. A recent study from 2024 might be more relevant and similar to the research done in this paper. Tavor examined the impact of bushfires in the United States of America from 2019-2022 and distinguished between directly- and indirectly- impacted sectors. The study concludes that "the analysis reveals that wildfires have distinctive repercussions for various sectors, underscoring the importance of sector-specific risk assessment and preparedness." (Tavor, 2024). This was shown in the results as some sectors like the food industry were found to have a consistent increase in CAR, contributed to a consistent heightened demand for food supplies. Other sectors like the insurance industry, the resilience and mitigation sectors and the energy sector consistently find a decrease in CAR.

Finally, another paper from 2023 by Yang *et al.* documents the financial impact of the 2019-2020 bushfires on the national tourism industry. They conclude that on a regional scale, bushfires only affected the firms during the initial 10 days after the fires started. Conversely, nation-wide financial markets were found to be affected for extended periods and seemed to not revert to its initial valuation.

These studies should help answer the research question and also give me some predictions/hypotheses. Based on the literature discussed I form the following prediction:
P1: The bushfire will increase overall stock return

This is based on the fact that previous studies by (Worthington & Valadkhani, 2004) and others mentioned above that bushfires specifically can lead to positive, rather than negative CAR, especially in the short term. This is different from other natural disasters which tend to decrease overall CAR.

Not many studies look specifically at bushfires, but in a broader perspective of natural disasters, the literature shows varying degrees of impact of different industries. Some are positive, some negative. Following the literature mentioned above I make another prediction:

P2: The impact of the bushfires will vary greatly depending on the industry

3. DATA AND EMPIRICAL METHODOLOGY

3.1 Data Description

This sections specifies the data collection process and the methodological framework to analyze the effect of the bushfires in Australia on the Australian Stock Exchange.

First of all, this study is an event study because the effect of the Australian bushfires, the event, on the stock market is being studied. The severe Australian bushfires started around the 1st of September on 2019. Before this period there had been a longer period of drought in Australia which eventually caused the severe bushfires. The bushfires persisted until the beginning of 2020 (around March it ended), marking an extended period of environmental damage. This study focusses on the effect of the initial start of the bushfires. The entire time frame of the bushfires is not useful for an event study like this due to the length of the period and the potential effects of all other variables on the stock market. Moreover, this study solely analyzes the effect of the bushfires on the Australian Stock Exchange, more specifically

the 300 largest companies on the Australian Stock Exchange. The day-to-day stock prices to estimate the effect of the bushfires on the stock prices have been retrieved from the LSEG Workspace.

In addition, these 300 companies have been categorized in their specific industries based on their SIC-codes provided by the LSEG Workspace. The industries have been categorized in whether the companies would be impacted by the bushfires on a direct or indirect basis. This classification of indirectly- or directly impacted industries is based on various institutions which assess the impact of natural disasters like (Khan, 2023) and on the study of (Tavor, 2024) whom assessed the financial impacts of significant bushfires on US capital markets, a very similarly conducted study.

3.2 Empirical approach/strategy

As mentioned earlier this particular study is an event study. In literature there is consensus that in an event study three periods must be specified; namely an estimation window, event window and post-event window. The estimation window used in this study is 205 days, which is a bit shorter than one trading year which is in line with previous literature (Tavor, 2024). This study uses two event windows to estimate the short-term effect on the Australian Stock Exchange with a window of [-5, +5] and a long-term effect with a window of [-5, +45]. These two time spans have been chosen to review both the immediate effect and sentiment of the market on the stock market. Appendix 1 shows a comprehensible overview of the timeline, and what windows are used in the empirical approach.

To investigate the impact of bushfires in Australia on the Australian Stock Exchange the variable that is used is the Cumulative Abnormal Return in the specified periods mentioned above. First of all the normal daily returns in the estimation period are calculated as follows:

1. $R_{it} = \frac{(P_t - P_{t-1})}{P_t}$

Where,

R_{it} denotes daily returns

P_t denotes the price today

P_{t-1} denotes the price before today

Initially, in the event window the expected returns must be estimated, this study uses the market model as a benchmark to measure the estimated returns.

