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Introduction

WE BEGIN with two tales from antiquity.

You may be familiar with the story of Mount Vesuvius, whose eruption covered an entire city in lava and ash. In the year A.D. 79, a long-dormant volcano on the southern coast of Italy suddenly detonated, sending a colossal plume of ash and smoke into the sky. The ensuing eruption wreaked havoc on the nearby city of Pompeii as scalding debris rained down with ferocious intensity, at a rate later estimated to have reached over 1.5 million tons per second.[1]

Some residents tried to evacuate the city. Others sought refuge in whatever shelter they could find. A second, more violent eruption is thought to have sent a surge of pyroclastic material across the coastline, likely leading to the nearly instant demise of those who had stayed behind. Researchers estimate that in the immediate aftermath of the blast temperatures in the dwellings of Pompeii may have reached 300°C, which would be enough to kill those sheltering inside in mere seconds.[2]

For the city of Pompeii, the eruption of Mount Vesuvius was, by any measure, catastrophic. Buried under a layer of lava and ash several meters deep, the once thriving metropolis was effectively erased from the map, not to be seen again until its excavation over a millenium later.

If starting a book about climate change with a parable of environmental catastrophe feels like a depressingly familiar trope to you, that's probably because it is.

The stories we tell ourselves about climate change too often have a subtext of looming cataclysm, focusing on the disaster scenarios, invoking fear and despair. We are in the eleventh hour, or worse, we have already crossed the irreversible threshold, the point of no return. Or so the narrative often goes.

This book seeks to challenge this tendency, to question the appropriateness of this familiar doomsday narrative. Not because climate change is not a serious problem. As we will see, if anything it may be a more insidious threat to human flourishing than many realize. But because a growing body of evidence suggests that the familiar *climate catastrophe* framing may be missing some of the most important features of the real climate change story. As a consequence, it may be hindering us from thinking more proactively about potential solutions.

Our second tale is about the fall of Rome.

The Western Roman Empire was what many consider to be the first and at the time largest world empire. At its zenith, it stretched across Europe, North Africa, and Western Asia, encompassing much of modern-day Italy, Spain, France, England, Morocco, Greece, and Turkey. Rome's military conquest and cultural accomplishments are legendary. Echoes of its extensive road network and extraordinary architecture endure to this day.

Economic data from that period is scarce at best, but archaeological evidence suggests that denizens of the Roman Empire may have experienced some of the highest material standards of living in the preindustrial era.[3]

While historians debate the precise causes of the Roman Empire's downfall, one thing seems clear. The fall of Rome was a gradual decline born both of internal and external forces, a slow deterioration stretched out over decades if not centuries.

We may never know the precise combination of causes that precipitated its decline. Theories include the so-called barbarians at the gates hypothesis, which points to the growing frequency and intensity of violent invasions that chipped away at military defenses and financial stability; disease-driven decline, in particular the Antonine Plague of

the late second century, which may have precipitated an erosion of health and human capital; political and institutional factors, including infighting among Rome's ruling classes; as well as rising economic inequality and social unrest, which some believe may have led to diminished political participation and a flight away from urban centers by the elite.[4]

In part because the decline was gradual, scholars continue to debate the precise date at which the Roman Empire "ended." Some would argue that the commonly accepted date of A.D. 476, when a coup overthrew emperor Romulus Augustulus, may mischaracterize the reality that spheres of Roman rule and influence persisted in many parts of the world for centuries thereafter.

What seems less debatable is the fact that gradually the Roman Empire's economic and cultural grandeur lost its sheen, as once mighty cities saw their populations decline and thriving interregional trade slowed to a crawl, leading to lower standards of living, diminished military power, and faded cultural and political influence overall.[5]

Slow Burn

This book is about the deeper consequences of a hotter planet. It isn't a climate change horror story. Nor is it a contrarian account of why we should all relax and direct our attention elsewhere.

It is an invitation to view the climate problem through a slightly different lens. One that is less about headline-grabbing catastrophes and more about the slow burn—the largely invisible costs that may not raise the same alarm, but which, in their pervasiveness and inequality, may be much more harmful than commonly realized, and call for swift action in ways you might not expect.

The central premise of this book is that the subtle setbacks of a changing climate may comprise some of its most important challenges: imperceptibly elevated health risks spread across billions of people; pennies off the dollar of corporate profitability; the immobilizing erosion of coastal and agricultural livelihoods; young people learning less, old people remembering less, many of us arguing more.

