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Climate Risk and the Price of Audit Services: The Case of Drought

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SUMMARY: This study examines the impact of drought on the pricing of audit services for U.S. firms over the period 2001–2015. We employ the Palmer Drought Severity Index (PDSI) to determine drought intensity conditions at the state level on a yearly basis and regress audit fees on drought intensity after controlling for other known factors of audit fees. We document that auditors charge significantly higher audit fees for client firms headquartered in areas affected by drought. The effect of drought on audit fees is more pronounced among firms with lower accruals quality and among firms with high business operation concentration in their headquarter states. Collectively, our findings suggest that climate risk in the form of drought not only affects firm risk but also audit risk, thereby highlighting that externalities from climatic conditions are relevant to firms and auditors.

Keywords: audit fees; drought; headquarter concentration; accruals quality.

Climate related risk is recognised by business as one of the most material issues.
—KPMG (2017)

Natural disasters linked to changing climate already cost us (at Unilever) more than US$300 million a year. Left unchecked, climate change has the potential to be a significant barrier to our gross, and that of nearly every other (business) sector.
—Paul Polmon, CEO of Unilever, quoted in the *Global Landscapes Forum* 09/12/2014.

I. INTRODUCTION

Studies in the scientific literature have unequivocally stressed that climate change directly increases drought probability, intensifies drought conditions, and exacerbates drought severity (Hao, AghaKouchak, and Phillips 2013; Hao, AghaKouchak, Nakhjiri, and Farahmand 2014; Leonard et al. 2014). Because climate change is adding heat to the climate system, while much of that heat goes into drying land, natural drought can set in quicker, become more intense, and last longer (Karl, Melillo, and Peterson 2009; Trenberth et al. 2014).[1] In addition, human activities have also caused large increases in heat-trapping gases, thereby significantly raising the global temperature, and this anthropogenic climate change further heightens drought risk (Dai 2011; Marvel et al. 2019). Given a strong nexus between climate change, global warming, and

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[1] Higher global temperature from climate change results in increased rates of surface evaporation and loss of water from plants (Melillo, Richmond, and Yohe 2014). According to a report by the National Oceanic and Atmospheric Administration (Karl et al. 2009), droughts have "become more frequent and intense during the past 40 or 50 years" as results of global warming. AghaKouchak, Cheng, Mazdiyasni, and Farahmand (2014) also document that the rising global temperature increases the probability of drought and heat waves occurring simultaneously.

drought conditions, this study seeks to understand the economic costs of climate change risk in the audit context and examines how auditors respond to climate change risk in the form of drought.[2]

Drought conditions represent exogenous natural disaster shocks that could affect business risk.[3] Water engineering studies find that drought places a direct impact on the profits and operations of firms in industries most reliant on water such as food processing, agriculture, power generation, and automotive (Blackhurst, Hendrickson, and Vidal 2010). Sectors that are not directly dependent on water can nevertheless be sensitive to drought risk because of reductions in output from other sectors that are directly affected by drought. This is because a sector's output could be affected either by its own production capacity or by other industries not providing the necessary inputs for the production process (Acemoglu, Ozdaglar, and Tahbaz-Salehi 2010; relatedly, Acemoglu, Carvalho, Ozdaglar, and Tahbaz-Salehi 2012). In addition, sectors that experience a cutback in production should also demand less from their suppliers. Thus, drought may bring about indirect vulnerability from reduced material or labor supply for firms operating in sectors that are not directly dependent on water.

Our main hypothesis is that drought is likely to engender higher audit risk for firms operating in drought conditions because crisis-affected firms are likely to exhibit poorer reporting quality and internal controls (Kane, Richardson, and Graybeal 1996; Das, Shroff, and Zhang 2009). Because increased audit risk requires greater audit effort, there are upward pressures on audit fees (Bedard and Johnstone 2004; Christensen, Omer, Sharp, and Shelley 2014; Doogar, Rowe, and Sivadasan 2015). In addition, as drought could be classified as a type of rare natural disaster event, we posit that firms exposed to drought exhibit higher business risk and auditors price this incremental risk accordingly.[4]

To test the relation between drought and audit fees, we first construct yearly PDSI index values for each state by averaging PDSI values for the particular state from the past 12 months for the fiscal year.[5] Next, based on this 12-month average PDSI variable, we create a three-level drought intensity variable indicating varying drought conditions as established in the climatology literature. Specifically, we construct three dummy variables that capture binary outcomes when a state is under *mild, severe,* and *extreme* drought conditions, respectively. Severe and extreme droughts are the two conditions of drought intensity that are considered the most damaging to economic activities. We also follow the existing literature (see, for example, Coval and Moskowitz 1999; Ivković and Weisbenner 2005; Pirinsky and Wang 2006; Hilary and Hui 2009; Korniotis and Kumar 2013) and use a firm's headquarter location, a proxy for the firm's principal location, to identify firm-level drought exposure, since it represents the core of a firm's business activities.

Our main empirical results can be summarized as follows. Using a sample of 50,376 firm-year observations from 2001 to 2015, we document a positive and statistically significant relation between drought periods and audit fees. We first document that severe drought and extreme drought are associated with significant increases in audit fees for firms headquartered in states affected by drought, after controlling for other determinants of audit fees, industry fixed effects, and year fixed effects. The relation between drought and audit fees is also of large economic magnitude. Based on dichotomous drought variables, we find that firms headquartered in states with severe or extreme drought conditions, on average, pay 8.98 percent higher audit fees relative to firms headquartered in states with normal conditions. Focusing on firms headquartered in states affected by extreme drought, these firms pay 7.68 percent higher audit fees. Our main results are robust to the alternative drought measure, the inclusion of industry-year paired fixed effects, in the firm fixed effects model, as well as in an annual change model. Results based on a difference-in-differences (DiD) analysis further lend support to our main findings. We document that firms pay significantly higher audit fees when they move from a non-drought condition to a severe or extreme drought condition, relative to the control matched firms that are not affected by drought.

In addition, we investigate the moderating effects of various firm attributes on the relations between drought and audit fees. First, we find that the extent to which drought affects a firm's business risk depends not only on the drought intensity itself, but also on the quality of the firm's financial reporting. We document that the positive effect of drought on audit fees is more

[2] While there have been heightened interests in understanding climate change risk from auditors (PwC 2012; KPMG 2017), firm management (World Economic Forum 2015), and various other stakeholders (SEC 2010; Eccles, Serafeim, and Krzus 2011; Mercer 2015), there is little research regarding auditors' assessment of firms when climate risk is imminent.

[3] We choose drought as the focus of our study for at least three reasons. First, among all natural disasters related to climatic conditions, drought is considered the most common natural disaster in the U.S. (Ding, Hayes, and Widhalm 2011) and also the most disastrous for economic activities (Lesk, Rowhani, and Ramankutty 2016). Second, droughts are geographically widespread and can affect most regions on a random basis over time (Cook, Seager, Cane, and Stahle 2007). Third, Palmer (1965) provides a method to identify drought and quantify its severity; namely, the Palmer Drought Severity Index (PDSI), which enables us to conveniently trace drought history and drought intensity across all states in the U.S.

[4] According to the rare disaster risk models (Chen, Joslin, and Tran 2012b), disaster risk premium increases significantly following a disaster event. For example, Berkman, Jacobsen, and Lee (2011) document that disaster risk in the form of international political crises results in large impacts on both the mean and volatility of world stock market returns.

[5] This measure of PDSI is the most popular data in climatology studies on drought (see, for example, Alley 1984; Dai 2011; Trenberth et al. 2014) and allows us to construct science-based definitions of drought intensity. It employs information on temperature and moisture in soil levels to derive an index that measures drought intensity in each station location. The data also allow researchers to compare the severity of drought across states or in a global setting on an equal footing basis (Dai 2011).

pronounced in firms with higher discretionary accruals relative to others. Thus, consistent with the notion that auditors are concerned with high cash flow risk associated with poor accruals quality (Cho, Ki, and Kwon 2017), auditors incrementally increase audit fees for firms with lower accruals quality in the event of drought. Second, we find that the positive effects of drought on audit fees are more pronounced for firms with more internal control deficiencies. However, there is weak evidence that a firm's corporate governance moderates the relations between drought and audit fees.

While our headquarter assumption is intuitively plausible (Chaney, Sraer, and Thesmar 2012), we acknowledge that this assumption places a uniform exposure of firms in a certain location to drought risk. In a number of cases, this may not be accurate as some firms may have operations outside their headquarter states. When firms' productions are in locations not affected by drought, it may not be reasonable to expect auditors to factor drought risk based on headquarter locations. We address this issue in two ways. First, using geographic locations of businesses from 10-K filings (García and Norli 2012), we find that firms with business operations concentrated in their headquarter states are subject to larger audit fee increases when in drought conditions. Second, we construct a weighted-average drought intensity measure that incorporates a firm's operations across multiple states. Using this more fine-grained measure of drought risk exposure, we also document a strong positive relation between the extent of firm-level drought exposure and audit fees.

We also report other additional analyses. First, we re-calibrate our drought intensity measures using PDSI values at the county level and confirm our main findings. Second, we find that the effect of drought on audit fees is significantly higher among firms from water-dependent industries. Interestingly, the relation between drought and audit fees remains significant for firms not from water-dependent industries, albeit of lesser economic magnitude. Third, because drought occurrence could be coincidentally more common in fast growing states, we exclude observations related to the states of California and Texas and re-run the baseline regressions with this subsample. The results of this analysis are consistent with our main empirical findings, which indicate that our results are not driven by influential states in our sample. Fourth, we construct a subsample of firms whose operations are mainly outside the U.S. Consistent with the expectation that these firms should have lower exposure to drought, we do not find any impact of drought on audit fees for these firms.

Our paper makes at least three important contributions to audit research and practice. First, while there is virtually no disagreement among researchers that climate change poses substantial costs to the economy (e.g., Burke, Hsiang, and Miguel 2015; Dietz, Bowen, Dixon, and Gradwell 2016; Lesk et al. 2016), an important issue for business risk assessment now is what exactly these costs are, how to measure them, and how to address them. In this study, we address these important questions by quantifying the effect of drought on risk assessment of auditors (via audit fees) and documenting that this effect is widespread due to an integrated economy. Our study asks questions and uses models that have been developed by auditing theory and shows how auditing research can contribute to the current discussion on climate risks.[6]

Second, our study highlights the importance of climate-related risk as an audit fees determinant. The majority of the audit pricing literature has mostly focused on identifying several risk characteristics of firms that are priced in the cross-section of audit fees, while paying less attention to how such risk characteristics may change due to externalities. For this reason, in 2018, CPA Australia has specifically addressed key climate change implications for audit work to ensure compliance with accounting standards and regulations. The body is especially concerned that little has been done in understanding climate change and professional liability risk for auditors while climate change is creating significant financial risks for client firms. We empirically document that climate risk arising from the surrounding environment affects a firm's business risk, and that auditors incorporate this risk in their audit risk assessment.

Third, our firm-level examination takes advantage of the heterogeneity in corporate policies and allows us to draw implications for managers and auditors as to how firms can palpably address climate risks in general and drought risk in particular. Specifically, we show that when a firm has larger geographic dispersion or has the majority of operations away from its headquarters, the increase in audit fees brought about by drought conditions is significantly mitigated.[7] This evidence, together with policies encouraging the disclosure of corporate exposure to climate risk (e.g., SEC 2010), is of interest to firm management, auditors, investors, and regulators alike, and especially informative in developing climate-change-related policies.

[6] While many existing large aggregate estimates only coarsely encapsulate the significant risks and severity of drought, audit fees are particularly relevant for a more precise cost analysis firm-level study. Audit fees are risk driven, free from model estimation errors, and form an important cost component to firms.

[7] Our study, therefore, joins a growing stream of research that studies how events of macro nature can systematically affect individual firms (Gulen and Ion 2016; Dessaint and Matray 2017; Dai, Rau, Stouraitis, and Tan 2020; Chen, Duh, Wu, and Yu 2019). A highlighted notion from these studies is that corporate strategies and firm characteristics can act as important natural mitigations. Controlling for the same exposure to drought, we show that the extent of audit fees increase varies significantly in corporate strategies (e.g., geographical concentration) and firm characteristics (e.g., accruals quality and internal control strength).

The article is organized as follows: Section II reviews the relevant prior studies and develops our testable hypotheses. Methodology and data are discussed in Section III. This is followed by discussions of the empirical results in Section IV and additional analyses in Section V. Section VI offers concluding remarks.