2. $ER_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it}$

Where,

ER_{it} denotes the expected daily return of asset i at time t

α_i denotes the constant return not explained by the market

β_i denotes the stock's sensitivity to the market

R_{mt} denotes the market return

ϵ_{it} denotes the idiosyncratic risk of a stock

All these variables have been estimated in R with the retrieved data from the LSEG Workspace. With the actual and expected returns the abnormal returns can be calculated as follows:

3. $AR_{it} = R_{it} - ER_{it}$

Where,

AR_{it} denotes the abnormal returns of the company i at time t

Consequently, with the abnormal returns the cumulative abnormal returns can be calculated to measure the impact of the bushfires on the Australian Stock Exchange. Which are calculated as follows:

4. $CAR_{i,t_1,t_2} = \sum_{t=t_1}^{t_2} AR_{it}$

A positive cumulative abnormal returns states that shareholders update their beliefs and expect higher returns due to the event, the bushfires. This study test whether the cumulative abnormal returns significantly deviates from zero which tests whether the Australian Stock Exchange reacts to bushfires in Australia. Which tests the first hypothesis of this research.

Besides testing whether the cumulative abnormal return significantly deviates from zero for both the short-term and long-term this study also focusses on the effect of the different industries. As mentioned earlier the companies have been allocated whether the wildfire impact them directly or indirectly. This is measured empirically with a dummy variable. Where a 1 is a company in a directly impacted industry and a 0 when the wildfire has an indirect impact on the specific company. Appendix 2 shows a list of how all industries have been classified. The effect of the industry dummy is measured with an ordinary least squares (OLS) regression. Two models will be performed, one for the effect of the industry dummy on the short-term CAR and one for the long-term CAR. These two models are specified below and test the second hypothesis.

5. $CAR_{short} = \beta_0 + \beta_1 INDUSTRY_i + \varepsilon_{it}$
6. $CAR_{long} = \beta_0 + \beta_1 INDUSTRY_i + \varepsilon_{it}$

4. RESULTS

Firstly, the cumulative abnormal returns are calculated. The cumulative abnormal returns (CAR) for each company of the top 300 companies in the Australian Stock Exchange and their allocated industry (direct vs indirect) have been determined based on the data from LSEG Workspace. For both the cumulative abnormal returns for the short term and long term a t-test has been performed. For the short-term CAR, figure 2 in appendix 4 shows the average daily returns for all companies within the window used to calculate the short-term CAR.

Table 1 shows the results for the short-term CAR t-test. Reviewing this results the p-value is highly significant and this states that the cumulative abnormal return on the short term significantly deviates from zero, which is estimated return of the estimation window. This offers grounds to assume that the Australian bushfires do have a significant effect on the Australian Stock Exchange. The mean of the cumulative abnormal return in the short term shows a positive mean, which indicates that the stock market reacts relatively positive on the Australian bushfires.

Table 1: t-tests short-term and long-term CAR

Event Window	Obs.	Mean CAR (%)	t-value	p-value	Std. Dev.	Min 95% CI	Max 95% CI
−5 to +5 days	263	2.30	4.82	< 0.001	1.10	1.36	3.24
−5 to +45 days	263	0.19	0.20	0.839	2.05	−1.72	2.11

Moreover, Table 1 also shows the results for the long-term CAR t-test. Analyzing the results of the t-test on the long-term CAR shows different results than for the short-term. The p-value is 0.8393 and is therefore insignificant. This suggests a basis for assuming that the bushfires do not have a significant impact on the sentiment of the market. The mean of the cumulative abnormal return is also close to zero, which is in line with expectation.

As mentioned in the methodology section, besides the t-tests this study also investigates the effect of the different industries of the company. The companies of the Australian Stock Exchange have been categorized in whether the bushfires are expected to have a direct or indirect impact and are categorized with a dummy. Below in Table 2 the results of the two OLS regressions are presented for again both the short-term and long-term CAR's.

Table 2: OLS regressions of industry on CAR

	Dependent Variable:	
	(1) ST **CAR (-5,+5)**	**(2)** LT **CAR (-5,+45)**
Intercept "Industry dummy" (directly affected)	$\beta_0 = -0.011$	$\beta_0 = -0.005$
Std. error	(0.009)	(0.017)
Intercept Constant (indirectly affected)	$\beta_1 = 0.026$***	$\beta_1 = 0.004$
Std. error	(0.006)	(0.013)
Observations	N = 296	N = 296
F-statistic(df = 1; 294)	1.525	0.070
Note:	*p<0.10; **p<0.05; ***p<0.01	

The significant positive intercept indicates that industries which are not directly exposed to the effect of the bushfires nonetheless experience a statistical significant positive effect in the cumulative abnormal returns. In contrast, the negative coefficient for the industry dummy suggests that the directly impacted industries performed worse than the indirectly affected companies. However, the coefficient of the dummy variable is not significant, which states that there can be no conclusion drawn from the effect.