This isn't to say that the risk of the planet's catastrophic heart failure is unimportant, but rather to suggest that the near certainty of its chronic inflammation may be reason enough to act, especially if the ripple effects of such metaphorical inflammation prove systemic in unexpected ways, and given that such chronic inflammation may, for some, prove fatal.

In this book, I highlight how our intuitions may be ill-suited for making informed decisions about climate change. Given the layer cake of uncertainty that climate change presents, our minds may be especially prone to defaulting into incomplete heuristics that paint a fatalistic picture of black and white, despite the many decision-relevant shades of gray in between.

This is not merely an academic distinction, especially when one considers the fact that getting climate policy right is not a one-time, all-or-nothing decision. Its massive scale and complex political economy mean that it will likely require sustained policy engagement and private sector investment over the course of several decades, not to mention continual balancing of salient current costs and murkier, often nonmonetary, future benefits. Moreover, its hidden and often heterogeneous social impacts demand a more nuanced understanding of climate vulnerability and adaptation, particularly for the world's poor, so that they may be acted upon swiftly and in an evidence-based way.

Both factors point to a real need for a balanced, data-driven understanding of the issue. As we will see, many of the effects of climate change may already be affecting our pocketbooks and our quality of life in not so obvious ways.

The Hidden Costs of a Warming World

This book attempts a stylized synthesis of a new wave of economic research on this topic. It draws from carefully conducted studies at the cutting edge of modern empirical social science, particularly those that bring real-world data and careful disentangling of cause and effect to bear on what historically has been a modeling and assumption-heavy enterprise. Many of these studies have only surfaced in the past decade or so.

This book is written with an understanding that, for most readers, statistics and econometrics may not have them jumping out of bed in the morning. Through a mix of stories and academic studies, we will unpack what the data tells us about how climate already affects our individual daily lives, in ways both seen and unseen.

For instance, did you know that, depending on the tasks one is responsible for, going to work on a day when the temperature is above 90°F may lead to a 5 or even 50 percent increase in the likelihood of serious injury compared to a cooler day in the 50s or 60s—mostly due to ostensibly unrelated accidents like falling off a ladder or mistakes while operating heavy machinery? Or that, when a student takes an exam on a 90-degree day in a building without working air-conditioning, their performance may fall by up to 10 percent, and that hotter temperature in the classroom may be widening academic achievement gaps between rich and poor, black and white, both in the United States and elsewhere? How about the fact that the number of gunshots in your neighborhood changes on a hot day, and that the number of suicides changes too? Could you guess in which direction?

Suppose that the quarterly earnings of your favorite equity investment already depend on the number of floods in China, heat waves in India, or cold spells in Canada? Or that the adverse effects of a seemingly minor climate event can ripple out across the global supply chain? Would you think differently about the risks posed by climate change?

An empirically nuanced understanding of how climate change affects the many aspects of our day-to-day lives may be a critical input to important decisions: both regarding the ideal stringency of climate mitigation—how quickly we should move away from fossil fuels and at what costs—as well as the adaptation investments necessary to prepare for the warming that is in store.

There are at least two reasons why. First, the costs of the slow burn may in aggregate be larger than the headline-grabbing climate disasters. I realize this depends on what we mean by climate disaster, and may strike some as a bold claim, especially given the doomsday imagery—whether of inundated cities or decimated ecosystems—often associated with climate change. We will examine the data supporting such a notion

in the chapters ahead. Provided the evidence adds up, this would suggest a more dispassionate, more immediate, and perhaps less morally charged reason to support mitigating greenhouse gas emissions aggressively. It also suggests that, even when one incorporates known and unknown risk into the equation, "solving climate change" will be more about choosing contributions on a sliding scale than a binary yes/no decision, which implies that, in a very real sense, and contrary to the doomsday slogans, we are never "too late" to make a difference.

Another way this perspective informs our decision-making is that, by looking differently at everyday phenomena we thought we understood, we can begin to appreciate the subtle social disparities that arise in a warmer world. This may influence our view of the seriousness of the climate problem globally. It may also reveal more immediate interventions locally, particularly when it comes to actions needed to prepare for the warming that is already baked in, especially given how much the intensity of climate damage is influenced by human choices.

A proactive stance toward adaptation and resilience may be useful from the standpoint of safeguarding one's own physical and financial security, whether as a homeowner or the head of a Fortune 500 company. It may be vital for ensuring that the ladders of economic opportunity are not fraying for those climbing its lower rungs. And not just at the level of "climate refugees from the third world," but also for the people who service your car, deliver your mail, and those who harvest, prepare, and cook the food you eat.