II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Audit Fees and External Factors

Prior studies in the auditing literature have extensively examined factors affecting auditors' decisions in pricing their audit services. These studies have almost exclusively focused on innate factors related to the client firm, auditors, and the audit process. For example, Gul, Chen, and Tsui (2003), Bedard and Johnstone (2004), and Charles, Glover, and Sharp (2010) examine attributes related to client firms, such as financial reporting risk, and how they affect audit fees.[8]

The link between audit pricing decision and factors external to the audit process has been hitherto sparsely covered in the literature. Some recent research focuses on how regulatory reforms, often viewed as factors that are not directly related to the audit process, affect audit fees. For example, Ghosh and Pawlewicz (2009) document an increase in audit fees after the enactment of the Sarbanes-Oxley Act 2002 (SOX) and argue that such an increase is driven by higher audit efforts and greater exposure to legal liability. Prior studies also find that audit fees are positively associated with mandatory audit firm rotation (Kwon, Lim, and Simnett 2014), mandatory audit partner rotation (Sharma, Tanyi, and Litt 2017), and mandatory joint audits (André, Broye, Pong, and Schatt 2016). Overall, these studies have contributed to the existing literature by exploiting exogenous shocks, such as changes in regulations, to study changes in the audit pricing process.

Drought and Economic Impacts

Our study investigates a fundamental link between climate risk, in the form of drought conditions, and audit pricing decisions. Drought is defined as "an interval of time, generally of the order of months or years in duration, during which the actual moisture supply at a given place rather consistently falls short of the time climatically expected or climatically appropriate moisture supply" (Palmer 1965). The adverse effects of drought develop and accumulate slowly with less obvious structural impacts (Wilhite 2000; Ding et al. 2011), and economic costs associated with drought can be long lasting. In addition, its damages have larger geographical dispersions compared to impacts resulting from other natural disasters (Wilhite 2000).[9]

While the agricultural sector is arguably the most severely affected by drought, prior studies demonstrate that the adverse impact of drought can also be observed across different industries. For example, industries that experience significant impacts in the aftermath of drought include fertilizer and agrochemical and farm services due to their dependence on the agricultural sector (Howitt, Medellín-Azuara, MacEwan, Lund, and Sumner 2015). Other non-agricultural sectors that could be directly affected by drought because of their heavy reliance on water consumption include tourism (Leones, Colby, Cory, and Ryan 1997; Schneckenburger and Aukerman 2002), horticulture and landscaping services (Hodges and Haydu 2003; Ding et al. 2011), and utilities (Gleick 2015; van Vliet, Sheffield, Wiberg, and Wood 2016).

Drought can also place significant impacts on those sectors that are seemingly less reliant on water availability. This is because a sector's output could be affected either by its own production capacity or by other industries not providing the necessary inputs for the production process. Thus, drought may bring about indirect vulnerability from reduced material or labor supply for firms operating in sectors that are not directly dependent on water. In line with this argument, prior studies (see, for example, Acemoglu et al. 2010; Acemoglu et al. 2012; Anjos and Fracassi 2015) show that negative shocks to a particular industry could also lead to large ripple effects on other sectors.[10]

[8] Other studies (see, for example, Carcello, Hermanson, Neal, and Riley 2002; Abbott, Parker, Peters, and Raghunandan 2003; Griffin, Lont, and Sun 2008; Hay, Knechel, and Ling 2008; Rainsbury, Bradbury, and Cahan 2009) examine the relation between corporate governance attributes, as other factors related to client firms, and audit pricing.

[9] Among all natural disasters arising from climatic conditions, drought is considered the most common natural disaster in the U.S. Ding et al. (2011) report that 14 percent of the country experiences severe or extreme drought at any one time. Drought is also the most devastating natural disaster for economic activities (Hong, Li, and Xu 2019). In a global setting, Lesk et al. (2016) find that droughts and extreme heat are associated with reduction in national cereal production by 9–10 percent, whereas floods and extreme cold do not seem to exhibit an effect on crop production. In the U.S., drought accounts for 41.2 percent of the estimated $349 billion of total economic losses related to weather disasters over the period 1980–2003 (Ross and Lott 2003).

[10] Economic models in Jovanovic (1987), Durlauf (1993), Bak, Chen, Scheinkman, and Woodford (1993), and recently in Gabaix (2016), show that when there are strategic or economic connections among sectors and firms, large inter-sector fluctuations may result from firm-level shocks. Relatedly, Acemoglu et al. (2012) characterize the U.S. economy as inter-sectoral input-output linkages and show that sizable aggregate volatility can originate from sectoral idiosyncratic shocks, while traditional diversification argument (e.g., Lucas 1977) often assumes microeconomic shocks would average out into negligible aggregate effects.

Hypothesis Development

Adverse operating conditions arising from external factors increase a firm's business risk and, consequently, create incentives for the firm to engage in earnings manipulation activities. For example, Byard, Hossain, and Mitra (2007) show that in the aftermath of Hurricanes Katrina and Rita, large petroleum refining firms manage earnings through income-decreasing accruals. In the context of our study, the economic impact of drought substantially increases a firm's business risk, as it results in adverse shocks to cash flows and operating performance. Consequently, firms operating in drought conditions are likely to have higher earnings volatility, which increases auditors' exposure to risk in the audit engagement. This exposure creates incentives for auditors to charge higher fees to their clients. In the event of a client's failure, auditors are exposed to litigation risk, and in order to protect themselves, auditors have incentives to (1) exert more audit effort such as conducting more costly audit testing, and/or (2) impose a fee premium to cover expected litigation losses (Stanley 2011).

Another theoretical motivation to examine the impact of drought on audit fees comes from the rare disaster risk model. In the disaster model of Chen et al. (2012b), disaster risk premium increases significantly following a disaster event. While much of the literature has focused on whether disasters can rationalize the returns and volatility of the aggregate market (Barro 2006; Berkman et al. 2011; Bansal, Kiku, and Ochoa 2017), researchers (Cremers, Halling, and Weinbaum 2015; Bai, Hou, Kung, Li, and Zhang 2019) have also extended the model to explain risk premium on individual firms, because certain firms are more exposed to rare events than others. Based on this theoretical framework, auditors may view a disaster-risky individual client as being subject to higher business risk in a drought disaster event.[11]

Taken together, based on the above discussions, as drought could be classified as a type of rare disaster event, we conjecture that firms operating in drought conditions are charged higher fees by their auditors. Hence, H1 is stated as follows:

H1: Firms operating during drought conditions are charged higher audit fees relative to others.

We also posit that during drought conditions, auditors perceive firms with lower accruals quality to be riskier than other firms of higher accruals quality.[12] Accruals quality informs users of financial information about the mapping of accounting earnings into cash flows. Firms with poor accruals quality have weaker mapping and thus are of higher cash flow risk.[13] Dechow and Dichev (2002) show that accruals quality is associated with innate factors that stem from a firm's business model and operating environment. Consistent with this notion (that accruals quality is associated with a firm's fundamental risk), Kim and Qi (2010) document that firms with low accruals quality are more vulnerable to economic shocks. In the setting of our study, drought could bring about shocks that make firms with low accruals quality more vulnerable and riskier. Because auditors infer cash flow risk from accruals quality and price their audit efforts accordingly (Cho et al. 2017), *ceteris paribus,* drought could be of larger concern to auditors if their clients have poorer accruals quality. Therefore, we hypothesize that:

H2: The positive effect of drought on audit fees is more pronounced in firms with lower accruals quality relative to others.

III. METHODOLOGY AND DATA

Time Period and Sample Selection

The sample period for this study commences from 2001, based on data availability on audit fees in the U.S., and ends in 2015. The sample selection process starts with all firm-year observations available in Compustat for the selected sample period, which consists of 186,925 firm-year observations. After merging with the Audit Analytics database and deleting 126,430 firm-year observations due to missing data related to audit fees or any of the control variables in the audit fee model, the sample size

[11] Traditionally, a rare disaster in economics refers to a collapse that is infrequent and large in magnitude, placing a negative effect on an economy. The recurring and lasting nature of drought means that this disaster may not be a strictly rare event, *per se*. However, the severity of the damages associated with drought is undoubtedly significant, and sometimes even larger than what is recorded to be a crash in the aggregate consumption. In addition, drought severity is hard to predict and complex to study (Mishra and Desai 2005). It is, therefore, conceivable that extreme events like drought represent a significant source of systematic disaster risk shock to firms.

[12] Earlier studies in the literature (Gul et al. 2003; Bedard and Johnstone 2004; Abbott, Parker, and Peters 2006; Charles et al. 2010; Krishnan, Sun, Wang, and Yang 2013) have extensively investigated the relation between discretionary accruals and audit fees, and documented a strong relation. In interpreting their findings, these studies suggest that poor earnings quality increases inherent risk, which is priced accordingly by auditors.

[13] In essence, this is the risk that reported accounting earnings may not be converted into cash flows. Consistent with this idea, Ogneva (2012) shows strong empirical evidence that firms with poor accruals quality exhibit more negative cash flow shocks in the future. Firms with poor accruals quality also exhibit higher idiosyncratic volatility (Chen, Huang, and Jha 2012a) and higher information uncertainty (Perotti and Wagenhofer 2014).

TABLE 1

Sample Selection and Description

Panel A: Sample Selection

Descriptions	Observations
U.S. publicly listed firms with available data in Compustat for 2001 to 2015	186,925
Less: Missing audit fees and audit fee model related control variables	(126,430)
Less: Foreign firms	(8,835)
Less: Firms operating in the financial service industry	(1,284)
Total Final Observations	50,376

Panel B: Distribution of Sample Firms by Industry

SIC		n	Percent
73	Business Services	7,084	14.06
28	Chemicals and Allied Products	5,716	11.35
36	Electronic/Other Electrical Equipment and Components	4,679	9.29
38	Instruments and Related Products	3,898	7.74
35	Industrial Machinery and Computer Equipment	3,080	6.11
13	Oil and Gas Extraction	2,201	4.37
49	Electric, Gas and Sanitary Services	1,877	3.73
48	Communications	1,757	3.49
20	Food and Kindred Products	1,208	2.40
80	Health Services	1,176	2.33
50	Wholesale Trade Durable Goods	1,147	2.28
37	Transportation Equipment	1,123	2.23
87	Engineering, Accounting, Research, and Management	1,049	2.08
59	Miscellaneous Retail	979	1.94
58	Eating and Drinking Places	844	1.68
	Others (56 industries)	12,558	24.93
	Total	50,376	100.00

(continued on next page)

reduces to 60,495. Eight thousand eight hundred thirty-five observations are deleted for foreign firms and 1,284 for firms operating in financial sectors (Francis, Reichelt, and Wang 2005; Fung, Gul, and Krishnan 2012).

The final sample consists of 50,376 firm-year observations (Panel A of Table 1) for 7,014 unique firms. Panel B of Table 1 reports the distribution of the selected sample based on the client industry. The statistics show that business services, chemical and allied products, and electronic/other electrical equipment and components industries make up 34.71 percent of the final sample across 71 industries.

We obtain PDSI data from the website of NOAA's (National Oceanic and Atmospheric Administration) National Centers for Environmental Information. Monthly data for the PDSI are available from January 1895 for each of the 344 climate divisions within the 48 contiguous U.S. states (PDSI data for Hawaii and Alaska are not available). The NOAA computes state-level averages of PDSI by combining the PDSI values from all climate divisions within each state, weighted by area, to ensure that PDSI values are not skewed toward areas with more climate stations. State-wide PDSI values are, therefore, area-weighted values of PDSI collected from various points in a state. The principal advantage of PDSI compared to other drought indices is that it enables researchers to compare the severity of drought across time and regions as well as in a global setting on an equal-footing basis (Lloyd-Hughes and Saunders 2002; Dai 2011). PDSI ranges from −10 (extremely dry) to +10 (extremely wet), where lower values of the index indicate more severe drought conditions.