Secondly, the model of the long-term CAR shows the same positive and negative relationships. But both the intercept and the coefficient are not significant. So no conclusion can be made on these results.

5. DISCUSSION

This goal of this research was to investigate the financial impact of the 2019-2020 bushfires in Australia, which were the most severe bushfires in recorded history. This study examines the financial effect of the stock market through statistical analysis using an event study approach. In order to answer the research question and sub-questions, some hypotheses were made based on the literature reviewed.

Regarding the first hypothesis, "*The bushfire will increase overall stock return"* I have some varying results. Significant results were found for the short-term returns and these results showed the CAR being positive, suggesting a significant increase in returns during the calculation window. This is in line with some of the previous literature like (Worthington & Valadkhani, 2004) which suggested that bushfires can lead to a positive effect on market returns, especially in the short-term, like the food. Some findings by (Wang & Kutan, 2013) also found that the insurance sector in Japan benefitted from the impact of natural disasters, contrary to their findings in the USA. My findings for each industry can be found in Appendix 3. Some industries like the Rubber and Miscellaneous Plastics, Water transportation and Miscellaneous Retail receive a high positive short-term effect. This might be explained by the fact that many companies within these industries supply products and/or services which become important in times of bushfires. Think of emergency supplies and water transportation to stop the fires. This would increase the demand for these supplies and thus explain the short-term effects. We see that most of the well-performing industries in the short term tend to lose their increase in stock-market prices after some time has passed. Thus, In the long-term no significant results were found though overall the mean of the returns seems to be positive though without statistical significance. Though some industries saw their stock prices increase even further compared to the short-term window. These industries are for the vast majority related to transportation and construction however which makes sense since people will try to build new homes or protect the one they have from the still ongoing fires. Overall the first prediction was found to be statistically significant for the short-term, but is not supported on the long-term scale.

The second hypothesis, "*The impact of the bushfires will vary greatly depending on the industry"* was tested based on industry-dummies that differentiated between industries either directly- or indirectly- affected industries. The regression analysis showed that indirectly- affected industries showed a significant positive effect in the short-term whereas the directly-affected industries found a negative impact, though insignificant. For the long-term the indirectly-affected industries still outperformed the directly-affected industries though both those results showed no statistically significance. Thus the second hypothesis is partially in-line with the results. Indirectly-affected

industries seem to perform better regardless of the length of the window used though only the short-term seems to have a statistically significant impact on CAR. These results or mostly in-line with discussed literature like (Fama, 1998) which stated that in the long-term the market efficiency survives and overreaction to an event like this bushfires is just as common as an underreaction. Here I see no significant long-term reactions either and the market seems to return to a relatively normal state. Overall this discussion helps answer the research question and sub-question and now I will write a conclusion.

5.1 Conclusion

The main question of this research was: "*How did the 2019-2020 Australian bushfires impact the stock performance of the affected industries?* In the discussion above the two predictions were used to discover the answers to the sub-questions and thus the main question of this research. The results showed that for the chosen short-term and long-term window we have no significant impact either on directly- on indirectly-affected industries apart from the short-term indirectly-affected industries. So the conclusion based on this research would be that the 2019-2020 bushfires in Australia had no lasting effect, at least not 45 days after the start of the fires, on the stock market. In the short-term window I assessed however the bushfires did significantly impact the indirectly-affected industries.

Now to conclude this thesis I will present some implications and limitations to this study in the following sections.

5.2 Implications

In terms of theoretical implications, the significance of the short-term CAR of indirectly-affected industries suggests that the market rapidly incorporated the new information which is in-line with the EMH discussed in the literature. The fact that the long-term CAR showed the market absorbing the effects of the fires in the long-term is also in-line with the EMH. In addition, the insignificant differences between directly- and indirectly-affected industries might also suggest that this form of industry-classification alone is not sufficient to capture variation in abnormal returns following nation-wide bushfires. However I do believe this research holds academic relevance since this type of research on the 2019-2020 is scarce and differentiates from existing literature which tends to focus on a specific industry or on local effects of the disaster. Therefore I do believe this literature adds to existing literature by adopting a nation-wide analysis.