A perhaps controversial claim of this book is that becoming more familiar with how climate change hurts us should, if anything, give us a greater sense of hope. Not a pollyannaish hope born of wishful thinking, but an active hope born of clear discernment, a sober assessment of climate vulnerabilities and the socioeconomic details of what can be done to help the world adapt.

Immediacy, Inequality, and Uncertainty

When it comes to climate change, three facts loom large.

The first is that there is a lot of warming in store, coming at us more quickly than many scientists used to believe. In part because the speed

at which a given amount of CO_2 translates into climate change may be faster than previously understood, significant warming is no longer only a matter of our children's or our grandchildren's future, but our own as well. For instance, there appears to be a positive feedback loop between rising CO_2 concentrations and warmer, more acidic oceans, which reduces the ocean's ability to remove CO_2 from the atmosphere. This means that older climate models that did not take such feedback loops into account may understate the rapidity of warming.[6]

At the time of this writing, the earth has already warmed by around 1.1°C. Even with the ambitious pledges of recent international accords, we are on pace to experience 1.9°C to 3°C of warming by the end of the century.

These numbers may at times be hard to make sense of intuitively. On a cold winter morning, a bit of warming may even sound nice. A more experientially anchored alternative may be to count the number of relatively extreme events, like the projected frequency of days above 32.2°C (90°F) per year. This is still an imperfect measure, but at least it might be a little easier to relate to. After all, most have experienced sweltering summer heat.

By this measure, Rome is expected to see a ten-fold increase in such days by 2050–2060, relative to preindustrial averages. Residents of Atlanta are expected to see fifty *additional* such days per year, on top of the twenty or so per year they experienced prior to anthropogenic warming.

As one gets closer to the equator, this number tends to grow. For the residents of Accra, Ghana, Mumbai, India, or Bangkok, Thailand, this number may be closer to 100. That isn't a typo. One hundred *additional* days per year above 32.2°C. In many such places, most homes do not yet have air-conditioning. Physical acclimatization, while effective to a point, likely has its limits.

Regardless of whether we are able to reduce emissions rapidly starting today, some level of warming is essentially locked in, at least for the next several decades.

This isn't to suggest that reducing emissions won't help. Quite the contrary, especially in terms of reining in warming during the latter half of the century and beyond, reducing emissions will be crucial.

In fact, the somber backdrop of most climate conversations often obscures the reality that, actually, a great deal of progress has already

been made. Even as of the early 2010s, many models had humanity on pace to exceed 4°C or more of warming by the end of the century. Middle-of-the-road scenarios now put us closer to 2.5°C by 2100.[7] In 2022, the United States, which is the largest historical emitter and long a laggard when it came to binding climate action at the national level, passed major climate legislation through Congress, which would put it on track to nearly halve US emissions by 2030 relative to 2005 levels.

These are no small achievements. But they may merely be down payments on the century-long mortgage that is climate mitigation: a mortgage whose monthly installments may need to ratchet up over time as the incremental costs of cutting additional emissions grows.[8]

One cannot avoid the fact that, for the time being, there is too much momentum in the system to avoid a significant amount of warming within our lifetimes. The earth's climate is a slow-moving Leviathan, and we've been aggravating it for over a century. As we will see, even if we are able to stave off planetary collapse in the long term, this inertial warming may have very serious—in many cases life or death—consequences for millions of people over the next several decades.

Which brings us to fact number two: inequality. In many parts of the world, this warming comes amid a backdrop of significant and growing economic inequality, particularly between individuals with and without access to the infrastructure and skills needed to participate in the modern global marketplace.

While wages for those at the top of the US income distribution have risen rapidly since the 1990s, wages for most—particularly those without a college education—have stagnated. In real terms, that is, accounting for changes in costs of living, incomes for non-college workers have actually declined.

Similar trends have been documented in much of Europe, though not always as pronounced as in the United States, and in parts of Asia as well. Four decades ago in China, the bottom half of workers earned 27 percent of total national income, while the top 1 percent earned about 6 percent, a ratio of roughly four to one. As of 2015, the income shares have become closer to 15 percent and 14 percent, respectively, or a

roughly one-to-one ratio.[9] This means that, in China today, the top 1 percent—mostly the wealthy elite of Shanghai, Beijing, and other major metropolises—now earn almost as much as the bottom 50 percent combined, which amounts to more than 700 million people. (For reference, the numbers for the bottom 50 percent and the top 1 percent income shares in the United States are 12 percent and 20 percent, respectively. In more egalitarian France, the bottom half earn 22 percent, the top 1 percent earn 10 percent.)[10]

How do the risks of climate change vary across the income distribution in your home country or city? Could climate change be a force that further increases the gap between the haves and have-nots? What are the social and economic implications if so?

