1 Introduction

Why Adaptation to Climate Change?

The improvised power outages first implemented by Pacific Gas & Electric (PG&E), one of the largest utilities in the United States, in early October 2019, provide a stark example of the desperate low-tech adaptation measures enacted to respond to natural mega disasters (Fuller, 2019). The short-notice premeditated shutdown of power transmission lines to about 2 million people (roughly 700,000 households and/or businesses) in huge areas of Northern California was aimed at preventing catastrophic wildfires like those sparked by power lines in Napa and Sonoma counties in late 2017. Concurrently, Southern California Edison, another major electricity company in the state, shut down electricity to about 13,000 households in Central and Southern California.[1]

Moreover, at the end of October 2019, both California utilities again preemptively responded to forecasted extreme winds and dry conditions with additional and more wide-ranging precautionary blackouts, affecting several million California consumers (Serrano, Rubenstein, & Morris, 2019). At the same time these aggressive and widely unpopular adaptation tactics were implemented, PG&E's malfunctioning equipment was believed to have started another large and fast-growing wildfire (the Kincade wildfire), which affected California's wine country. In the fall of 2020, in the face of another record-breaking catastrophic wildfire season, which burned about 4.2 million acres (also severely affecting Oregon, Washington State, and Colorado), PG&E and other West Coast utilities were again preemptively shutting off power to millions of consumers for days at a time. Insurance companies were following suit with improvised low-tech adaptation by also preemptively revoking homeowners' insurance

[1] Both PG&E and Southern California Edison agreed to pay local California governments about 1.3 billion USD to settle lawsuits related to their liability in the 2019 and 2020 associated with wildfires sparked by their equipment.

policies (Fuller & Flavelle, 2020). And local governments, even in major cities like Portland, Oregon, were issuing state of emergency declarations that involved last-minute evacuation orders for a few suburban areas.

Also, in February 2021 a record-breaking snowstorm and historically frigid low temperatures triggered power outages across Texas,[2] which in turn forced the emergency shutdown of many power generation plants to keep the entire state's electricity generation system from collapsing into a statewide blackout, potentially lasting many weeks (Mulcahy, 2021). This improvised adaptation to a record-breaking weather-related disaster left 3–5 million Texans without power for almost a week (plus millions more without safe tap water for drinking for over 10 days) and resulted in at least 30 deaths (Mulcahy, 2021).

The frequency and severity of mega wildfires in California are aggravated by extremely dry and fast winds (known as El Diablo – "The Devil" in English – in Northern California and as the Santa Ana winds in Southern California) that damage electrical power lines, sparking flames. Such high-speed winds are not new, and their existence has not been linked to climate change (Nolte, 2019). Yet, warmer temperatures linked to climate change exacerbate other trends (e.g. scorching summers that generate overly dry vegetation, and millions of trees killed by drought and pine beetle infestations, which are triggered by warmer temperatures). These trends, combined with the winds and the aftermath of the unprecedented drought of 2011–2019, result in dangerous matchbox conditions that generate huge and rapidly spreading fires (Williams et al., 2019). Worsening mega wildfires amplified by climate change are not unique to California. Indeed, beginning in October 2019 Australia's east coast provinces were devastated by the severest wildfires in decades, blanketing Sydney and other major cities with dense smoke, destroying thousands of homes, and forcing the evacuation of tens of thousands of people (Cave, 2019).

Indeed, in 2019 PG&E sought to declare bankruptcy in the face of about 30 billion USD in liability damages associated with powerline-sparked fires in California's wine country in 2018. PG&E's drastic

[2] Particular extreme weather events cannot be linked to climate change. Yet, there is increasing evidence that the long term trend to more frequent and more extreme storms is related to climate change (IPCC, 2018).

actions were an improvised low-tech adaptation strategy by a company driven to declare bankruptcy, in part due to the increased frequency and severity of extreme weather events linked to climate change. Indeed, rolling blackouts are the most rudimentary low-tech reactive approach for adapting to California wildfire risks now understood to be exacerbated by climate change (Williams et al., 2019).[3]

