An Introduction to Natural Disaster Economics

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Chapter One: Introduction

The fires in Los Angeles ignited in January 2025. I will use this shock to explore the microeconomics of natural disasters as I focus on the causes and consequences of extreme weather events; including hurricanes, tornadoes, wildfires, extreme heat, and pollution spikes. I will ask (and sketch answers to) some tough questions: Why do these shocks cause damage? Why weren't people, firms, and governments prepared for such shocks? What does it mean "to be ready"?

Economists study trade-offs. In a boxing match, a fighter can defend himself by remaining in a crouched-defensive position. If we are always in a crouched position, we may protect ourselves from a hard punch, but it is challenging to lead a fulfilling life while in that position. I won't push this analogy of a boxer too far, but I want you to think about the fact that we choose how much risk we expose ourselves to. We choose how much time and effort to devote to achieving resilience. Through market competition, we have an ever-growing menu of options to protect ourselves. For example, Amazon offers an impressive array of air filter products to reduce indoor PM2.5 exposure. Fire resistant roofs are produced by many companies.

Each of us seeks to be safe. Urbanites worry about their crime exposure. They can avoid crime by moving to a safe neighborhood, or by installing an alarm system and having their own gun. They can spend less time in urban public space to avoid interacting with strangers. Urbanites also rely on the police to protect them.

This urban safety example highlights that our safety is determined by our own choices and by the choices of the government. Throughout this book, I will explain cases where government's actions hinder our resilience and cases where government's actions enhance our adaptation capacity. I will focus on how the government's "rules of the game" affect our incentives to enhance our risk resilience.

When we go to Las Vegas, we gamble. When some of us drive under the influence, we take a gamble. When we place bets on the Super Bowl, we gamble. What types of gambles do we allow people to take? A gambler would love to play a game where if the coin flip is heads, he wins but if it is tails, we pay for his loss. Economists reject this bet. We believe that gamblers should flip two sided coins! If you take a gamble and it doesn't work out, you should bear the consequences for your decision.

This raises important issues regarding our social compact: what do we owe each other? Suppose the government promises to rebuild the homes of disaster victims. What are those rules' intended and unintended consequences, especially in a world where resources are limited? I will explore these questions in this book.

Natural Disasters?

Natural disasters are often described as acts of nature—exogenous shocks that impose damage on an otherwise stable economic system. This framing is convenient, but it is incomplete. The economic consequences of disasters are not determined by physical forces alone. They are shaped, often decisively, by human behavior, market institutions, and public policy.

At any moment in time, a coastal home, a suburban neighborhood, or a wildfire-prone hillside represents not just a bundle of physical assets, but a set of choices made under uncertainty. Households decide where to live, how much to invest in protection, and whether to insure. Firms decide how to price risk and allocate capital. Governments decide whether to subsidize rebuilding, regulate insurance markets, or restrict land use. These decisions collectively determine how much damage a given hazard ultimately causes.

This book adopts a simple but powerful premise: disaster losses are endogenous. They emerge from an equilibrium shaped by incentives. Traditional approaches to climate damage and disaster risk often treat losses as a function of physical exposure—temperature, rainfall, wind speeds, or flood depth. In such models, damages rise mechanically as hazards intensify. While this perspective captures important physical realities, it abstracts away from the fact that people respond to risk. They relocate, invest in protection, innovate, and update their

expectations. When incentives change, behavior changes. And when behavior changes, realized damages change as well.

A world with accurate risk pricing, flexible land use, and access to capital will experience very different outcomes than a world in which prices are suppressed, risks are pooled indiscriminately, and adaptation is discouraged.

Consider the role of information. In recent years, advances in data science have dramatically expanded our ability to measure localized risk. High-resolution flood maps, wildfire models, and property-level climate projections are increasingly available to households, insurers, and investors. This growing information set allows for more precise expectations about future hazards. In turn, it enables more granular pricing of risk in insurance markets and property values.

When risk is accurately priced, it creates incentives for adaptation. Homeowners may invest in mitigation—elevating structures, hardening roofs, or managing vegetation. Developers may shift construction toward safer locations. Financial markets may reward resilience and penalize exposure. Over time, these responses can reduce the vulnerability of the built environment, even as the underlying hazards intensify.

However, these adjustments depend critically on whether prices are allowed to convey information. In many settings, public policy dampens or distorts price signals. Insurance premiums may be capped. Governments may provide disaster aid that subsidizes rebuilding in high-risk areas. Land use regulations may restrict housing supply in safer locations while encouraging expansion into more hazardous regions. These interventions are often motivated by equity concerns or political pressures, but they can have unintended consequences. By weakening incentives for self-protection and relocation, they may increase long-run exposure to risk.