As we will see, emerging research suggests that the consequences of moderate, noncatastrophic warming may be severe, especially for society's disadvantaged. This raises important questions around the *how* of adaptation and the targeting of climate assistance, many of which can benefit greatly from better data, helping policymakers approach adaptation with more of a precision scalpel than a hacksaw. Given fact number one above—the amount of warming that is baked in—these and other related questions will likely need to inform collective decisions around how best to adapt to a warming world.

This is not exactly the form of inequality one may be accustomed to hearing about in the context of *climate justice*. Most will be familiar with the fact that climate change has historically been a problem caused by historical emissions of rich people in the Global North, many already dead, whereas its consequences are being felt by everyone, including young people in poorer countries of the Global South.

This inequality in attribution has been a major reason why rich and poor countries have not seen eye to eye on climate change. To paraphrase the point made by developing countries: You took your turn at the cheap energy well and raced ahead economically. Now that it's our turn, you're telling us to find a cleaner alternative, which is going to slow us down even further. You can't expect us to be happy with that.

This international aspect of climate equity is critical both for ethical and practical reasons. It seems only fair that those who benefited more

from the caffeine boost of cheap fossil fuels should pay proportionately more for the cleanup, so to speak.

One claim put forth in this book, however, is that the implications of climate change and energy policy for *interpersonal* inequality—the variation in how lived experiences are impacted across dimensions of race, gender, immigrant status, and class, within rich and poor countries alike—are likely to be important as well. For instance, these differences may prove pivotal in determining whether the political appetite for a long-run clean energy transition can be sustained, especially if higher energy prices begin to squeeze wallets—particularly for the lower half of the income distribution in countries where the steepest initial cuts will be necessary.

Because of the way the modern economy rewards certain skills in the workplace, the workers who bear the brunt of health and productivity impacts of a warmer world may also tend to be those hit hardest by parallel drivers of inequality—forces like automation, globalization, and skill-biased technical change. Some of these occupations are ones we might expect, like agricultural or construction workers. But others, we might not: manufacturing workers, parking lot attendants, food processing workers, janitorial staff, and warehousing workers also appear to be exposed to workplace climate risks.

Similarly, because of the way housing markets sort people based on income, poorer families may be increasingly likely to live in the most climate hazard exposed areas. The market forces giving rise to such patterns of inequality aren't always obvious to spot, and devising effective interventions can be more challenging than common intuition might suggest.

In this book, we will explore a growing body of research that asks how the contours of climate damages may be altered by the many social and economic dimensions of vulnerability, including the way labor markets and real estate markets are organized, and what kinds of social safety nets people have access to. I will try to make the case that, while the task of mobilizing financial support for poorer nations may indeed be an important one, expanding the evidentiary base regarding how best to design and target adaptation assistance may be equally pressing.

Fact number three is uncertainty. We find ourselves in a landscape of pervading uncertainty. This is true with respect to whether truly catastrophic climate change may be averted in our children's lifetimes. It is also true regarding the many practical decisions around how best to adapt to the changes that are occurring already: that is, whether and how we can meaningfully alter the realized impacts of a rapidly warming world.

At the societal level, there is a growing understanding that reducing emissions will be critical to stave off the worst effects of runaway climate change: a growing consensus on *whether* climate mitigation should be a policy imperative. And yet, *when* and *how* and *at what cost* (borne by whom) remain perennially debated. The swift reversal of bans on drilling for oil in the United States in the fallout of the war in Ukraine and rising energy prices is just one of many possible cases in point, as is the debate surrounding whether and when to phase out internal combustion engines from automotive markets. The tension is often magnified in developing countries, where trade-offs between growth and green can be steeper.

At the individual level, decisions around how best to reduce climate risk—whether as a homeowner, an investor, a manager, or a mayor—often remain distressingly opaque. At what point do you consider selling the family home to move to higher ground? How well-insulated is your retirement portfolio against a potential *climate correction*? Do your child's classrooms—or standardized testing sites—have reliable climate control?