PG&E has repeatedly failed for decades to implement basic proactive safety and fire prevention adaptation measures (such as tree trimming and transmission equipment inspections) to protect hundred-year-old power transmission installations (about 20,000 miles of power lines and almost 7000 transmission towers) that have exceeded their useful life (Blunt & Gold, 2019). PG&E's lack of proactive adaptation and maintenance in the face of repeated record-breaking wildfire seasons speaks to extreme corporate negligence; the company apparently did not have knowledge of the exact age of thousands of transmission towers and power lines, which had not been inspected in decades (Blunt & Gold, 2019). Thus, stopping sales of electricity – PG&E's core product – could be deemed a desperate last-minute strategy to avoid more damage claims in the middle of bankruptcy proceedings, which were themselves originated by previous catastrophic wildfires.[4]

Do PG&E's response to wildfires – wildfires that year after year break historical records – illustrate problematic adaptation strategies adopted by companies to deal to natural disasters exacerbated by climate change trends? If so, how then might businesses adapt to adversity caused by climate change in a way that is less costly and disruptive? These are the core questions we explore in our book.

Core research questions of our book:

How do firms adapt to natural disasters exacerbated by climate change?

How do businesses adapt to chronic slow-onset nature adversity conditions linked to climate change?

[3] Well planned adaptation by other energy utilities to wildfire risk include the use of local microgrids that, when needed, can be isolated from long power transition lines prone to spark fires.

[4] These deliberate power outages are seen by some costumers and California government officials as a belligerent political strategy (one adopted after failing to influence politicians through lobbying and political donations). The perception is that the power outages are used to relax California's strict liability regulations that hold utilities responsible for wildfires sparked by their ageing equipment and extreme weather events (Blunt & Gold, 2019, WSJ).

Business school scholarship indifference to climate change.

Writ large, the response of business to natural disasters seems to involve a dynamic that begins with denial, advances through indifference, delay, avoidance, and other forms of resistance, then moves on to proactive preparedness. When catastrophic consequences of natural disasters first occur, the business response pattern is one of last-minute haphazard adaptation measures. If a company survives the event, its managers tend to develop an arrogance about their ability to confront the next disaster; or they may decide that catastrophic weather events are flukes of nature. The obstinacy of this dynamic is much stronger for slow-onset, climate-change–induced adverse conditions whose negative effects are imperceptible in the short term.

The resistance of businesses to prepare and recognize the importance of climate change adversity conditions is also pervasive among the most prestigious academic business management journals. Almost all top academic business journal editors as well as the leaders of business academic societies stress, in a pro forma way, the need to study and address "grand challenges" like climate change. In reality, they do not seem to view climate change and businesses' response/lack of response to it as a legitimate area for academic research, as evidenced in the very few papers addressing business responses (or lack thereof) to climate change actually get published in the premiere business research journals.

For the 1998 to mid-2015 period, only 32 out of 22,903 (0.15 percent) articles published in the top 23 elite business academic journals mentioned "global warming," "climate change," "greenhouse," or "carbon" in the title, abstract, or keywords.

The dearth of business and climate change articles in top academic business journals has attracted the attention of scholars who specialize in examining academic publications trends. Goodall's (2008) bibliographic study found that between 1970 and 2006, the top 30 management journals (by impact factor) published a total of 31,000 articles. Of those, only 9 (~0.03 percent) mentioned "global warming" or "climate change" in the title, abstract, or keywords. This study also indicated that the top two cited management journals, *Academy of Management Journal* (*AMJ*) and *Academy of Management Review* (*AMR*) published no articles mentioning these terms in the title, abstract, or keywords from the mid-1970s to 2006.