From a practical perspective this research might help managers or investors form an idea as to how the market will react to these nation-wide disasters both in the short-term and long-term. For investors this might be a good indication that opportunities for investment are with the indirectly- affected industries as they saw significant positive short-term CAR. Therefore identifying firms within this indirectly- affected group of industries might give some opportunities to investors given they can identify signs of bushfires like this happening again before the short-term effects take place. For the long-term CAR industries seemed to not be impacted significantly because of the bushfires which might suggest to firms affected by the disasters that the market might not penalize them uniformly. However it might also suggest that the market reactions did not fully capture the actual exposure since psychological effects for example were not incorporated in this research.

5.3 Limitations and future research

One of the limitations of this research paper is that there are not many papers with similar literature. Therefore comparing this to any other papers is difficult since bushfires hardly ever last the better part of a year. In addition choosing an appropriate event window is also very difficult in this case since limited similar research has been done. The fact that the coronavirus also emerged near the end of the bushfires might also limit options to investigate CAR after all the fires stopped since corona might also interfere with the stock market. This research also has limited control variables which might help further explain the results found in this thesis. Therefore I recommend future research to increase the granularity of the research and dive deeper into data about different kinds of industries and I also recommend future research to use firm-specific climate vulnerability metrics like for example carbon footprint and physical asset locations. These are just some examples of how future research can build on this thesis and expand knowledge about the financial implications of the 2019-2020 bushfires on the stock market.

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7. APPENDIX

7.1 Appendix 1: Timeline overview of the study

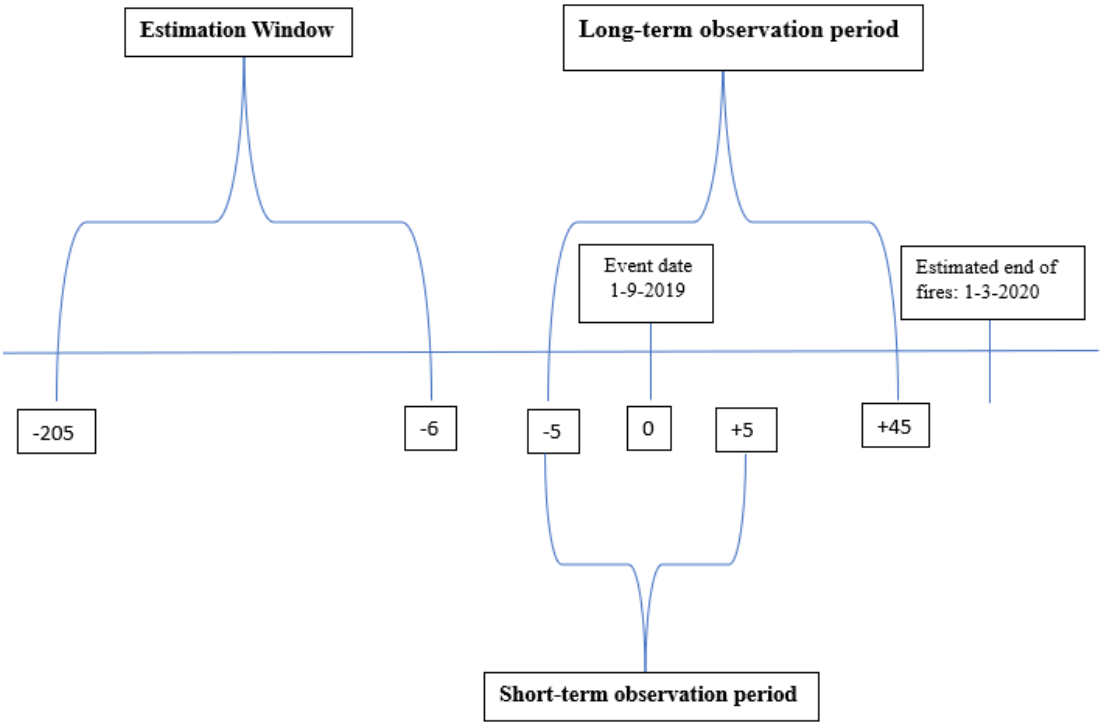

Figure 1 - timeline overview and observation windows

7.2 Appendix 2: Industry Classification – Direct or Indirect impact

SIC Code	Industry	Wildfire Impact
1	Agricultural Production - Crops	Direct
2	Agricultural Production - Livestock	Direct
7	Agricultural Services	Indirect
8	Forestry	Direct
9	Fishing, Hunting, and Trapping	Indirect
10	Metal Mining	Indirect
12	Coal Mining	Indirect
13	Oil and Gas Extraction	Indirect
14	Mining and Quarrying (except Oil and Gas)	Indirect
15	Building Construction	Indirect
16	Heavy Construction, except Building Construction	Indirect
17	Construction Special Trades	Indirect
20	Food and Kindred Products	Indirect
21	Tobacco Products	Indirect
22	Textile Mill Products	Indirect
23	Apparel and Other Finished Products Made From Fabrics	Indirect
24	Lumber and Wood Products	Direct
25	Furniture and Fixtures	Indirect
26	Paper and Allied Products	Direct