A recent survey of CEOs and CFOs of the largest companies in the world found that 86 percent of respondents agreed that addressing climate risk was important.[11] Some of this may be a direct response to increased shareholder interest; the number of climate-related shareholder proposals has increased fourfold since 2011.

At the same time, more than three in four CEOs and CFOs (77 percent) admit their firms are not fully prepared for the adverse financial impact of a changing climate. Indeed, few appear to have a clear sense of which climate risks matter and why. Is it the risk of flooding, wildfire, or extreme heat waves? Where in the supply chain could climate risk be lurking, and what can be done to address it cost-effectively? Will

the risk fall on physical assets like factories and warehouses, or human assets like call center workers?

Perhaps it is no surprise then that eight out of ten executives (82 percent) believe that their companies have little to no control over such an impact on their businesses.[12]

As we will see in the pages ahead, having clearer metrics of physical risks—how much hotter will an area become, or how many more wildfires can we expect per year by 2030?—is probably an important start. But in many cases, it may be insufficient. The more we learn about the socioeconomic details of climate vulnerability, the more it becomes clear that physical and economic risk are not one and the same, and often depend on complex institutional and structural factors.

Considering the potential for systemic financial risks—for instance, the triggering of rapid price revisions and instability in the housing market—as well as the potential fiscal consequences, debates over the proper role of government in adapting to climate change are likely to grow in the years ahead. And these debates will arrive at your doorstep even if the most visible physical hazards, whether they be wildfires or floods, do not.

All of this suggests that there is likely individual and collective value in becoming more fluent consumers of the economic facts, the hidden everyday costs of climate change. While this book will not be able to answer these questions definitively, the hope is that it can equip the reader with some tools to tackle them more proactively.

There is one particular form of uncertainty that we need to address first, and that is the uncertainty around whether climate change's importance in our lives hinges on the notion of climate catastrophe.

How We Think and Talk about Climate Change

> I don't want you to be hopeful. I want you to panic. I want you to feel fear every day, and I want you to act as if the house is on fire, because it is.
>
> —GRETA THUNBERG

> Just because there is a problem doesn't mean that we have to solve it, if the cure is going to be more expensive than the original ailment.
>
> —BJORN LOMBORG

Much of the popular discourse about climate change has revolved around some notion of civilizational calamity. For some, it is increasingly assumed that the threat is existential. For others, such rhetoric serves as ammunition for derision, grist for the culture war mill, in which environmental fearmongering is but one of many ploys to trample individual liberties, or a case of misguided progressive zeal.

Implicit in these positions are two assumptions that are flawed, or at least worth careful reexamination. The first is that climate change isn't a priority unless the risk is truly existential for humanity, full stop. Only when it threatens civilizational collapse does climate change rise to the level of urgent social challenge. Painting dramatic stories of impending doom and an uninhabitable earth are warranted, even if they sometimes stretch the evidence, because that is the only way most human beings will pay attention—so the argument goes. Conversely, from the opposing standpoint, it is assumed sufficient to poke holes in the most extreme disaster scenarios without stopping to assess whether even the more moderate claims would satisfy the cost-benefit criterion for action.

As I hope the following pages make clear, climate change need not clear the bar of existential global risk in order for it to be worth paying attention to. We may well need the Greta Thunbergs of the world to galvanize interest in protecting the planet for posterity. But we may also need a more dispassionate quantification of the harms that climate change may pose today and in the near future—harms that may, on aggregate, be a far cry from imminent civilizational collapse, but may mean serious loss of livelihood or even life for many individuals, businesses, and communities.

The data increasingly suggests that, well before we reach the level of existential crisis for humanity, the ways climate change will make many of our activities incrementally less productive and fulfilling may warrant serious concern. Whether one's own ethical basis for action is economic efficiency or social equity or both, it may well be that a sober assessment of such subtler damages may provide reason enough to act. This is especially true to the extent that our own personal and collective actions can often amplify or mitigate these damages considerably.

To be clear, acting aggressively to mitigate climate change as a form of insurance policy against potential ecological and civilizational

collapse is a highly sensible idea. When possible, we take out insurance against low-probability, high-pain scenarios all the time, whether in the form of property insurance or life insurance. One could argue that focusing our attention on the possibility of annihilation has been instrumental in jolting many of us out of our complacency. In fact, much of the progress that has been made to reduce emissions may not have been possible without the concern and mobilization this narrative has triggered, particularly among young people.