Since a firm's headquarters represents its core business activities (Pirinsky and Wang 2006; Chaney et al. 2012; Tuzel and Zhang 2017), we follow the extant literature (e.g., Coval and Moskowitz 1999; Ivković and Weisbenner 2005; Pirinsky and Wang 2006; Hilary and Hui 2009; Korniotis and Kumar 2013) and determine a firm's location as the location of its

TABLE 1 (continued)

Panel C: Descriptive Statistics

	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
MILD_DROUGHT	0.030	0.171	0.000	0.000	0.000
SEV/EXT_DROUGHT	0.053	0.224	0.000	0.000	0.000
EXT_DROUGHT	0.032	0.176	0.000	0.000	0.000
LogAFEE	13.225	1.447	12.150	13.274	14.238
DISACC	0.135	0.176	0.017	0.052	0.169
SEGMENTS	1.516	0.773	1.099	1.099	2.197
DISTRESS	0.536	10.062	−2.552	−1.358	−0.018
BIG4	0.668	0.471	0.000	1.000	1.000
SIZE	5.478	2.437	3.834	5.574	7.191
SQRT_EMP	1.689	2.087	0.377	0.921	2.145
FOREX_OP	0.248	0.432	0.000	0.000	0.000
EXT_ITEMS	0.084	0.278	0.000	0.000	0.000
RECINV	0.252	0.192	0.092	0.216	0.366
SP_ITEMS	−0.027	0.115	−0.015	0.000	0.000
MB	2.712	6.841	1.039	1.915	3.496
LIQ	2.757	2.761	1.201	1.938	3.222
OP_INCOME	−0.116	0.656	−0.064	0.052	0.106
LOSS	0.554	0.497	0.000	1.000	1.000
SALES_GR	0.174	0.714	−0.047	0.059	0.201
OPINION	0.091	0.288	0.000	0.000	0.000
MISSTATE	0.131	0.338	0.000	0.000	0.000
BUSY	0.696	0.460	0.000	1.000	1.000
INITIAL	0.154	0.361	0.000	0.000	0.000
LogNAFEE	10.061	4.322	9.616	11.294	12.687
SOX	0.933	0.250	1.000	1.000	1.000
GFC	0.140	0.347	0.000	0.000	0.000
GDP_PER_CAPITA	10.801	0.150	10.702	10.805	10.900
GDP_GROWTH	0.009	0.022	−0.002	0.013	0.024
Observations	50,376				

headquarters.[14] Next, based on PDSI of the states where a firm's headquarters is located, we follow the convention in climatology (e.g., Dai, Trenberth, and Qian 2004), and construct three drought dummy variables: *MILD_DROUGHT, SEV_DROUGHT,* and *EXT_DROUGHT*. These three variables capture the binary drought outcomes of the states where a firm's headquarters is located. This drought severity classification has been used extensively in the climatology literature to categorize drought conditions from different geographical locations on an equal-footing basis (see, for example, Alley 1984; Briffa, Jones, and Hulme 1994; Zou, Zhai, and Zhang 2005; Briffa, van der Schrier, and Jones 2009; Ding, Schoengold, and Tadesse 2009; Verdon-Kidd and Kiem 2010; Dai 2011). To even out short-term fluctuations in PDSI, we average state-level PDSI values across 12 rolling months to arrive at yearly PDSI values.

Specifically, the variable *MILD_DROUGHT* is a dummy variable that takes a value of 1 when the 12-month average state-level PDSI value is greater than −3 and equal to or smaller than −2, indicating mild drought conditions, and 0 otherwise. The variable *SEV_DROUGHT* is a dummy variable that takes a value of 1 when the 12-month average state-level PDSI is greater than −4 and equal to or smaller than −3, indicating severe drought conditions, and 0 otherwise. The variable *EXT_DROUGHT* is a dummy variable that takes a value of 1 if the 12-month average state-level PDSI is equal to or smaller than −4, indicating extreme drought conditions, and 0 otherwise.

[14] Chaney et al. (2012) find that headquarters and firms' major production plants tend to cluster in the same state, and suggest that a firm's headquarter location is a reasonable proxy for the location of its business operations. Based on headquarters location from Compustat data, the authors further find that firms tend to have greater real estate ownership in the states of their headquarters and suggest that a firm's headquarter location is a reasonable proxy for the location of its business operations (Chaney et al. 2012).

Panel C of Table 1 reports descriptive statistics based on the full sample used in this study. The mean (median) of log of audit fee is 13.225 (13.274). The statistics reported for extreme drought (*EXT_DROUGHT*) show that 3.20 percent of the firm-year observations have experienced extreme drought conditions over the sample period. Severe or extreme drought (*SEV/EXT_DROUGHT*) has a mean of 0.053, suggesting that 5.30 percent of the firm-year observations are in either severe or extreme drought conditions. Descriptive statistics for other control variables are mostly comparable to prior audit fees studies (e.g., Cahan, Jeter, and Naiker 2011; Paterson and Valencia 2011; Fung et al. 2012; Cairney and Stewart 2015).

Empirical Models

To test the first hypothesis of this study, we adopt the audit fee model proposed by Simunic (1980). The dependent variable, *LogAFEE* (natural logarithm of audit fees) is regressed on *MILD_DROUGHT, SEV_DROUGHT,* and *EXT_DROUGHT*, and control variables.[15] Appendix A provides the definition of control variables and the expected association with audit fees. The audit fee model to test H1 is as follows:

$$LogAFEE_{i,t} = \beta_0 + \beta_1 MILD\_DROUGHT_{i,t-1} + \beta_2 SEV\_DROUGHT_{i,t-1} + \beta_3 EXT\_DROUGHT_{i,t-1} + \sum_{i=1}^{n} \gamma_{i,t} CONTROLS + INDUSTRY_{j,t} + YEAR_t + e_{i,t} \quad \text{(Model 1)}$$

where the subscripts *i, j,* and *t* denote firm, industry, and year, respectively. Given that the variation in drought conditions is at the state level, consistent with prior studies (see, for example, Serfling 2016; Flammer and Luo 2017; Houston, Lin, Liu, and Wei 2019), we cluster the standard errors by states in all our empirical analyses.

To further test our H1, we replace the three aforementioned drought dummy variables and re-run two separate additional regressions with *SEV/EXT_DROUGHT* and *EXT_DROUGHT* as our variables of interest. We focus on severe and extreme drought conditions because these are the two conditions of drought intensity that are considered the most damaging to economic activities.

In testing H2, we include the interaction between discretionary accruals and drought in our baseline regressions to capture the extent to which the impact of drought on audit fees depends on a firm's financial reporting quality.

$$LogAFEE_{i,t} = \beta_0 + \beta_1 MILD\_DROUGHT_{i,t-1} + \beta_2 SEV\_DROUGHT_{i,t-1} + \beta_3 EXT\_DROUGHT_{i,t-1} + \beta_4 DISACC_{i,t-1} + \beta_5 DISACC * MILD\_DROUGHT_{i,t-1} + \beta_6 DISACC * SEV\_DROUGHT_{i,t-1} + \beta_7 DISACC * EXT\_DROUGHT_{i,t-1} + \sum_{i=1}^{n} \gamma_{i,t} CONTROLS + INDUSTRY_{j,t} + YEAR_t + e_{i,t} \quad \text{(Model 2)}$$

where the subscripts *i, j,* and *t* denote firm, industry, and year, respectively. We include all the control variables used in Model 1. In both models, we also control for the industry (*INDUSTRY*) and year (*YEAR*) fixed effects to reduce the potential of capturing the effects of industry and year on audit fees.

Table 2 and Figure 1 present the sample distribution of incidences of drought by state and year. Overall, there are 103 state-years of severe or extreme drought between 2001 and 2015. Thirty-one states in total have experienced at least one year of severe or extreme drought during this period. The states of Arizona and Nevada were in severe or extreme drought for ten out of 15 years during our sample period. This is followed by California and Georgia with eight and seven severe or extreme drought years, respectively. In total, there are 17 states that have experienced two years or more continuous severe or extreme drought during the sample period.[16] Nevada, Arizona, Wyoming, and California show the lowest average PDSI values.

In relation to the distribution of sample firms by state, California shows the highest number of observations. On average, there are 593 observations from California per year. This is followed by Texas with 360 yearly observations on average. New Mexico and Wyoming show the lowest representation in our sample.

[15] Following prior studies in the literature (Ferguson and Stokes 2002; Ferguson, Francis, and Stokes 2003; Francis et al. 2005; Cahan et al. 2011; Blankley, Hurtt, and MacGregor 2012; Cairney and Stewart 2015; Huang, Chang, and Chiou 2016), we control for various factors that are found to affect audit fees. We also include two dummy variables (*SOX* and *GFC*) to the baseline regression to capture effects of the Sarbanes-Oxley Act and the global financial crisis. Finally, we control for state-level variables such as state-level GDP per capita (*GDP_PER_CAPITA*) and state-level one-year GDP growth rate (*GDP_GROWTH*).

[16] In relation to the incidence of extreme drought, there are 18 states that experienced at least one year of extreme drought during our sample period, with the total of 57 state-years of extreme drought. The state of Nevada was in extreme drought for eight out of 15 years during this period, followed by California, Colorado, Florida, and Texas with five extreme drought years each. Overall, there are 12 states that experienced two years or more continuous extreme drought during the sample period.

TABLE 2

Drought across State and Year

State	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total	Mean (PDSI)	Std. Dev. (PDSI)	Avg. No. Firms
Arizona	0	1	1	1	0	1	1	0	1	0	1	1	1	1	0	10	−2.096	1.916	48
Nevada	1	1	1	0	0	0	1	1	1	0	0	1	1	1	1	10	−2.185	2.799	38
California	0	1	0	0	0	0	1	1	1	1	0	0	1	1	1	8	−1.586	2.564	593
Georgia	0	1	0	0	0	1	1	1	0	0	1	1	1	0	0	7	−0.998	2.330	91
Florida	1	0	0	0	0	1	1	1	0	0	1	1	0	0	0	6	−1.417	2.064	164
Texas	0	0	0	0	0	1	0	0	1	0	1	1	1	1	0	6	−1.003	2.635	360
Utah	0	1	1	1	0	0	1	0	0	0	0	1	1	0	0	6	−1.530	2.460	37
Colorado	0	1	1	1	0	0	0	0	0	0	0	1	1	0	0	5	−1.406	2.581	99
North Carolina	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0	4	−0.811	1.854	69
Oklahoma	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	4	−0.313	1.882	102
South Carolina	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	4	−1.134	1.700	14
Nebraska	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	3	0.486	3.206	14
New Mexico	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	3	−1.123	2.305	3
Oregon	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	3	−1.115	1.513	33
Wyoming	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	3	−1.931	3.829	2
Idaho	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2	−1.217	1.637	10
Illinois	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0.875	1.874	134
Maryland	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0.025	1.820	184
Tennessee	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2	0.262	1.899	46
Virginia	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0.073	1.912	81
Remaining States	0	2	0	1	0	0	1	0	0	0	1	5	1	0	0	11	0.525	1.766	1,235
Total	3	14	6	5	0	5	11	9	5	1	7	17	13	4	3	103			3,357

IV. EMPIRICAL RESULTS

Correlation Matrix

Table 3 reports the Pearson matrices for dependent and independent variables. In analyzing the test variable, specifically drought variables, log of audit fees is positively correlated with severe or extreme drought (coefficient = 0.014; p-value < 0.01) and with extreme drought (coefficient = 0.032; p-value < 0.01). The highest variance inflation factor (VIF) relates to firm size (*SIZE*) with a VIF of 4.35. Since the VIF statistic is below the threshold of 10 as proposed by Kennedy (2003), this indicates that multicollinearity issues are unlikely to affect the results of the regression analysis.

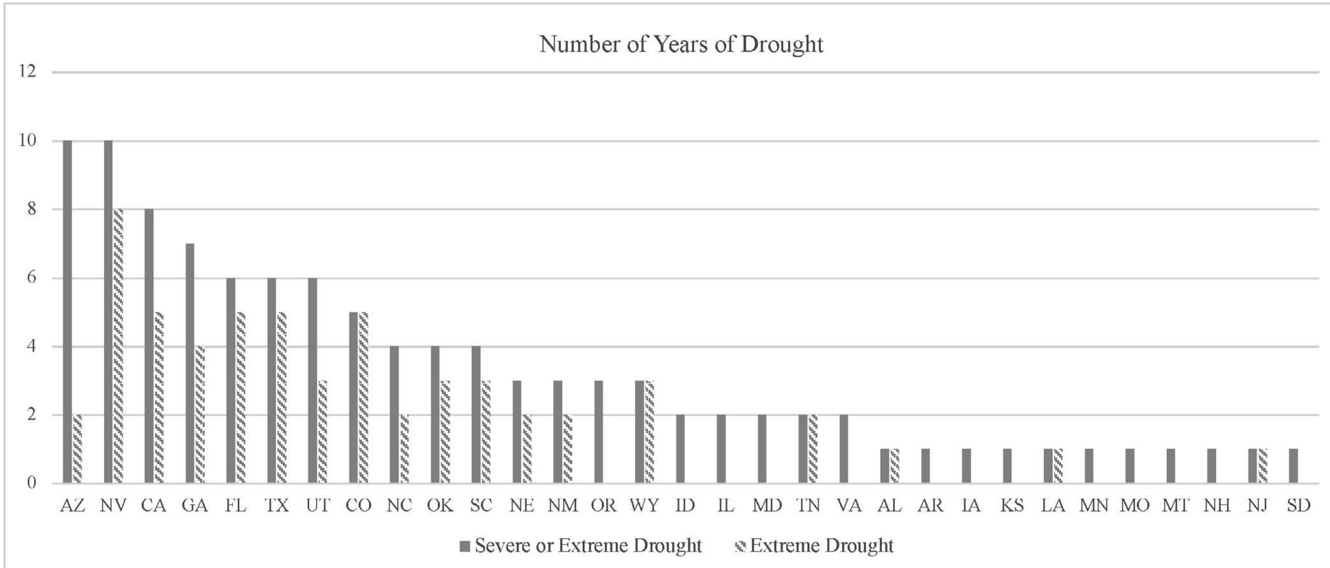
Audit Fees and Drought

Table 4 presents the multivariate regression results after estimating Model 1 for the test of H1. Results for all drought types are reported in Column (3), and those for severe or extreme drought (*SEV/EXT_DROUGHT*) and extreme drought (*EXT_DROUGHT*) are in Columns (4) and (5), respectively.