27	Printing, Publishing, and Allied Industries	Indirect
28	Chemicals and Allied Products	Indirect
29	Petroleum and Coal Products	Indirect
30	Rubber and Miscellaneous Plastics Products	Indirect
31	Leather and Leather Products	Indirect
32	Stone, Clay, Glass, and Concrete Products	Indirect
33	Primary Metal Industries	Indirect
34	Fabricated Metal Products	Indirect
35	Industrial Machinery and Equipment	Indirect
36	Electronic and Other Electrical Equipment	Indirect
37	Transportation Equipment	Indirect
38	Measuring, Analyzing, and Controlling Instruments; Photographic, Medical, and Optical Goods	Indirect
39	Miscellaneous Manufacturing Industries	Indirect
40	Railroad Transportation	Direct
41	Local and Suburban Transit	Direct
42	Motor Freight Transportation and Warehousing	Indirect
43	United States Postal Service	Indirect
44	Water Transportation	Indirect
45	Transportation by Air	Indirect
46	Pipelines, Except Natural Gas	Indirect
47	Transportation Services	Indirect
48	Communications	Direct
49	Electric, Gas, and Sanitary Services	Direct
50	Wholesale Trade - Durable Goods	Indirect
51	Wholesale Trade - Nondurable Goods	Indirect
52	Building Materials, Hardware, Garden Supply, and Mobile Home Dealers	Indirect
53	General Merchandise Stores	Indirect
54	Food Stores	Indirect
55	Automotive Dealers and Gasoline Service Stations	Indirect
56	Apparel and Accessory Stores	Indirect
57	Home Furniture, Furnishings, and Equipment Stores	Indirect
58	Eating and Drinking Places	Indirect
59	Miscellaneous Retail	Indirect
60	Depository Institutions (Banks)	Indirect
61	Nondepository Credit Institutions	Indirect
62	Security and Commodity Brokers, Dealers, Exchanges, and Services	Indirect
63	Insurance Carriers	Direct

64	Insurance Agents, Brokers, and Services	Direct
65	Real Estate	Direct
67	Holding and Other Investment Offices	Indirect
70	Hotels and Other Lodging Places	Direct
72	Personal Services	Indirect
73	Business Services	Indirect
75	Auto Repair, Services, and Parking	Indirect
76	Miscellaneous Repair Services	Indirect
78	Motion Pictures	Indirect
79	Amusement and Recreation Services	Direct
80	Health Services	Direct
81	Legal Services	Indirect
82	Educational Services	Indirect
83	Social Services	Direct
84	Museums, Botanical, Zoological Gardens	Direct
86	Membership Organizations	Indirect
87	Engineering and Management Services	Indirect
89	Services, Not Elsewhere Classified	Indirect
91	Executive, Legislative, and General Government, Except Finance	Direct
92	Justice, Public Order, and Safety	Direct
93	Finance, Taxation, and Monetary Policy	Indirect
94	Administration of Human Resource Programs	Indirect
95	Environmental Quality and Housing	Direct
96	Administration of Economic Programs	Indirect
97	National Security and International Affairs	Indirect
99	Nonclassifiable Establishments	Indirect

7.3 Appendix 3: Industry CAR sorted by highest to lowest short-term CAR

Industry name	**Short-term CAR**	**Long-term CAR**
Rubber and Miscellaneous Plastics Products	0,1678	0,1070
Water Transportation	0,1079	0,2333
Miscellaneous Retail	0,0905	0,0689
Fabricated Metal Products	0,0654	0,0967
Wholesale Trade - Nondurable Goods	0,0577	-0,0036
Personal Services	0,0575	-0,0021
Business Services	0,0510	0,0494
Motor Freight Transportation and Warehousing	0,0504	0,1470
Insurance Agents, Brokers, and Services	0,0476	0,1159
Heavy Construction, except Building Construction	0,0465	0,0561
Amusement and Recreation Services	0,0457	0,0914
Building Materials, Hardware, Garden Supply, and Mobile Home Dealers	0,0452	0,0173
Chemicals and Allied Products	0,0433	-0,0367
Wholesale Trade - Durable Goods	0,0425	0,1252