So when I extol the virtues of paying attention to the noncatastrophic, slow burn, it is not to denigrate or dismiss the importance of recognizing the very real—albeit highly uncertain and likely very distant—risk of truly catastrophic climate change. In fact, given the deep uncertainty inherent in climate projections and our growing understanding of nonlinear feedback loops (commonly referred to as "tipping points"), there are good reasons to proceed cautiously and to retain the catastrophe insurance framework as a complementary heuristic. Even when central tendencies of many climate models converge to lower levels of predicted warming than before, the tails of the probability distributions remain uncomfortably long and subject to deep (also known as Knightian) uncertainty, which could be summarized as a problem of unknown unknowns.

But there are serious psychological challenges of motivating sustained engagement based on doomsday scenarios. Moreover, they offer little actionable intel as to the practical challenges of adapting to the warming that is inevitable. It therefore seems imperative that we expand the set of mental models we employ as decision-makers and voters on the issue of climate change. That, at minimum, we consider the narrative heuristic of climate change as a slow and unequal burn—not so much as an alternative, but a complementary one to that of climate change as existential crisis for life on earth.

Of course, economic approaches to environmental problems risk the tyranny of measurement: we are prone to look for our keys under the lamp post because that's where the light shines. What we cannot measure well or quantify in dollars and cents may not get valued as highly, despite immeasurable intrinsic value. This risk notwithstanding, I hope to show

that even when limiting our analysis to things we can measure reasonably well, the benefits of many clean energy investments very likely far exceed the costs.

As we will see in the pages ahead, the data now suggests that reducing emissions, even at reasonable cost, is probably worthwhile due to the preponderance of what I am calling the slow burn. This may be the case even before one considers existential tipping points in the climate system, or the very hard-to-value destruction of the natural world, such as biodiversity loss or the degradation of sacred groves. The lower probability extreme outcomes may well be increasingly likely and potentially devastating, and the as-yet poorly measured value of natural capital possibly very high. But I hope to make the case that, even when focusing squarely on the direct human losses associated with noncatastrophic warming in the near term, the cost-benefit of climate mitigation may favor aggressive emissions cuts.

A second flawed assumption in most climate change discussions is that the damages from climate change are somehow globally applicable, like an extinction-level asteroid or an alien invasion. That there is one universal phenomenon that is climate change, a riptide that affects all of us on planet earth equally. Here humanity sits, precariously balanced on a cliff, a modern-day Noah's ark. "We will all act together, or we will all die together" is often the implicit motif.

While such imagery may provide useful narrative devices, it is inconsistent with the available evidence. Especially when one considers how the rich and poor differ in their exposure to (and ability to adapt to) climate risk. Indeed, the previously listed facts one (immediacy) and two (inequality) necessitate a way of thinking about climate change that is less about all-or-nothing planetary poker, and more about the actions that may need to be taken to manage the warming that is inevitable during our lifetimes, and perhaps helping to shield the most vulnerable from its blows.

Both the perspective of the ark and that of pain management can be entertained—and the respective goals of mitigation and adaptation pursued—in parallel. One can, out of concern about the risk of fatal kidney failure in the future, decide to make swift and persistent changes

to one's diet and exercise routine while simultaneously seeking immediate medical attention to address the progressing symptoms of chronic kidney disease now.

As I hope to illustrate through a series of studies and examples, these long- and short-term approaches—which together amount to walking and chewing gum at the same time—may become especially important when one considers just how unequal the realized effects of climate change already are.

This is not only because some parts of the world will warm faster than others or be more prone to flooding or hurricanes or wildfire. It is also because the way a given climatic event translates into realized human suffering (or flourishing) is almost always a highly complex function of the social, economic, and institutional environment in which it plays out.

A collision at thirty miles per hour in a Mercedes with seat belts fastened may lead to a few bruises and some insurance paperwork. Colliding at the same velocity in a rickshaw without a helmet may prove fatal, especially if there are no ambulances or hospitals nearby. So it is with many climate shocks as well. It turns out that the mortality consequences of a 95°F day can vary by a factor of ten or more between a place like India and a place like the United States. Even within the United States, the effect of such heat on health may vary by an order of magnitude, depending on highly localized and individual factors such as income, occupation, industry, and neighborhood.

Similarly, affluent homeowners may be able to erect protective bulwarks against storm surges and wildfires, or finance the move to safer terrain, while the poor may become stuck in increasingly natural disaster-prone places with eroding balance sheets that make them even less able to move out of harm's way.