Results reported in Column (3) of Table 4 show that *SEV_DROUGHT* and *EXT_DROUGHT* are positively and significantly associated with audit fees (coefficient = 0.110; p-value < 0.01 for *SEV_DROUGHT*; coefficient = 0.071; p-value < 0.05 for *EXT_DROUGHT*), suggesting that auditors charge firms higher fees for audit services during periods of severe and extreme drought. The coefficient estimate on *MILD_DROUGHT* is not statistically significant, suggesting that low drought intensity is not associated with higher audit fees.

We also document similar results for *SEV/EXT_DROUGHT* (coefficient = 0.086; p-value < 0.01) and *EXT_DROUGHT* (coefficient = 0.074; p-value < 0.05) in the two separate additional regressions, thus, lending further support to H1. The relations between drought and audit fees are of large economic importance. On average, when in severe or extreme drought

FIGURE 1
Distribution of Incidence of Severe and Extreme Drought by State during the Sample Period (2001–2015)



conditions, firms pay 8.98 percent higher audit fees. When in extreme drought conditions only, firms pay 7.68 percent higher audit fees.[17] Collectively, our results indicate the positive effect of drought on audit fees is greater during severe and extreme drought conditions, which confirms our expectation that the effect of drought is small and unimportant in low drought intensity but quickly and significantly escalates in high drought intensity.[18]

We also re-run our baseline regressions using continuous PDSI measurements (*DROUGHT_PDSI*) to ascertain the robustness of our main results. This measure is an inverse proxy for drought conditions, that is, a lower value indicates more severe drought conditions. The results, reported in Panel A of Table 5, show a negative and significant coefficient on *DROUGHT_PDSI* (coefficient = –0.005; p-value $<$ 0.01), which is consistent with our main findings. Further, to control for the industry effect, we include the industry-year paired fixed effects in the baseline regression model. The empirical results reported in Panel B of Table 5 show that the coefficient estimates on *SEV_DROUGHT* and *EXT_DROUGHT* are positively and significantly associated with audit fees (coefficient = 0.125; p-value $<$ 0.01 for *SEV_DROUGHT*; coefficient = 0.070; p-value $<$ 0.01 for *EXT_DROUGHT*). In the two separate additional regressions, we also document similar results for *SEV/EXT_DROUGHT* (coefficient = 0.091; p-value $<$ 0.01) and *EXT_DROUGHT* (coefficient = 0.065; p-value $<$ 0.01). Taken together, these results confirm our main findings that drought is positively related to audit fees.

To mitigate concerns that our results might be affected by omitted firm-level characteristics, we include firm fixed effects in the baseline model and re-run the regression analysis.[19] Using a subsample of 8,840 firm-year observations, our results

[17] The magnitude of the increase in audit fees due to drought is largely comparable to the effect of broad economic conditions on audit fees. For example, Whitehouse (2010) documents a median decline of 5.4 percent in audit fees for S&P 500 firms from 2008 to 2009. Chen, Krishnan, and Yu (2018) report an average audit fee decrease of around 11.5 percent during the GFC relative to the pre-GFC period.

[18] In relation to control variables, we find positive and significant coefficients on *BIG4, SIZE, SQRT_EMP, MB, OPINION, MISSTATE, BUSY, LogNAFEE, SOX,* and *GDP_PER_CAPITA,* which is consistent with our expectation. Our results also show that firms with more complex operations and higher inherent risk are charged higher audit fees, as evident from positive coefficients for *SEGMENTS, FOREX_OP, EXT_ITEMS,* and *RECINV*. Further, we also find that auditors charge higher fees for firms that have worse financial performance (*LIQ, OP_INCOME,* and *LOSS*). Overall, these results are consistent with studies in the audit fees literature. The adjusted R^2 for the three regression models is 86.30 percent, providing a reasonable explanation of the variation in the audit fees, and they are comparable with prior studies (e.g., Ferguson et al. 2003; Fung et al. 2012).

[19] Because many firms in our full sample never experience drought throughout the whole sample period, drought variables for these firms (that never experience drought) do not vary over time (i.e., *SEV/EXT_DROUGHT* and *EXT_DROUGHT* are always equal to zero for these firms). Given drought variables are time-invariant attributes of such firms (not changing from one observation of that firm to the next), these drought variables will be collinear with the collection of firm indicators (which are also time invariant). Thus, the inclusion of the non-drought firms and firm fixed effects in the baseline model will cause high collinearity between drought variables and firm indicators. Accordingly, for the firm fixed effects analysis, we restrict our sample to only firms headquartered in the states that have experienced at least one year of severe or extreme drought during our sample period.

TABLE 3
Correlation Matrix

Panel A: Correlation Matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1 *SEV/EXT_DROUGHT*												
2 *EXT_DROUGHT*	**0.830**											
3 *LogAFEE*	**0.014**	**0.032**										
4 *DISACC*	**0.033**	**0.017**	**−0.096**									
5 *SEGMENTS*	**−0.086**	**−0.061**	**0.389**	**−0.072**								
6 *DISTRESS*	**0.022**	**0.019**	**−0.250**	**0.226**	**−0.160**							
7 *BIG4*	−0.003	**0.009**	**0.587**	**−0.104**	**0.224**	**−0.226**						
8 *SIZE*	**−0.020**	0.005	**0.868**	**−0.163**	**0.420**	**−0.391**	**0.597**					
9 *SQRT_EMP*	**−0.066**	**−0.042**	**0.642**	**−0.093**	**0.345**	**−0.124**	**0.368**	**0.690**				
10 *FOREX_OP*	0.007	**0.014**	**0.302**	**0.017**	**0.109**	**−0.083**	**0.144**	**0.206**	**0.117**			
11 *EXT_ITEMS*	**−0.026**	**−0.018**	**0.134**	**−0.016**	**0.116**	**−0.024**	**0.048**	**0.117**	**0.093**	**0.022**		
12 *RECINV*	**−0.065**	**−0.056**	**−0.100**	**−0.012**	**0.049**	**−0.015**	**−0.142**	**−0.166**	**−0.010**	**0.073**	**−0.040**	
13 *SP_ITEMS*	**−0.022**	**−0.025**	**0.053**	**−0.030**	**0.061**	**−0.261**	**0.053**	**0.117**	**0.060**	**0.012**	−0.001	**0.020**
14 *MB*	**0.016**	**0.014**	**0.039**	−0.008	−0.007	**−0.150**	**0.044**	**0.042**	**0.025**	0.004	**−0.016**	**−0.053**
15 *LIQ*	**0.010**	0.002	**−0.150**	−0.005	**−0.129**	**−0.221**	0.004	**−0.110**	**−0.204**	**−0.009**	**−0.055**	**−0.093**
16 *OP_INCOME*	**−0.039**	**−0.026**	**0.345**	**−0.215**	**0.228**	**−0.829**	**0.266**	**0.498**	**0.226**	**0.103**	**0.031**	**0.082**
17 *LOSS*	**0.063**	**0.043**	**−0.342**	**0.093**	**−0.236**	**0.206**	**−0.214**	**−0.416**	**−0.315**	**−0.085**	−0.004	**−0.049**
18 *SALES_GR*	**0.047**	**0.040**	**−0.081**	**0.076**	**−0.068**	**0.024**	**−0.062**	**−0.076**	**−0.087**	**−0.036**	**−0.048**	**−0.068**
19 *OPINION*	**0.020**	**0.010**	**−0.333**	**0.155**	**−0.212**	**0.532**	**−0.299**	**−0.446**	**−0.197**	**−0.099**	**−0.019**	**−0.009**
20 *MISSTATE*	**−0.027**	**−0.023**	**-0.012**	**−0.015**	**0.077**	**−0.019**	**0.028**	−0.003	−0.004	**−0.014**	0.002	0.007
21 *BUSY*	**0.060**	**0.055**	**0.079**	**0.032**	**−0.031**	**0.028**	**0.055**	**0.062**	**−0.037**	**−0.012**	**0.017**	**−0.181**
22 *INITIAL*	**−0.020**	**−0.016**	**−0.175**	−0.001	**−0.043**	**0.016**	**−0.190**	**−0.151**	**−0.120**	**−0.033**	−0.001	**0.049**
23 *LogNAFEE*	**−0.041**	**−0.023**	**0.461**	**−0.084**	**0.263**	**−0.202**	**0.408**	**0.498**	**0.383**	**0.147**	**0.081**	**−0.028**
24 *SOX*	**0.025**	**0.020**	**0.165**	**0.051**	**−0.019**	**0.022**	**−0.016**	**0.032**	**0.015**	**0.071**	0.007	**−0.022**
25 *GFC*	**0.038**	**0.039**	**0.062**	**−0.021**	**0.025**	**0.014**	**−0.038**	0.000	−0.004	**0.018**	**0.010**	0.006
26 *GDP_PER_CAPITA*	**0.025**	**0.031**	**0.065**	**0.029**	**−0.094**	**0.015**	**−0.027**	**−0.042**	**−0.081**	**0.072**	**−0.009**	**−0.047**
27 *GDP_GROWTH*	**−0.054**	**−0.057**	**−0.015**	**−0.042**	**−0.065**	**−0.015**	**0.018**	**−0.015**	**−0.026**	**−0.012**	0.006	0.006

Correlations significant at the two-tailed 0.05 level and lower are in bold.
Variable definitions are listed in Appendix A.

Panel B: Correlation Matrix (continued)

Variables	13	14	15	16	17	18	19	20	21	22	23	24	25	26
14 *MB*	**0.048**													
15 *LIQ*	**0.066**	**0.058**												
16 *OP_INCOME*	**0.222**	**0.115**	**0.092**											
17 *LOSS*	**−0.117**	**−0.019**	**0.027**	**−0.292**										
18 *SALES_GR*	−0.001	**0.053**	**0.031**	**−0.057**	**0.095**									
19 *OPINION*	**−0.181**	**−0.101**	**−0.186**	**−0.549**	**0.266**	**0.056**								
20 *MISSTATE*	**0.009**	0.004	**−0.012**	**0.014**	0.004	0.007	**−0.021**							
21 *BUSY*	**−0.026**	**0.027**	**−0.023**	**−0.034**	**0.055**	**0.052**	**0.025**	0.002						
22 *INITIAL*	**−0.029**	**−0.010**	**−0.015**	**−0.038**	**0.095**	**0.017**	**0.052**	**0.049**	−0.003					
23 *LogNAFEE*	**0.035**	**0.032**	**−0.067**	**0.250**	**−0.184**	**−0.047**	**−0.248**	**0.012**	**0.016**	**−0.141**				
24 *SOX*	**0.066**	**0.013**	**−0.018**	−0.004	**−0.234**	**0.021**	**0.019**	**0.048**	0.000	**−0.016**	**−0.077**			
25 *GFC*	**−0.047**	**−0.025**	**−0.015**	**−0.009**	**−0.072**	**0.012**	**0.015**	**−0.023**	**−0.017**	**−0.041**	**−0.031**	**0.107**		
26 *GDP_PER_CAPITA*	−0.009	**0.021**	**0.093**	**−0.049**	**0.027**	**0.020**	0.002	**−0.037**	**−0.017**	**−0.025**	**−0.030**	**0.102**	**0.103**	
27 *GDP_GROWTH*	**0.044**	**0.032**	**0.018**	0.002	0.007	**0.051**	−0.006	**0.026**	**−0.018**	**0.038**	0.005	**0.098**	**−0.261**	**−0.019**

Correlations significant at the two-tailed 0.05 level and lower are in bold.
Variable definitions are listed in Appendix A.