This trend was also seen in the 1998 through mid-2015 period, with only 32 out of 22,903 (0.15 percent) articles published in the top 23 elite business academic journals mentioning "global warming," "climate change," "greenhouse," or "carbon" in the title, abstract, or keywords (Diaz-Rainey et al., 2017). For this period, the most elite (by impact factor) general management journals, *AMJ*, *AMR* and *Administrative Science Quarterly* (*ASQ*) published just two articles out of a total of 721 (0.28 percent) (Diaz-Rainey et al., 2017). The tendency to almost completely neglect climate change is worse in other business academic disciplines in the 1998 to mid-2015 period**.** For this timeframe, **out of 8,737 articles published in the top three finance journals**[5] **and top five marketing journals (by impact factor), *zero* mentioned "global warming," "climate change," "greenhouse," or "carbon" in the title, abstract, or keywords.**[6] To be sure, given that these bibliographic analyses focused on title, abstract, and keywords, the actual number of publications studying topics related to climate change is likely higher. For instance, in the 2011–2020 period, we identified five additional manuscripts published in the top four empirical general management journals (*AMJ*, *ASQ*, *SMJ*, and *Organization Science*) that examined how natural disasters affect business strategies. Yet, to illustrate the extent of disregard, even if climate change-related manuscripts published by elite business academic journals numbered a thousand percent greater, the proportion of articles examining climate change-related topics would still be only 1.5 percent. Since 2015, there has been a small increase in the number of articles focusing on climate change-related topics in top business academic journals, but the tendency to give marginal attention to this topic remains.

Strategic management theories and climate change adversity. The lack of attention to how businesses respond to climate change adversity is also reflected in the dominant *strategic management theory* frameworks. Understanding how firms change their strategies to fit the external environment is a foundational question in strategic management. A business' external context is widely understood to be a key driver of its strategic choices. Accordingly, multiple strategic management theories rely on an open systems perspective that gives prominence

[5] *Journal of Finance*, *Journal of Financial Economics*, and *Review of Financial Studies*.
[6] *Journal of Consumer Psychology*, *Journal of Consumer Research*, *Journal of Marketing*, *Journal of Marketing Research*, *Marketing Science*.

to a business' external contextual factors as key drivers of strategic choices and behavior (e.g. institutional theory, contingency theory, population ecology, resource dependency theory, stakeholder theory, and industrial organization framework). Yet, for these theories "external context" is usually constrained to industry, economy, and, to a lesser degree, government and non-profit actors. Seldom is the *natural environment* given more than lip service and in most cases it is assumed away.

Until recently, in the absence of visible harmful effects from climate change, the tendency to ignore these adverse conditions has made sense for strategic management scholars. To be sure, it is well understood that over the last 10,000 years, weather, climate, geological, and ecological conditions have been exceptionally steady, particularly when compared with other geological periods (Rockström et al., 2009; Whiteman & Cooper, 2011). Interestingly, the growing organization and natural environment literature has focused mainly on examining the negative impacts of organizations on nature, while paying relatively little attention to the reverse relationship: the effects of nature's adverse biophysical conditions on organization strategies and behavior (King, 1995; Linnenluecke & Griffiths, 2010; Winn et al., 2011). Notable exceptions to this trend involve seminal research done by Martina Linnenluecke, Monika Winn, Ans Kolk, Jonathan Pinkse, Andrew Hoffman, Peter Tashman, Tima Bansal, Gail Whiteman, and Nardia Haigh among others.

Natural scientists, however, have increasingly stressed the growing confidence in the global evidence that climate change trends are exacerbating slow-onset nature-adversity conditions and extreme weather events. Accelerating climate change trends and their associated detrimental effects are also receiving increased attention from top corporate managers, policymakers, the media, and international stakeholders. Despite the increasing understanding of – and agreement about how – climate change is linked to the worsening of weather-related natural disasters and slow-onset, adverse conditions in nature, fierce debate remains – particularly in the United States – among politicians and interest groups about the best ways to manage its effects. Debates over climate change causes and solutions have become a quintessential 'culture war' issues. These discussions include trade-offs between economic prosperity and environmental protection, as well as, competing ideological, political, and geopolitical factors and institutional logics.