Food and Kindred Products	0,0414	-0,1098
Security and Commodity Brokers, Dealers, Exchanges, and Services	0,0404	-0,0329
Communications	0,0374	-0,0412
Furniture and Fixtures	0,0351	-0,1268
Engineering and Management Services	0,0318	-0,0451
Automotive Dealers and Gasoline Service Stations	0,0306	0,0869
Fishing, Hunting, and Trapping	0,0240	-0,0147
Nondepository Credit Institutions	0,0225	-0,0694
Transportation by Air	0,0169	-0,0350
Holding and Other Investment Offices	0,0165	0,0700
Construction Special Trades	0,0159	0,0118
Primary Metal Industries	0,0156	-0,0003
Real Estate	0,0151	0,0378
Printing, Publishing, and Allied Industries	0,0139	0,0281
Insurance Carriers	0,0128	0,0537
Hotels and Other Lodging Places	0,0113	-0,0069
Educational Services	0,0099	-0,0464
Building Construction	0,0094	0,0111
Social Services	0,0089	0,1561
Miscellaneous Manufacturing Industries	0,0084	0,0216
Depository Institutions (Banks)	0,0082	0,0467
Stone, Clay, Glass, and Concrete Products	0,0075	0,0150
Home Furniture, Furnishings, and Equipment Stores	0,0062	0,0069
Metal Mining	0,0054	-0,0012
Lumber and Wood Products	0,0048	-0,0710
Transportation Services	0,0037	-0,0878
General Merchandise Stores	0,0022	-0,0571
Eating and Drinking Places	0,0011	-0,1246
Paper and Allied Products	0,0000	0,0000
Coal Mining	-0,0048	0,0595
Health Services	-0,0110	-0,0237
Electronic and Other Electrical Equipment	-0,0113	0,0360
Apparel and Accessory Stores	-0,0141	-0,1182
Railroad Transportation	-0,0146	-0,0189
Electric, Gas, and Sanitary Services	-0,0207	0,0063
Food Stores	-0,0254	-0,0417
Oil and Gas Extraction	-0,0259	-0,0674
Auto Repair, Services, and Parking	-0,0292	-0,1386
Measuring, Analyzing, and Controlling Instruments; Photographic, Medical, and Optical Goods	-0,0343	-0,0576
Mining and Quarrying (except Oil and Gas)	-0,0350	-0,0685
Transportation Equipment	-0,0476	-0,1491
Grand Total	**0,0204**	**0,0018**

7.4 Appendix 4: Short-Term (-5, +5) average Daily Abnormal Returns (AR)

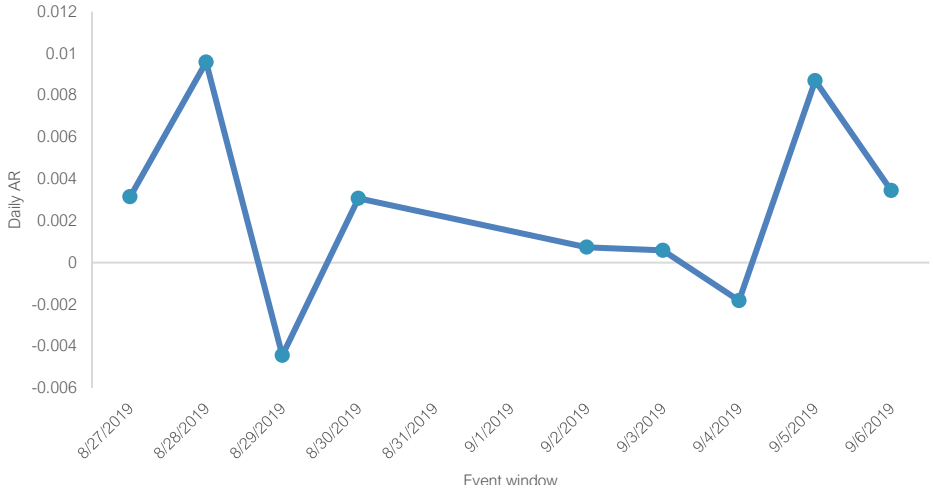

Figure 2 - average Daily Abnormal Returns for all companies in the Short-term window