TABLE 4

Audit Fees and Drought

		Dependent Variable = *LogAFEE*		
	Expected Sign	**All Drought Types**	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept		5.748*** (5.67)	5.763*** (5.68)	5.787*** (5.68)
MILD_DROUGHT	H1+	0.024 (1.41)		
SEV_DROUGHT	H1+	0.110*** (6.17)		
EXT_DROUGHT	H1+	0.071** (2.20)		0.074** (2.35)
SEV/EXT_DROUGHT	H1+		0.086*** (3.24)	
DISACC	+	−0.001 (−0.59)	−0.001 (−0.58)	−0.001 (−0.56)
SEGMENTS	+	0.083*** (7.49)	0.083*** (7.43)	0.082*** (7.19)
DISTRESS	+	0.002 (1.47)	0.002 (1.45)	0.002 (1.40)
BIG4	+	0.422*** (17.43)	0.422*** (17.56)	0.423*** (17.38)
SIZE	+	0.456*** (69.70)	0.456*** (70.07)	0.456*** (70.12)
SQRT_EMP	+	0.053*** (9.06)	0.053*** (9.04)	0.052*** (8.91)
FOREX_OP	+	0.209*** (12.42)	0.209*** (12.44)	0.209*** (12.47)
EXT_ITEMS	+	0.133*** (12.74)	0.133*** (12.73)	0.132*** (12.73)
RECINV	+	0.343*** (6.58)	0.343*** (6.59)	0.341*** (6.53)
SP_ITEMS	+	−0.292*** (−11.30)	−0.292*** (−11.35)	−0.292*** (−11.25)
MB	+	0.001*** (2.72)	0.001*** (2.72)	0.001*** (2.75)
LIQ	−	−0.026*** (−14.63)	−0.026*** (−14.68)	−0.026*** (−14.72)
OP_INCOME	−	−0.126*** (−10.13)	−0.126*** (−10.17)	−0.127*** (−10.10)
LOSS	+	0.191*** (15.19)	0.191*** (15.15)	0.192*** (15.06)
SALES_GR	+	−0.034*** (−8.90)	−0.034*** (−8.95)	−0.034*** (−8.84)
OPINION	+	0.064*** (2.77)	0.065*** (2.78)	0.064*** (2.77)
MISSTATE	+	0.059*** (7.71)	0.059*** (7.69)	0.059*** (7.67)
BUSY	+	0.126*** (6.56)	0.127*** (6.51)	0.127*** (6.61)
INITIAL	−	−0.013 (-0.95)	−0.013 (−0.97)	−0.013 (-0.99)
LogNAFEE	+	0.010*** (7.61)	0.010*** (7.65)	0.010*** (7.48)

(continued on next page)

TABLE 4 (continued)

	Expected Sign	All Drought Types	Severe/ Extreme Drought	Extreme Drought
		Dependent Variable = *LogAFEE*		
SOX	+	0.154***	0.155***	0.154***
		(7.23)	(7.26)	(7.26)
GFC	+/−	0.022	0.023	0.026
		(1.42)	(1.45)	(1.57)
GDP_PER_CAPITA	+	0.403***	0.401***	0.399***
		(4.27)	(4.25)	(4.21)
GDP_GROWTH	+	0.363	0.373	0.368
		(0.77)	(0.79)	(0.79)
Year Fixed Effects		Yes	Yes	Yes
Industry Fixed Effects		Yes	Yes	Yes
Observations		50,376	50,376	50,376
Adj. R^2		0.863	0.863	0.863

, * Indicate significance at the 0.05 and 0.01 levels, respectively.

reported in Column (2) in Panel C of Table 5 show that *SEV_DROUGHT* and *EXT_DROUGHT* are significantly and positively associated with audit fees (coefficient = 0.027; p-value < 0.01 for *SEV_DROUGHT*; coefficient = 0.022; p-value < 0.10 for *EXT_DROUGHT*). In the two separate additional regressions, we document similar results for *SEV/EXT_DROUGHT* (coefficient = 0.023; p-value < 0.05) and *EXT_DROUGHT* (coefficient = 0.021; p-value < 0.10), as shown in Columns (3) and (4) in Panel C of Table 5, respectively. The coefficient estimates on drought variables show that audit fees are significantly higher in drought periods for the same firm than in non-drought periods, and this specification would minimize concerns about omitted firm-level characteristics that are not fully accounted for in the baseline model. To the extent that the inclusion of firm fixed effects in our analyses addresses the potential time-invariant omitted firm characteristics, our additional tests provide consistent support to the main findings. For firms that experience both drought and non-drought periods, audit fees are significantly higher in drought periods.

Audit Fees and Change in Drought Conditions

To further support the inferences based on our main tests and to address potential firm-level time-invariant omitted variables, we conduct two additional analyses. First, we employ change analysis by investigating how changes in our test variables affect changes in audit fees. The dependent variable in this analysis is the change in audit fees from the previous year (*CH_LogAFEE*). We regress this variable with the change in drought conditions and change in all control variables (calculated as the current year change from the prior year) in the audit fee model. The results from this analysis are reported in Panel A of Table 6. Our findings show positive coefficients on *CH_SEV_DROUGHT* (coefficient = 0.014; p-value < 0.10) and *CH_EXT_DROUGHT* (coefficient = 0.012; p-value < 0.05). In the two additional regressions, we find positive and significant coefficients on change in severe or extreme drought (coefficient = 0.011; p-value < 0.05 for *CH_SEV/EXT_DROUGHT*), and change in extreme drought conditions (coefficient = 0.013; p-value < 0.05 for *CH_EXT_DROUGHT*), which is consistent with the main results that drought is associated with higher audit fees.[20]

Due to the inherent design of the annual change model, the change in drought variables would equal 0 not only for firms that are not affected by drought conditions, but also for firms impacted by the same type of drought in two consecutive years. Accordingly, to complement our annual change model, we investigate how changes in drought conditions affect the level of audit fees, and include three additional variables in our regressions: *FIRSTTIME_DROUGHT*, *CONTINUOUS_DROUGHT*, and *END_OF_DROUGHT*. For all three measures, we consider the two drought severity conditions; namely (1) severe or extreme drought, and (2) extreme drought, separately.

[20] As suggested by Ettredge, Xu, and Yi (2014), change models would normally have lower explanatory power. In our case, the adjusted R^2 from a change model is 0.210, which is comparable to those reported in prior studies using a change model specification (see, for example, Greiner, Kohlbeck, and Smith 2017).

TABLE 5

Audit Fees and Continuous PDSI Measurements, Industry-Year Paired Fixed Effects, and Firm Fixed Effects

Panel A: Audit Fees and Continuous PDSI Measurements

	Dependent Variable = *LogAFEE* Continuous PDSI Measurements
Intercept	5.755***
	(11.60)
DROUGHT_PDSI	−0.005***
	(−2.90)
Control Variables	Included
Year Fixed Effects	Included
Industry Fixed Effects	Included
Observations	50,376
Adj. R^2	0.864

Panel B: Industry-Year Paired Fixed Effects

	Dependent Variable = *LogAFEE*		
	All Drought Types	Severe/ Extreme Drought	Extreme Drought
MILD_DROUGHT	0.022		
	(1.50)		
SEV_DROUGHT	0.125***		
	(7.31)		
EXT_DROUGHT	0.070***		0.065***
	(5.03)		(4.65)
SEV/EXT_DROUGHT		0.091***	
		(8.24)	
Control Variables	Included	Included	Included
Industry-Year Paired Fixed Effects	Included	Included	Included
Observations	50,376	50,376	50,376
Adj. R^2	0.866	0.866	0.866

(continued on next page)

Our measure of *FIRSTTIME_DROUGHT* is a dummy variable coded 1 if a firm moves from a no drought condition to a drought condition, and 0 otherwise. Our measure of *CONTINUOUS_DROUGHT* is a dummy variable coded 1 if a firm continues to operate in a drought condition, and 0 otherwise. Our third measure of *END_OF_DROUGHT* is a dummy variable coded 1 if a firm moves from operating in a drought condition to a no drought condition, and 0 otherwise. For this analysis, we consider change based on drought conditions in time t–1 as compared to time t–2.

Panel B of Table 6 presents the results of this analysis. In our first regression, reported in Column (2) of Panel B of Table 6, our measure of *FIRSTTIME_DROUGHT* is equal to 1 if a firm moves from a no drought condition to either a severe or extreme drought condition, and 0 otherwise. We document a positive and significant coefficient on *FIRSTTIME_DROUGHT* (coefficient = 0.067; p-value $<$ 0.05), which indicates that as firms move from a no drought condition to either a severe or extreme drought condition, they pay higher audit fees. Further, we also run the same analysis for firms that move from a no drought condition to an extreme drought period in the second regression. Consistent with the findings for severe or extreme drought, the results reported in Column (3) of Panel B of Table 6 show that when firms move from a normal to an extreme drought condition, they are charged higher fees (coefficient = 0.077; p-value $<$ 0.10).

TABLE 5 (continued)

Panel C: Firm Fixed Effects

	Dependent Variable = *LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	5.433*	5.281*	5.067*
	(1.90)	(1.80)	(1.72)
MILD_DROUGHT	−0.009		
	(−0.62)		
SEV_DROUGHT	0.027***		
	(2.71)		
EXT_DROUGHT	0.022*		0.021*
	(1.81)		(1.70)
SEV/EXT_DROUGHT		0.023**	
		(2.34)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
Firm Fixed Effects	Included	Included	Included
Observations	8,840	8,840	8,840
Adj. R^2	0.942	0.942	0.942

*, **, *** Indicate significance at the 0.1, 0.05, and 0.01 levels, respectively.

Further, firms that continue to operate in a drought condition also experience incremental increases in audit fees, with the coefficient estimates on *CONTINUOUS_DROUGHT* considerably higher compared to those on *FIRSTTIME_DROUGHT* (coefficient = 0.138; p-value < 0.01 for severe or extreme drought; coefficient = 0.164; p-value < 0.01 for extreme drought). We do not find significant coefficient estimates on *END_OF_DROUGHT*. Thus, when firms move from a drought condition to a normal condition, increases in audit fees, as expected, disappear.[21]

Taken together, the results of these two additional analyses are consistent with our main results reported in Table 4 and suggest that clients pay higher audit fees as they move to drought conditions. The evidence on audit fees is less clear when clients move from a drought period to a non-drought period.

Difference-in-Differences Analysis

To mitigate concerns about unobservable time-invariant differences between the treatment group (firms affected by drought) and the control group (firms not affected by drought) that could affect the relation between drought and audit fees, we employ a staggered difference-in-differences (DiD) design. This approach has been used in prior studies with similar research settings that examine staggered treatment events (see, for example, Bertrand and Mullainathan 2003; Dou, Khan, and Zou 2016; Kraft, Vashishtha, and Venkatachalam 2018; Jiang, I. Wang, and K. Wang 2019). Following Kim and Klein (2017), we first divide our drought timeline into a drought-transition period (year t), a pre-drought period (year $t-1$), and a post-drought period (year $t+1$). We designate the drought-transition period as the year when a firm moves from a non-drought period to a drought period. Consistent with Kim and Klein (2017), to better isolate the effect of drought on audit fees, we exclude observations from this transition period and only include the year in the pre-drought period and the year in the post-drought period, thereby creating the window $[t-1, t+1]$ for the DiD. *POST* is a binary variable equal to 1 for the post-drought period, and 0 for the pre-drought period. Here, the post-drought period means that firms are currently exposed to drought and it refers to either a severe or an extreme drought condition. *D* is the indicator for drought-affected firms. We estimate the following DiD model:

[21] One possible explanation for the insignificant results on the coefficient of *END_OF_DROUGHT* is that the decrease in audit fees perhaps occurs in different points in time and not necessarily at the end of a drought episode. For example, when regressing future audit fees on *END_OF_DROUGHT*, we find some evidence, albeit of weaker magnitude, that audit fees are lower.