In our book we contribute to the debate by developing conceptual ideas and propositions seeking to understand how businesses respond to climate change-related natural disasters and slow-onset adversity conditions. In particular, our book focuses on:

1. Examining how and why nature's adversity conditions and weather-related natural disasters linked to climate change affect different business adaptation strategies and performance.
2. Identifying how the relationships between climate change adversity conditions and business adaptation strategies are moderated by firm characteristics.

To examine our conceptual ideas and propositions, in the second part of our book we describe and discuss multiple empirical studies involving panel data analyses of: (a) Western U.S. ski industry adaptation to warmer temperatures, and (b) the effect of natural disasters on the foreign investment of European multinational corporations.

Challenges of Climate Change Mitigation and the Need for Adaptation

We use the term 'adaptation' to refer to business efforts and strategies that aim to achieve a better fit with a changed external environment. *Adaptation to climate change* is defined by the International Panel on Climate Change (IPCC) as: "Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2014b). Given that adaptation has just recently been embraced, examples of it tend to be limited to infrastructure and technological efforts adopted by vulnerable companies like ski resorts that produce artificial snow (Linnenluecke & Griffiths, 2015; Tashman & Rivera, 2016). However, business adaptation to climate change can include a wide variety of strategies such as: diversification at the product, service and/or geographic levels, mergers and acquisitions of competitor companies, government lobbying for friendlier adaptation restrictions and incentives, and purchasing of insurance and other financial hedging instruments.

Adaptation is distinguished from *mitigation of climate change*, the latter "[involving] actions that reduce the rate of climate change … by limiting or preventing greenhouse gas (GHG) emissions and by

enhancing activities that remove these gases from the atmosphere" (IPCC, 2014c). **Mitigation is, of course, the safer and more effective approach for dealing with the negative effects of climate change.** However, climate change adaptation efforts are fundamental and urgently needed to guarantee the well-being of humanity, even if at some point technological and political-economic breakthroughs allow us to implement dramatically successful climate change mitigation (Haigh, 2019). This urgent need for adaptation to climate change is justified for multiple reasons.

First, humanity has so far failed dismally in its efforts to reduce GHG emissions sufficiently to limit average earth warming to under 2°C relative to preindustrial levels. A global average increase of 2°C above preindustrial times (1850–1900) was in the past regarded as the maximum temperature increase humans could adapt to without risking dangerous climate change-related harm. More recently, the IPCC indicated that an average increase of 1.5°C above preindustrial levels is a safer boundary, one that would allow humans to adequately cope with the harsh negative effects of climate change and avoid widespread high risk (IPCC, 2018). Even if all of the promises agreed to in the 2015 Paris Agreement were fully implemented, average earth temperatures are projected likely to rise by about 3.2°C by the end of this century (UNEP, 2019).[7] To hold warming to below 2°C starting from the year 2020, countries would have to triple their GHG reduction commitments under the Paris Agreement to about 2.7 percent per year on average (Christensen & Olthoff, 2019; UNEP, 2019). Staying within the safer 1.5°C average increase range would require drastic reductions of GHG, allowing a net zero level to be achieved by 2050 (IPCC, 2018). Earth has experienced an average temperature increase of about 1°C, as measured from preindustrial times (IPCC, 2018). Though many consider this amount of average warming insignificant, in fact, a 1°C global average temperature increase over approximately 100 years is dramatic (IPCC, 2018).

Global emissions of GHG rose at an annual average rate of about 1.5 percent during the decade beginning in 2009. This rate puts us on pace for an increase of about 4°C in global average warming by 2100 (UNEP, 2019).

[7] "Likely" in this sentence means, according to IPCC standards, to communicate the degree of certainty in assessment findings, "66–100 percent probability" (IPCC, 2014).

Worse, the United States and other countries (e.g. Australia, Brazil, China, and India) have been engaging in policies that not only exacerbate climate change but also explicitly and falsely deny that climate change even exists. To be sure, global emissions of GHG rose at an annual average rate of about 1.5 percent during the decade beginning in 2009, putting the planet on pace **for an increase of about 4°C** in global average warming by 2100 (UNEP, 2019). Moreover, even in the face of this worsening trend, after pulling out of the Paris Agreement, in 2017, the Trump administration continued to aggressively derail international efforts to agree on meaningful improvements in GHG reduction commitments and to create a regulated global carbon market.