However, as we peel back the layers of the onion on climate vulnerability it becomes clear that physical investments such as seawalls, air-conditioning, and more tree cover are only a small part of the solution set. In fact, in many of the world's poorest places, the most important adaptation interventions may ostensibly have little to do with the environment. We will explore the perhaps unexpected influences of banking

systems, education systems, and labor markets in absorbing or amplifying the adverse effects of climate change on our well-being.

An explosion of research, much of it coming online over the past few decades, is quickly recasting our understanding of the hidden but pervasive ways in which temperature and extreme weather already affect our daily lives—thanks in part to parallel developments in the availability of data and the so-called credibility revolution in economics.

This book is largely a product of engaging with such data and the new quasi-experimental methods that help unlock insights hidden in them: both in my own research and as a member of a growing cadre of applied economists working on what one might call the microeconomics of climate change. This more data-driven, statistically minded manner of climate discourse will be essential to making more informed decisions about climate change.

Between 2010 and 2021 alone, there were over 400 peer-reviewed studies that combine real-world data and quasi-experimental research designs to shed light on climate damages.[13] These are studies that use techniques that enable us to better disentangle cause and effect (e.g., does hotter temperature actually lead to increased crime locally?) and that use data to inform our understanding of how societies respond and adapt or not. Among other things, these improvements help us to better identify the specific populations and places most vulnerable to climate shocks, as well as the potential effectiveness of various interventions. Much of what is practically valuable from these analyses may not yet be fully incorporated into policies or individual decision-making, despite potentially significant practical value.

There are no doubt many pitfalls in relying on past data to inform the future, particularly for a phenomenon as unprecedented in scale and speed as climate change. I hope to be mindful of such limitations early and often, and by no means does this book attempt to engage in anything resembling economic forecasting. These pitfalls notwithstanding, this book is written as an invitation to consider an economically nuanced perspective on climate change as, at the very least, a useful complement to other ways of perceiving and acting on the problem.

The Slow Burn and Its Silver Lining

Most professional athletes, musicians, and craftsmen will tell you that their prowess is a product of years of dedicated training, even though they may be naturally gifted in some way. Successful businesswomen and men know that, alongside their flashes of entrepreneurial insight were hundreds of incremental innovations that built the company's success over time. Spiritual teachers in Buddhism and elsewhere often refer to the process of "sudden awakening, gradual cultivation."

The obverse can also be true. Doctors know that, for every freak accident that lands a patient on their operating table, many arrive as the cumulative consequence of a million small choices: the extra cigarettes smoked; the midnight oil burned; the side of fries chosen instead of a salad. Bankruptcy attorneys will tell you that, while some personal bankruptcies are instigated by the financial strain of a sudden uninsured disaster, many are the cumulative consequence of daily habits.

Of course, there isn't quite a mirror symmetry here. Whether for bodies, businesses, or credit, it's usually easier to destroy than to build.

But a possibility this book invites us to consider is that, when it comes to climate change, much of the real damage may come not from the spectacular disasters but from the quiet, slow burn. The less salient, incremental disruptions spread out across a million seemingly mundane activities, processes, and interactions. That the more appropriate allegory to hold in our minds is not so much Mount Vesuvius and the annihilation of Pompeii, but the melange of epidemics, skirmishes, and managerial missteps that eventually crippled the mighty Roman Empire.

If the story of Pompeii is one of instant and catastrophic annihilation, the story of the fall of Rome is one of gradual decline. The former, while ostensibly more relevant to climate as a story of environmental destruction, has little to teach us about climate change. The latter, while a messier and more ambiguous affair, may turn out to be the more appropriate mental model as we confront what climate change means for our social and economic reality.

There is an important silver lining that emerges from this perspective. It is the recognition that there are more ways one can make a positive

difference than first meets the eye, particularly in helping the most vulnerable communities adapt to a warmer future, whether they reside in the world's poorest rural hinterlands or the most dilapidated neighborhoods of your hometown.

Whereas the binary framing of climate change as impending catastrophe incites fear and fatalism, the subtleties of noncatastrophic climate damages just might, I submit, instill compassionate resolve and perhaps even informed optimism. It can show us how we are never too late to slow the progression and to better manage the pain of a warming planet. It might just help steel our collective determination for the decades of hard work ahead—that is, for the work of transitioning our societies and economies toward cleaner and more climate-resilient versions of themselves.