TABLE 6

Audit Fees and Change in Drought Conditions, Difference-in-Differences Analysis, and State Fixed Effects

Panel A: Audit Fees and Change in Drought Conditions: Annual Change Analysis

	Dependent Variable = *CH_LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	0.009	0.010	0.007
	(0.39)	(0.40)	(0.36)
CH_MILD_DROUGHT	0.018		
	(1.57)		
CH_SEV_DROUGHT	0.014*		
	(1.93)		
CH_EXT_DROUGHT	0.012**		0.013**
	(2.02)		(2.09)
CH_SEV/EXT_DROUGHT		0.011**	
		(2.33)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
Industry Fixed Effects	Included	Included	Included
Observations	35,549	35,549	35,549
Adj. R^2	0.210	0.210	0.210

Panel B: Audit Fees and Change in Drought Conditions: First Time, Continuous, and End of Drought

	Dependent Variable = *LogAFEE*	
	Severe/ Extreme Drought	**Extreme Drought**
Intercept	6.782***	6.795***
	(4.19)	(4.20)
FIRSTTIME_DROUGHT	0.067**	0.077*
	(2.02)	(1.87)
CONTINUOUS_DROUGHT	0.138***	0.164***
	(4.59)	(7.99)
END_OF_DROUGHT	0.025	0.024
	(0.96)	(0.74)
Control Variables	Included	Included
Year Fixed Effects	Included	Included
Industry Fixed Effects	Included	Included
Observations	50,376	50,376
Adj. R^2	0.862	0.862

(continued on next page)

$$LogAFEE_{i,t} = \beta_0 + \beta_1 POST_t + \beta_2 D_i + \beta_3 POST_t * D_i + \sum_{i=1}^{n} \gamma_{i,t} CONTROLS + FIRM_i + YEAR_t + e_{i,t} \qquad \text{(Model 3)}$$

where the subscripts i and t denote firm and year, respectively. We include all the control variables used in Model 1. We also include firm and year fixed effects in these models as a generalization of the difference-in-differences design, which allows causal inference (Bertrand and Mullainathan 2003; Angrist and Pischke 2009; Armstrong, Balakrishnan, and Cohen 2012).

We require that each drought event lasts for at least two years and that in the three years before the drought event, there is no drought in the state. Thus, a drought event is truly an exogenous shock and other prior drought periods do not relate to the

TABLE 6 (continued)

Panel C: Difference-in-Differences Analysis

	Dependent Variable = *LogAFEE*
	Severe/ Extreme Drought
Intercept	4.674***
	(3.62)
POST	0.034
	(1.04)
D	−0.008
	(−0.30)
POST ∗ *D*	0.114***
	(2.68)
Control Variables	Included
Year Fixed Effects	Included
Firm Fixed Effects	Included
Observations	2,396
Adj. R^2	0.786

Panel D: State Fixed Effects

	Dependent Variable = *LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	4.549***	4.560***	4.475***
	(3.50)	(3.51)	(3.44)
MILD_DROUGHT	0.027		
	(1.59)		
SEV_DROUGHT	0.071***		
	(4.05)		
EXT_DROUGHT	0.043***		0.043***
	(2.86)		(2.88)
SEV/EXT_DROUGHT		0.047***	
		(3.33)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
State Fixed Effects	Included	Included	Included
Observations	50,376	50,376	50,376
Adj. R^2	0.858	0.858	0.858

*, **, *** Indicate significance at the 0.1, 0.05, and 0.01 levels, respectively.

outcome variable. Given such data requirements, we derive a sample of 599 treatment firms matched with an equal number of control firms for this DiD analysis.[22,23]

Results reported in Panel C of Table 6 show that the coefficient on *D* is insignificant, indicating that treatment firms do not exhibit higher audit fees in the pre-drought period. The coefficient on $POST * D$ is positive and significant (coefficient = 0.114; p-value < 0.01). This suggests that the treatment firms, i.e., firms affected by severe or extreme drought conditions, show significantly higher audit fees in the post-drought period, compared to control firms. Overall, findings from this DiD setting provide strong evidence on the positive relation between drought and audit fees, which support our main results. Most important, the robust DiD results indicate that unobservable time-invariant differences between the treatment and control groups are unlikely to be an issue in our study.

State Fixed Effects

While the main evidence shows that drought affects audit fees, it is also possible that our results are driven by certain state-level characteristics. We address this issue by including state-level fixed effects in our main regressions. Consistent with prior results, we document a positive and significant association between severe and extreme droughts and audit fees (coefficient = 0.071; p-value < 0.01 for *SEV_DROUGHT*; coefficient = 0.043; p-value < 0.01 for *EXT_DROUGHT*), as reported in Panel D of Table 6. Further, we also find similar results in the two separate additional regressions with *SEV/EXT_DROUGHT* and *EXT_DROUGHT* as our variables of interest (coefficient = 0.047; p-value < 0.01 for *SEV/EXT_DROUGHT*; coefficient = 0.043; p-value < 0.01 for *EXT_DROUGHT*).

Overall, these results confirm our previous findings that drought increases audit fees, and the relation documented in our study is not subject to certain unobservable state-level characteristics.

Effect of Drought on Audit Fees and Financial Reporting Quality

Panel A of Table 7 reports regression results for the test of H2, which considers the incremental effect of accruals quality of firms operating in drought conditions on audit fees.

Column (2) of Panel A of Table 7 shows that the coefficient for $DISCACC * EXT\_DROUGHT$, which measures the incremental effect of accruals quality on audit fees of drought-affected firms, is positive and significant (coefficient = 0.015; p-value < 0.01). In the regressions reported in Columns (3) and (4) of Panel A of Table 7, we also document positive and significant estimates on the interaction between discretionary accruals and severe or extreme drought (coefficient = 0.016; p-value < 0.05) and extreme drought (coefficient = 0.016; p-value < 0.01). Collectively, these findings indicate that drought-affected firms with higher discretionary accruals are more likely to pay higher audit fees, and provide support to H2.

A possible alternative interpretation of the positive interaction between drought and discretionary accruals is that drought conditions play a role in moderating the relations between accruals quality and audit fees. That is, these findings suggest that accruals might be priced differently by auditors across different drought conditions. Prior research in the literature has investigated how accruals pricing might vary in different conditions. For example, Choi, Kim, and Lee (2011) and Eliwa, Haslam, and Abraham (2016) find that accruals are priced differently during the financial crisis. Further, Chen, Dhaliwal, and Trombley (2008) report that the effect of accruals quality on cost of capital increases as a firm's fundamental risk increases. Another stream of research within this literature shows that the relation between discretionary accruals and stock returns is more pronounced among firms audited by Big 6 auditors than those firms audited by non-Big 6 auditors (Krishnan 2003). Thus, our findings also contribute to this strand of literature by showing that auditors price the accruals quality higher in drought periods relative to non-drought periods.

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22 We employ a propensity score matching (PSM) method (using caliper of 0.10 without replacement) to derive a sample of control firms for this DiD setting. This method assumes that the probability of severe or extreme drought, the propensity score, can be determined by observable characteristics of firms operating in drought-affected regions. While we do not aim to model the probability of drought *per se,* our main goal is to obtain a set of control firms that (1) are not affected by drought conditions during the three-year period, and (2) exhibit no or little observable differences in firm characteristics.

23 We have examined several underlying assumptions for this DiD approach. The first assumption that the treatment group is subject to drought is clearly satisfied given the strong consensus of scientific definition of drought in the climatology literature. Second, our sample is balanced in the number of firms in both the pre-drought period and the post-drought period. Third, drought should place a significant effect on the treatment group. We find that earnings volatility of the treatment group increases significantly post-drought, consistent with the notion that business risk increases for these firms. Finally, we find that the outcome variable of audit fees exhibits a parallel trend in the pre-drought period for the treatment firms and control firms.

TABLE 7

Moderating Effects of Firm Characteristics on the Relations between Drought and Audit Fees

Panel A: Moderating Effect of Accruals Quality on the Relations between Drought and Audit Fees

	Dependent Variable = *LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	6.070***	6.086***	6.116***
	(5.82)	(5.84)	(5.84)
MILD_DROUGHT	0.021		
	(1.09)		
SEV_DROUGHT	0.098***		
	(3.71)		
EXT_DROUGHT	0.080**		0.083**
	(2.48)		(2.64)
SEV/EXT_DROUGHT		0.090***	
		(3.04)	
DISACC	−0.004**	−0.004**	−0.003*
	(−2.12)	(−2.11)	(−1.91)
DISACC ∗ *MILD_DROUGHT*	0.007		
	(1.03)		
DISACC ∗ *SEV_DROUGHT*	0.014		
	(1.56)		
DISACC ∗ *EXT_DROUGHT*	0.015***		0.016***
	(2.72)		(2.98)
DISACC ∗ *SEV/EXT_DROUGHT*		0.016**	
		(2.59)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
Industry Fixed Effects	Included	Included	Included
Observations	43,396	43,396	43,396
Adj. R^2	0.866	0.866	0.866

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Moderating Effects of Corporate Governance and Internal Control

While the above results suggest the effect of drought on audit fees varies across firms with different accruals quality, we also investigate whether a firm's corporate governance and internal control strength play a role in moderating the relations between drought and audit fees. These variables are closely related to firms' abilities to manage business risk, which could affect auditors' risk perceptions. Thus, one could expect that the adverse impact of drought on audit fees is mitigated in firms with better governance and internal control.

To test this proposition, we include the interaction between variables capturing drought and corporate governance in our baseline regression.[24] We present the empirical results in Panel B of Table 7. The results show that the interaction variable *GOVERNANCE* ∗ *SEV_DROUGHT* is marginally positive and significant at the 10 percent level (coefficient = 0.056; p-value < 0.10). Thus, there is weak evidence that a firm's governance moderates the relations between drought and audit fees.

In addition, we use *ICW* (the count of the number of internal control weaknesses reported under SOX Section 404) as the inverse proxy for internal control strength. We interact this variable with our drought measures to investigate the extent to which the impact of drought on audit fees could be moderated by the level of firms' internal control strength.

[24] We measure corporate governance (*GOVERNANCE*) based on data from Kinder, Lydenberg, and Domini; hereafter, KLD). KLD assess a firm's CSR performance based on both positive and negative indicators on the following dimensions: community, corporate governance, diversity, employee relations, human rights, products, and environment. We then rank the score for corporate governance (*GOVERNANCE*) from 0 to 1, where higher score suggests better corporate governance.

TABLE 7 (continued)

Panel B: Moderating Effect of Corporate Governance on the Relations between Drought and Audit Fees

	Dependent Variable = *LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	3.705**	3.880**	3.983**
	(2.60)	(2.64)	(2.66)
MILD_DROUGHT	0.034		
	(1.42)		
SEV_DROUGHT	0.096***		
	(3.40)		
EXT_DROUGHT	0.099***		0.096***
	(3.75)		(3.70)
SEV/EXT_DROUGHT		0.089***	
		(3.32)	
GOVERNANCE	0.027	0.021	0.024
	(1.63)	(1.44)	(1.61)
*GOVERNANCE * MILD_DROUGHT*	−0.048		
	(−1.54)		
*GOVERNANCE * SEV_DROUGHT*	0.056*		
	(1.79)		
*GOVERNANCE * EXT_DROUGHT*	−0.012		−0.005
	(−0.52)		(−0.22)
*GOVERNANCE * SEV/EXT_DROUGHT*		0.017	
		(0.84)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
Industry Fixed Effects	Included	Included	Included
Observations	6,423	6,423	6,423
Adj. R^2	0.746	0.745	0.745

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We present the empirical results of this analysis in Column (2) of Panel C in Table 7. The results show that the interaction variables *ICW * SEV_DROUGHT* and *ICW * EXT_DROUGHT* are positive and significant (coefficient = 0.034; p-value < 0.05 for *ICW * SEV_DROUGHT*; coefficient = 0.035; p-value < 0.05 for *ICW * EXT_DROUGHT*). We also find similar results in the two additional regressions on the severe or extreme drought and only extreme drought conditions. Taken together, these findings suggest that the positive effects of drought on audit fees are more pronounced for firms with a higher level of internal control weaknesses.

Alternative Drought Exposure

In interpreting our main findings, we acknowledge that some firms may have operations outside their headquarters states, and the impact of drought on these firms may vary. Thus, the assumption of homogenous drought exposure based on the state of its headquarters, while simple and intuitively plausible, may not well capture a firm's true exposure to drought risk. To address this issue, we consider the level of firms' geographic dispersion in examining the effect of drought on audit fees.