President Joe Biden, on his first day in office, signed an executive order to have the United States rejoin the Paris climate agreement (Restuccia, 2021). He also initiated the multi-year process that would reestablish President Obama's climate change mitigation regulations and quickly reverse multiple climate change-aggravating presidential executive orders enacted by the Trump administration. Indeed, the new Biden administration aims to tackle climate change as a top priority and seeks to position the United States as a global leader in adopting stringent and legally binding rules to reduce greenhouse gases. However, President Biden's executive orders can quickly be wiped out with the stroke of a pen by a subsequent president's executive action. For more long-lasting regulations, the Biden administration needs the cooperation and approval of the U.S. Congress, which at this writing has a 50–50 divided Senate, with Democrats holding only the slightest majority, with Vice President Kamala Harris' authority to cast tie-breaking votes. Furthermore, opposition from Democratic senators from states like West Virginia with large fossil fuel industries has to be overcome. It is also important to note that cap-and-trade legislation to mitigate climate change failed to pass in the Senate during the early years of the Obama administration, even when Democrats had a 60-vote, filibuster-proof majority.

Second, adaptation is also fundamental to long-term global prosperity and survival because the cumulative negative effects of climate change will continue for many centuries, even if – what seems like a miracle now – humans could manage to completely stop emitting greenhouse gases today (IPCC, 2013). That is, even under this most optimistic climate change mitigation scenario, our distant descendants – many

generations beyond our great grandchildren – will likely still experience adverse conditions from climate change such as an acceleration of slow-onset increased average temperatures, rising oceans, and desertification. Also, they will be more likely to experience frequent and severe climate-related extreme events like heat waves, hurricanes, floods, droughts, and wildfires.

These deteriorating nature-adversity conditions may accelerate and generate cascading disaster conditions resulting in record fatalities, economic loss, and other hardships for humanity. The year 2020 offered an illustration of such a cascading catastrophic dynamic, one that combined multiple natural disasters exacerbated by climate change (e.g. in the U.S. a record number of wildfires occurred, and the highest number of named hurricanes were recorded), along with other natural calamities not related to climate change (e.g. the COVID-19 pandemic).[8] To be sure, the actual amount of economic loss and the loss of human life lost due to climate change is currently very difficult to estimate (IPCC, 2014a). Yet, already observed examples include natural disaster-related fatalities, business bankruptcies, and damages to infrastructure (some reaching catastrophic levels) (Linnenluecke & Griffiths, 2015). Also, the forced displacement of large populations due to increased lack of fresh water, decline in crop yields, collapse of fisheries and coral reefs, spread of tropical diseases and pests to colder latitude countries, and the acceleration of massive biodiversity loss and extinction of animals and plants, among other factors, is on the rise (IPCC, 2014a; WRI, 2019).

Third, climate change mitigation is strongly opposed by multiple powerful actors in business and government. Some who oppose it are driven by conspiracy theories suggesting that mitigation is not needed because climate change is a "hoax." Others claim climate change

[8] Cascading disasters occur when an initial disaster sets off a sequence of events that "result in physical, social or economic disruption" and are, "associated more with the magnitude of vulnerability" than with the specific type of hazard involved (Pescaroli & Alexander). A classic example of a cascading disaster that affected multinational enterprises (MNEs) and their global supply chains was the earthquake off the coast of Japan in 2011. One hundred people died as a result of the earthquake. Another 18,000 people were killed after the earthquake triggered a tsunami. The tsunami then damaged the Fukushima Dai'ichi nuclear power plant's reactors, leading to the evacuation of 200,000 more people from the area (Pescaroli & Alexander). Overall, at least 32 million people in Japan are thought to have been affected by radioactive fallout (Smith, 2015).