My own hope is that this book will spark greater curiosity regarding the possible interventions, individual and societal, that could help manage the complex interplay of climate change and the inequities and uncertainties of modern economic existence. Additionally, I hope it might help us to be more curious about why a hotter climate can be more damaging to some than others and to learn how we might invest in the knowledge, policies, and processes that will help blunt climate change's inevitable blows. We all may be surprised to learn how poorly adapted some communities are to the current climate (let alone the future one), and how the most cost-effective adaptation strategies may have seemingly nothing to do with climate.

It is easy to demonize others about the dire straits we find ourselves in: The oil companies who chose to obfuscate rather than educate; the politicians who put expediency above principle; the earlier generations who grew fat and complacent on the sugar high of a fossil fuel–intensive economy.

The truth, however, is more uncomfortable. The truth is that we are all complicit in the fossil-fuel economy to some degree. Moreover, the way our minds incline hinder us from grasping the scale and abstraction of the problem in an actionable way. The fact is that as humans we are not naturally inclined to think statistically or probabilistically about climate change (or for that matter, most policy problems).

As such, we may all be predisposed to overlook crucial pieces of the puzzle, including the understanding that, despite it being ostensibly a physical environmental phenomenon, much of what determines whether climate change hurts or helps has to do with the complex interplay between environmental and economic systems. The new data and perspective offered in this book underscore in particular the mitigating or exacerbating influence of economic context. What hurts us are not simply the natural phenomena of hotter temperature, rising sea-levels, or more variable rainfall, but how they interact with human institutions—economic, educational, legal, and political.

I want to be careful not to make this yet another *moral failing*. If anything, part of the difficulty we face may be the morally charged tenor of much climate change discussion. What I am referring to here is less a moral failing, more an issue of our *mental foibles* and how they influence the way we think and talk about climate change.

Caveats of a Two-Handed Economist

A frustrated US president Harry Truman once demanded that his aides find him a "one-handed economist," lamenting the tendency of his economic advisers to caveat everything with "on the one hand . . . on the other."

Lest you think this economist was going to buck that trend, here are some important caveats before we proceed.

In the chapters that follow, I appeal to vignettes and anecdotes frequently. This book is intentionally long on intuition and short on equations. This is mainly to make the ideas more digestible, to help the concepts stick.

While anecdotes are powerful tools for communication, they are not a substitute for rigorous scientific evidence. Anecdotes can be chosen to make a particular causal story more intuitive, but it is not the story that makes the causal statement true. We rely on the scientific method to provide us with generalizable facts about the path between cause and effect. That, for instance, a particular vaccine causally reduces the likelihood of hospitalization and death. That, given how the assessment was conducted (e.g., a randomized controlled trial of sufficient size and

duration), the arrow of causality runs in a particular direction—vaccine causing improved immunity—and is probably not being driven by other unobserved factors or by selection bias (e.g., healthier individuals having been more likely to take the vaccine).

It is therefore with great caution and care that I offer the anecdotes and vignettes included in the pages that follow. Unless otherwise stated, or clearly offered as allegory, they are chosen with the understanding that the narratives presented are consistent with the results of peer-reviewed scientific research. Of course, there will be limited space to discuss the details of how we know what we know and with what degree of certainty. For the reader who would like greater technical substantiation, I have included endnotes where I reference and sometimes expand on the studies that form the basis of such assertions and at times describe their data, methods, and specific strengths and weaknesses in greater detail, as well as mention other studies that allow you to delve even deeper should you find something to be of particular interest.

Along similar lines, both the coverage of this book and the applicability of its central idea are inherently flawed and incomplete. My intention is to introduce a different way of looking at the issue of climate change, not to provide a comprehensive overview of the subject. As such, there will invariably be major aspects of climate change—or parts of the world affected, different disciplinary perspectives to be considered—that are discussed only sparingly, or not at all. And as with all heuristics, the ones I offer here are imperfect at best; at worst, hindsight and more research may reveal them to be grossly misguided.

Finally, the book also does not pretend to provide definitive answers to all the questions raised. In some cases, what the data reveals will be unsatisfyingly ambiguous, simply giving rise to different questions. Hopefully I have managed to be clear about where there is general consensus within my field, and where I am merely providing food for thought. For readers who would like a more methodical treatment of the levels of consensus and uncertainty, I would recommend the latest Intergovernmental Panel on Climate Change reports, as well as country-specific analogs such as the National Climate Assessment in the United States or reports by the UK Climate Change Committee.

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Note: Page numbers in *italics* indicate figures.