First, we test for the effect of headquarters concentration on audit fees of firms operating in drought conditions based on the percentage of a firm's operations in the headquarters state relative to other states. Following García and Norli (2012) and Smith (2016), the measure of geographic concentration in the headquarters state (*HQCONCEN*) is constructed by calculating the ratio of the number of mentions of the headquarters state relative to all other states mentioned in Form 10-K. This measure is computed on a yearly basis and it matches well with our annual audit fees and drought intensity, and, by construction, ranges from 0 to 1, with a score of 1 indicating that the firm has all its operations in the headquarters state. The variable of interest in our analysis is the interaction between geographic concentration in the headquarters state (*HQCONCEN*) and drought measures, which indicates the degree a firm's geographic concentration influences the impacts of drought on audit fees. We

TABLE 7 (continued)

Panel C: Moderating Effect of Internal Control on the Relations between Drought and Audit Fees

	Dependent Variable = *LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	6.904*** (6.99)	6.916*** (7.01)	6.954*** (6.97)
MILD_DROUGHT	0.018 (1.07)		
SEV_DROUGHT	0.128*** (6.16)		
EXT_DROUGHT	0.112*** (3.90)		0.115*** (4.30)
SEV/EXT_DROUGHT		0.121*** (4.71)	
ICW	0.079*** (14.13)	0.078*** (14.47)	0.078*** (14.73)
ICW ∗ MILD_DROUGHT	−0.027 (−0.81)		
ICW ∗ SEV_DROUGHT	0.034** (2.22)		
ICW ∗ EXT_DROUGHT	0.035** (2.13)		0.041** (2.09)
ICW ∗ SEV/EXT_DROUGHT		0.039* (1.93)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
Industry Fixed Effects	Included	Included	Included
Observations	31,858	31,858	31,858
Adj. R^2	0.848	0.847	0.847

*, **, *** Indicate significance at the 0.1, 0.05, and 0.01 levels, respectively.

restrict our sample period to 2001–2008 for this analysis as the geographic concentration data are only available up to 2008. We include all the control variables used in Model 1.

Panel A of Table 8 reports regression results for the test of the effect of a firm's geographic concentration on the relation between drought and audit fees. Column (2) in Panel A of Table 8 shows positive and significant coefficient estimates on the interaction terms between headquarters concentration (*HQCONCEN*) and drought conditions (coefficient = 0.202; p-value $<$ 0.01 for severe drought; coefficient = 0.162; p-value $<$ 0.05 for extreme drought). We also find consistent results for severe or extreme and only extreme drought conditions (p-values $<$ 0.05 or lower), as reported in Columns (3) and (4) in Panel A of Table 8. These results suggest that when in drought, firms with more concentrated operations in the headquarters state pay higher audit fees relative to more geographically dispersed firms.

The coefficient estimates on *HQCONCEN* are negative and significant at the 10 percent level, consistent with the idea that audit efforts and audit fees are generally lower among firms with less geographical dispersion. The positive and significant results on the interaction between headquarters concentration and drought also indicate that the negative relations between headquarters concentration and audit fees are less pronounced for firms operating in drought conditions.

Collectively, our findings show that drought-affected firms with diversified business operations are more likely to have lower business risk. Therefore, the related risk for auditors is lower during drought conditions, relative to less-diversified firms. These results also support the proposition that geographical dispersion offers benefits to firms that face negative externalities from the surrounding environment.

Second, we construct a new weighted-average drought measure that incorporates a firm's operations in multiple states. This measure allows drought risk exposure to vary across firms based on the locations of their operations rather than solely based on headquarters locations. Specifically, we use the percentage of a firm's operation in each state as mentioned in the

TABLE 8

Audit Fees and Drought Based on Alternative Drought Exposure

Panel A: Drought Based on Headquarters Concentration

	Dependent Variable = *LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	5.784***	5.801***	5.825***
	(5.70)	(5.71)	(5.70)
MILD_DROUGHT	0.009		
	(0.31)		
SEV_DROUGHT	0.059**		
	(2.12)		
EXT_DROUGHT	0.054		0.040
	(1.10)		(0.97)
SEV/EXT_DROUGHT		0.072**	
		(2.06)	
HQCONCEN	−0.062*	−0.059*	−0.055
	(−1.85)	(−1.79)	(−1.63)
HQCONCEN ∗ *MILD_DROUGHT*	0.099		
	(1.23)		
HQCONCEN ∗ *SEV_DROUGHT*	0.202***		
	(3.61)		
HQCONCEN ∗ *EXT_DROUGHT*	0.162**		0.140**
	(2.33)		(1.99)
HQCONCEN ∗ *SEV/EXT_DROUGHT*		0.160***	
		(3.03)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
Industry Fixed Effects	Included	Included	Included
Observations	25,881	25,881	25,881
Adj. R^2	0.858	0.858	0.858

Panel B: Drought Based on Weighted-Average Drought Measure

	Dependent Variable = *LogAFEE*	
	Weighted_ Severe/Extreme Drought	**Weighted_ Extreme Drought**
Intercept	10.439***	10.429***
	(89.84)	(89.87)
WEIGHTED_SEV/EXT_DROUGHT	0.107**	
	(2.08)	
WEIGHTED_EXT_DROUGHT		0.174**
		(2.47)
Control Variables	Included	Included
Year Fixed Effects	Included	Included
Industry Fixed Effects	Included	Included
Observations	20,806	20,806
Adj. R^2	0.836	0.836

*, **, *** Indicate significance at the 0.1, 0.05, and 0.01 levels, respectively.

Form 10-K filing and multiply these percentages with the corresponding drought variables for these states. As such, we construct two new variables, denoted as *WEIGHTED_SEV/EXT_DROUGHT* and *WEIGHTED_EXT_DROUGHT*, which allow us to better capture a firm's overall risk exposure to severe or extreme, and extreme drought conditions, respectively, across its operations in multiple states. It is important to note that this measure also allows us to capture drought risk exposure in cases where the headquarters of firms are not in drought-affected areas while their operations are in drought-affected areas.

Panel B of Table 8 reports positive and significant coefficient estimates on these alternative drought risk exposure measures (coefficient = 0.107; p-value < 0.05 for *WEIGHTED_SEV/EXT_DROUGHT*; coefficient = 0.174; p-value < 0.05 for *WEIGHTED_EXT_DROUGHT*), which are consistent with our main results. Thus, allowing a more fine-grained measure of drought risk exposure, we also find a strong positive relation between the extent of firm-level drought exposure and audit fees.

V. ADDITIONAL ANALYSES

Drought Based on County-Level Measure of Drought

As some U.S. states have large geographic areas, we acknowledge that there might be some potential variation of drought conditions within the states. To address this issue, we re-construct our drought measures using PDSI values at the county-level from the National Center for Atmospheric Research (NCAR). Re-calibrating drought intensity at the county level, we document positive and significant relations (p-values < 0.05 or lower) between drought and audit fees across three regressions for severe and extreme drought conditions, as reported in Panel A of Table 9.

Taken together, these findings indicate that the effect of drought on audit fees is not subject to varying drought conditions within the states.

Audit Fees and Drought for Water-Dependent Industries

To the extent that firms operating in drought conditions pay higher audit fees, we acknowledge that firms in certain industries should be more affected by drought relative to others. That is, there might be systematic differences between the impact of drought on water-dependent industries and other industries, even though these firms may have the same physical exposure to drought conditions. To test this proposition, we include a dummy variable *WATER_DEP* in our baseline regressions. This variable is coded 1 if the firm operates in water-dependent industries, and 0 otherwise. We identified 15 industries based on the SIC two-digit code that are considered to be water dependent. Our selection of these industries is derived from various sources such as academic studies and reports issued by government bodies and independent organizations (see, for example, Deng and Burnett 2000; Ellis, Dillich, and Margolis 2001; Mielke, Anadon, and Narayanamurti 2010; DHS/OCIA 2015; Howitt et al. 2015; Sohns, Rodriguez, and Delgado 2016; Lund, Medellin-Azuara, Durand, and Stone 2018; Miller, Horvath, and Monteiro 2018). Appendix B provides detailed discussions on these sources and the list of water-dependent industries used in this study.

Our interest is in the coefficient estimate on the interaction between *WATER_DEP* and drought variables, which captures any incremental effect of droughts on audit fees for firms in water-dependent industries. Panel B of Table 9 shows that the coefficients on the interaction between *WATER_DEP* and our drought measures are positive and significant (coefficient = 0.119; p-value < 0.05 for severe or extreme drought; coefficient = 0.181; p-value < 0.05 for extreme drought), thereby supporting the conjecture that drought effects on audit fees are higher among firms in water-dependent industries.[25] We notice that the coefficients estimates on both *SEV/EXT_DROUGHT* and *EXT_DROUGHT* remain positive and significant, suggesting that drought also brings about higher audit fees for firms that are not from water-dependent industries.

Overall, our results show that the impact of drought on audit fees is more pronounced for firms that operate in water-dependent industries; but at the same time, the impact is also present in other industries, albeit of lesser economic magnitude.

Subsample Analyses Excluding High Growth States

While our main empirical findings suggest that firms headquartered in states that experience drought are charged higher audit fees, drought occurrence could be coincidentally more common in fast growing states as compared to states with slower economic growth during our sample period. To address this issue, we examine our first hypothesis using a subsample of firms after removing observations related to the states of California and Texas. The rationale of this sample restriction is that these

[25] Further, we also test our main hypothesis by restricting the sample to only firms in the aforementioned 15 water-dependent industries. The coefficients on the drought variables in this subsample analysis (untabulated) are positive and significant at the 1 percent level, and the magnitudes of these coefficients are also higher than those estimated from the full sample.

TABLE 9

Additional Analyses

Panel A: Drought Based on County

	Dependent Variable = *LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	6.267***	6.271***	5.291***
	(4.25)	(5.30)	(5.61)
MILD_DROUGHT	0.020		
	(0.54)		
SEV_DROUGHT	0.119***		
	(3.43)		
EXT_DROUGHT	0.103**		0.105**
	(2.06)		(2.56)
SEV/EXT_DROUGHT		0.072***	
		(3.54)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
Industry Fixed Effects	Included	Included	Included
Observations	50,376	50,376	50,376
Adj. R^2	0.822	0.822	0.822

Panel B: Water-Dependent Industries

	Dependent Variable = *LogAFEE*	
	Severe/ Extreme Drought	**Extreme Drought**
Intercept	6.135***	6.132***
	(6.91)	(6.35)
SEV/EXT_DROUGHT	0.067***	
	3.55	
EXT_DROUGHT		0.050**
		(2.01)
WATER_DEP	−0.196***	−0.194***
	(−3.89)	(−3.85)
WATER_DEP ∗ *SEV/EXT_DROUGHT*	0.119**	
	2.29	
WATER_DEP ∗ *EXT_DROUGHT*		0.181**
		(2.06)
Control Variables	Included	Included
Year Fixed Effects	Included	Included
Industry Fixed Effects	Included	Included
Observations	50,376	50,376
Adj. R^2	0.863	0.863

(continued on next page)

two states are fast-growing states with more robust economies relative to others, and they not only experience large counts of drought periods in our sample, but also host the headquarters of a large number of firms in our sample.

As shown in Panel C of Table 9, using a subsample of 35,818 firm-year observations, we document positive and significant coefficients on *SEV_DROUGHT* and *EXT_DROUGHT* (coefficient = 0.060; p-value $<$ 0.05 for *SEV_DROUGHT*; coefficient = 0.050; p-value $<$ 0.05 for *EXT_DROUGHT*). In addition, we also document similar results for *SEV/EXT_DROUGHT*

TABLE 9 (continued)

Panel C: Subsample Analyses Excluding High Growth States

	Dependent Variable = *LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	6.403***	6.427***	6.442***
	(6.52)	(6.57)	(6.58)
MILD_DROUGHT	0.045*		
	(1.96)		
SEV_DROUGHT	0.060**		
	(2.17)		
EXT_DROUGHT	0.050**		0.054**
	(2.20)		2.14
SEV/EXT_DROUGHT		0.074**	
		(2.57)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
Industry Fixed Effects	Included	Included	Included
Observations	35,818	35,818	35,818
Adj. R^2	0.872	0.872	0.872

Panel D: Firms with Foreign Operations

	Dependent Variable = *LogAFEE*		
	All Drought Types	**Severe/ Extreme Drought**	**Extreme Drought**
Intercept	6.770***	6.778***	6.791***
	(4.17)	(4.20)	(4.20)
MILD_DROUGHT	−0.011		
	(−0.33)		
SEV_DROUGHT	0.017		
	(0.92)		
EXT_DROUGHT	0.024		0.033
	(0.74)		(1.09)
SEV/EXT_DROUGHT		0.046	
		(1.22)	
Control Variables	Included	Included	Included
Year Fixed Effects	Included	Included	Included
Industry Fixed Effects	Included	Included	Included
Observations	12,498	12,498	12,498
Adj. R^2	0.850	0.850	0.850

Panel E: Placebo Test

	Mean	**Min.**	**Max.**	**Median**	**25th Percentile**	**75th Percentile**	**Std. Dev.**
PS_SEV/EXT_DROUGHT	0.009	−0.039	0.053	0.009	0.001	0.019	0.013
PS_EXT_DROUGHT	0.006	−0.032	0.051	0.006	−0.004	0.019	0.016

*, **, *** Indicate significance at the 0.1, 0.05, and 0.01 levels, respectively.

(coefficient = 0.074; p-value < 0.05) and *EXT_DROUGHT* (coefficient = 0.054; p-value < 0.05) in the two separate additional regressions.[26]

Collectively, these findings suggest that our results remain robust using this subsample and, hence, are not driven by influential states in our sample. In addition, these results suggest that the impact of drought is also observed for firms located outside large economic hubs or for firms in locations with less frequent drought periods.

Audit Fees and Drought for Firms with Foreign Operations

To further explore the impact of drought on audit fees, we test the effect of drought on a subsample of firms with high foreign operations. The intuition behind this test is that firms with more operations in countries outside the U.S. should have lower exposure to drought conditions surrounding their headquarters. In doing so, we consider the effect of pre-tax foreign income as a percentage of total pre-tax income to determine a firm's dependence on foreign operations for profit. Specifically, we construct a subsample consisting of firms that have 50 percent or more of their pre-tax income attributed to foreign operations and re-run our main baseline model on this subsample.

As shown in Panel D of Table 9, we do not find significant coefficient estimates for any of our drought measures. Our results suggest that foreign operations reduce a firm's exposure to drought conditions in the U.S. This is consistent with the expectation that drought conditions surrounding headquarters do not necessarily expose firms to higher business risk if their operations are mostly away from home.

Placebo Analysis

To investigate the possibility that our results may be driven by chance, we implement a placebo analysis by randomly selecting firm-year observations in non-drought conditions and assign them as "pseudo-drought" observations. Specifically, we randomly select 2,680 non-drought firm-year observations (the same number of the actual severe or extreme drought observations), and treat them as "pseudo severe or extreme drought" conditions. We undertake the same process for extreme drought observations and randomly select 1,621 non-drought firm-year observations to be treated as "pseudo extreme drought" conditions. We repeat these procedures 1,000 times.

Panel E of Table 9 reports the distributions of placebo test coefficients. We find that the mean and median values of the placebo test coefficients for *PS_SEV/EXT_DROUGHT* (0.009) and *PS_EXT_DROUGHT* (0.006) are close to zero. These values are also significantly smaller than the actual coefficient estimates reported in the main test (0.086 and 0.074 for *SEV/EXT_DROUGHT* and *EXT_DROUGHT*, respectively, as reported in Columns (4) and (5) of Table 4). Further, the third quartile and maximum coefficients (0.019 and 0.053, respectively) are substantially smaller than the magnitude of the actual coefficients for severe or extreme drought. The results are similar for extreme drought.

Overall, the placebo tests indicate that our prior findings on the association between drought and audit fees are less likely to be driven by chance.[27]

VI. CONCLUSION

Firms operating in areas affected by drought face the risk of increased operational costs, disrupted business, increased earnings volatility, and higher uncertainty of future cash flows. While the audit industry is increasingly aware of climate risk implications (PCAOB 2010; CPA Australia 2018), whether climate risk is reflected in the assessment of audit risk by auditors remains an open empirical question. In this study, we address this important question by first quantifying the effect of drought on the risk assessment of auditors (via audit fees), documenting that this effect is widespread due to an integrated economy, and then investigate various firm characteristics that could moderate the effect of drought on audit risk.[28]

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[26] Alternatively, we re-run our baseline model after removing the top two states in terms of drought counts (i.e., Arizona and Nevada) and also document similar findings.

[27] In untabulated tests, we examine the relation between drought and audit fees for a subsample of firms that (1) have operations mainly outside their headquarters, and (2) when such operations are not in locations of drought. Consistent with our expectation, we do not find significantly higher audit fees for these firms when drought affects their headquarters. The results from this analysis complement those reported in our placebo tests.

[28] Because we do not have data on audit hours or a reliable proxy for audit demand, we cannot further differentiate whether the increase in audit fees is due to (1) an increase in demand for audit efforts, (2) an audit fee premium, or (3) both. Nevertheless, we examine whether firms operating in drought-affected states experience an increase in the audit-report lag (*ARL*), as this measure is widely accepted as a reasonable proxy for audit effort. We define *ARL* as the number of days between the end of a firm's fiscal year and the signature date of the audit report. Regressing *ARL* on our drought measures and other known factors of reporting lag, our untabulated results of two separate regressions show positive and significant estimates on severe or extreme drought (coefficient = 2.550; p-value < 0.10) and extreme drought (coefficient = 5.003; p-value < 0.05). This indicates that drought is positively associated with greater audit efforts. This finding helps validate our main findings that auditors view drought as a relevant audit risk.

First, we document that severe drought and extreme drought conditions are associated with significantly higher audit fees. Audit fees are 8.98 percent higher when firms operate in severe or extreme drought conditions. This finding is robust to alternative drought specifications, to the inclusion of industry-year paired fixed effects and firm fixed effects, or to the annual change model specification. Further, employing a difference-in-differences (DiD) approach, we document that firms experience significantly higher audit fees when entering an extreme or severe drought period from a non-drought period. This phenomenon, however, does not exist among the control matched firms. Next, we find that the effect of drought is amplified among firms that have business concentrated in their headquarters states or among firms that exhibit low accruals quality. We also document that the effect of drought is significantly higher among firms from water-dependent industries, but this effect also remains significant among firms in other industries.

Our findings offer a number of important implications for auditors, firm management, regulators, and investors. We first provide empirical evidence that drought conditions, as an external risk factor, are important in determining audit fees. With rising concerns about the unprecedented impacts of climate change risks, the findings of our study are timely and relevant in raising public awareness of this issue. This study is also relevant for auditors in considering this risk factor in the audit process and in managing their client portfolios.

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APPENDIX A

Table of Variables

Variable		Description
LogAFEE		Natural log of audit fees (Audit Analytics).
DROUGHT_PDSI		Palmer Drought Severity Index (PDSI), ranging from −10 (extremely dry) to +10 (extremely wet) where lower values of the index indicate more severe drought conditions.
MILD_DROUGHT		Takes a value of 1 when the 12-month average state-level PDSI is greater than −3 and equal to or smaller than −2, indicating mild drought conditions, and 0 otherwise.
SEV_DROUGHT		Takes a value of 1 when the 12-month average state-level PDSI is greater than −4 and equal to or smaller than −3, indicating severe drought conditions, and 0 otherwise.
EXT_DROUGHT		Takes a value of 1 if the 12-month average state-level PDSI is equal to or smaller than −4, indicating extreme drought conditions, and 0 otherwise.
SEV/EXT_DROUGHT		Takes a value of 1 when the 12-month average state-level PDSI is equal to or smaller than −3, indicating severe or extreme drought conditions, and 0 otherwise.
DISACC	+	Absolute value of discretionary accruals measured using the cross-sectional modified Jones (1991) model as described in Dechow, Sloan, and Sweeney (1995).
HQCONCEN	−	The ratio of the number of mentions of the headquarters state relative to all other states mentioned in Form 10-K.
SEGMENTS	+	Natural log of number of business segments (Compustat).
DISTRESS	+	Zmijewski's probability of bankruptcy score, where higher scores indicate greater financial distress.
BIG4	+	Coded 1 if a firm is audited by any of the Big 4 audit firms (Deloitte, KPMG, PwC, or EY), and 0 otherwise.
SIZE	+	Natural log of total assets (Compustat AT).
SQRT_EMP	+	Square root of the number of total employees (Compustat EMP).
FOREX_OP	+	Coded 1 if the firm has foreign operations, as indicated by foreign currency adjustments to income (Compustat FCA), and 0 otherwise.
RECINV	+	Inventory (Compustat INVT) plus accounts receivable (Compustat RECT) divided by total assets.
SP_ITEMS	+	Special items (Compustat SPI) divided by total assets.
EXT_ITEMS	+	Coded 1 if the firm reports extraordinary items (Compustat XIDO), and 0 otherwise.
LIQ	−	Ratio of current assets divided by current liabilities (Compustat LCT).
LOSS	+	Coded 1 if the firm reported a loss (Compustat NI) in either of the two previous years, and 0 otherwise.
OP_INCOME	−	Operating income (Compustat OIADP) divided by total assets.
SALES_GR	+	Growth in sales (Compustat SALE) over the previous year's sales.
MB	+	Market-to-book ratio, where market equity is calculated by multiplying the closing share price (Compustat PRCC_F) by total shares outstanding (Compustat CSHO) and book equity is total common equity (Compustat CEO).
BUSY	+	Coded 1 if the fiscal year (Compustat FYEAR) ends December 31, and 0 otherwise.
OPINION	+	Coded 1 if the firm received a modified going concern opinion, and 0 otherwise (Audit Analytics).
INITIAL	−	Coded 1 if the audit engagement is in the first or second year, and 0 otherwise (Compustat).
MISSTATE	+	Coded 1 if the client firm misstated its financial statement during the year, and 0 otherwise (Audit Analytics).
LogNAFEE	+	Natural log of total nonaudit fees (Audit Analytics).
SOX	+	Coded 1 if the firm has financial year-end after July 31, 2002, and 0 otherwise.
GFC	+/−	Coded 1 if the firm has financial year-ends between July 31, 2007 and July 31, 2009, and 0 otherwise.
GDP_PER_CAPITA	+	Log of states' real GDP per capita (U.S. Bureau of Economic Analysis).
GDP_GROWTH	+	Growth rate of states' real GDP per capita (U.S. Bureau of Economic Analysis).
Additional Test Variables		
GOVERNANCE	+	Governance score based on the KLD data.
ICW	+	The count of the number of internal control weaknesses reported under SOX Section 404.
WATER_DEP	?	Coded 1 if the firm operates in water-dependent industries, and 0 otherwise. The list of water-dependent industries is provided in Appendix B.

APPENDIX B

List of Water-Dependent Industries

SIC	Industries
01	Agricultural production—Crops
02	Agricultural production—Livestock and animal specialties
07	Agricultural services
08	Forestry
09	Fishing, hunting and trapping
12	Coal mining
13	Oil and gas extraction
16	Heavy construction, except building construction, contractor
20	Food and kindred products
28	Chemicals and allied products
29	Petroleum refining and related industries
32	Stone, clay, glass, and concrete products
58	Eating and drinking places
70	Hotels, rooming houses, camps, and other lodging places
80	Health services

Our selection of these industries is derived from various sources such as academic studies and reports issued by government bodies and independent organizations. For example, according to Howitt et al. (2015), Lund et al. (2018), and the Department of Homeland Security's Office of Cyber and Infrastructure Analysis (DHS/OCIA 2015), agriculture (SIC 01, 02, 07) is the sector most affected by drought. Further, other sectors within the Agriculture, Forestry, & Fishing classification, such as Forestry (08) and Fishing, hunting, and trapping (09) are also water-intensive industries based on their water consumption (Ellis et al. 2001; Lund et al. 2018).

According to the United Nations World Water Development Report (UN-Water 2014), the Coal mining (12) and Oil and gas extraction (13) industries use large volumes of water for various processes such as drilling, washing, and processing (Mielke et al. 2010; Sohns et al. 2016). Within the manufacturing sector, Food and kindred products (20), Chemicals and allied products (28), Petroleum refining and related industries (29), and Stone, clay, glass, and concrete products (32) are also affected by droughts as they use large amounts of water (see, for example, Ellis et al. 2001; DHS/OCIA 2015; Miller et al. 2018).

While it is reasonably straightforward to argue that the aforementioned industries are water dependent, there is evidence suggesting that droughts could also directly affect the retail trade (e.g., eating and drinking places) and services industries (e.g., hotels and health services). For example, prior research (e.g., Deng and Burnett 2000) shows that hotels use large amounts of water in their operations, such as laundry and restaurants. Further, in relation to health services, DHS/OCIA (2015) argues that healthcare facilities, such as hospitals and clinics, rely heavily on water for heating, cooling, and ventilation systems.