The tension between short-run protection and long-run adaptation is a central theme of this book. Policies that shield current homeowners from losses can slow the reallocation of people and capital toward safer locations. They can also discourage investments in resilience.

As a result, they may increase aggregate vulnerability over time, even as they provide immediate relief.

Understanding this tradeoff requires a broader view of disaster economics—one that integrates microeconomic behavior, market design, and political economy. Households are not passive victims; they are decision-makers responding to incentives. Insurance markets are not merely mechanisms for risk sharing; they are also systems for generating and transmitting information. Governments are not neutral actors; they respond to the demands of organized groups, often favoring concentrated interests over diffuse beneficiaries.

These elements interact in complex ways. For example, when insurance markets incorporate detailed risk data, they can differentiate premiums across properties with increasing precision. This reduces cross-subsidies and strengthens incentives for mitigation. But it also creates distributional tensions, as households in high-risk areas face rising costs. These households, often politically organized, may push for regulatory interventions that limit price adjustments. In doing so, they can slow the very adaptation processes that would reduce risk in the long run.

The central message is not that markets always work perfectly or that government intervention is inherently counterproductive. Rather, it is that the effectiveness of any policy depends on how it shapes incentives. Policies that align private incentives with social goals—encouraging accurate risk pricing, facilitating mobility, and supporting investment in resilience—can reduce disaster losses over time. Policies that obscure risk or discourage adaptation may have the opposite effect.

This perspective reframes how we think about climate change and natural disasters. Instead of asking only how hazards will evolve, we must also ask how people will respond. The future path of disaster losses is not predetermined. It will depend on the institutions we build, the information we generate, and the incentives we create.

In this sense, the economics of natural disasters is fundamentally about adaptation. It is about how societies adjust to risk in a world of uncertainty.

Natural Disasters and Place-Based Capital

A key insight that motivates this book is that natural disasters destroy **place-based capital**. Houses, office buildings, infrastructure, and neighborhoods are all long-lived investments tied to specific locations.

For most American households, the largest component of their wealth is their home. In this sense, many families hold what we might call a "one place-based egg." Unlike a diversified stock portfolio, housing wealth is concentrated in a single geographic location. When a wildfire, hurricane, or flood strikes, the financial consequences for households can therefore be severe.

Real estate is a durable capital asset that faces uncertain but evolving climate risks. Over time, new information about wildfire exposure, flood zones, or heat risk can change the expected returns to living in different locations. As this information becomes available, individuals and firms update their beliefs and make new decisions about where to live, how to build, and how much to invest in protection.

Understanding how markets respond to these risks—through insurance pricing, migration decisions, innovation in building materials, and financial contracts—is a central theme of this book.

A Brief History of My Thoughts About Urban Quality of Life and Local Risk

In my 2006 Green Cities book, I focused on the day to day attributes of a city that makes it a great place to live and work. Los Angeles exemplifies the "Green City" on a typical day. It enjoys a temperate winter climate, which attracts many people due to its beautiful blue skies and low humidity. On most days, the westside of Los Angeles experiences very little smog.

On a typical day, no disasters take place. While Los Angeles has experienced earthquakes, riots, and major wildfires, on most days the Los Angeles Times leads with stories about Hollywood and the Los Angeles Lakers!

The challenge of disaster resilience presents a significant high-stakes test for neoclassical economics, which emphasizes the role of market competition in improving our quality of life. Market participants are “free to choose” their paths based on their desires and limited resources. The role of markets versus mandates in protecting us from natural disaster risks becomes even more critical if climate change exacerbates these risks over time.

I examine the microeconomics of disasters by studying many choices made by households and firms such as where people live and how much they invest in protecting their homes.

What is society’s best strategy for developing rules that enable more individuals to thrive despite disaster risks? I will use the 2025 Los Angeles wildfires to illustrate many of my points.

Information, Data, and the Rising Market for Risk Measurement

One reason to be optimistic about disaster resilience is that our ability to measure risk is rapidly improving. A new industry is emerging that produces highly granular climate risk data. Using satellites, LiDAR, historical claims data, and machine learning algorithms, firms are now generating parcel-level risk scores for flooding, wildfire, heat exposure, and storm damage. These scores increasingly appear in real estate listings, insurance pricing models, and mortgage underwriting decisions.

For the first time in history, potential homebuyers can access detailed information about the long-term risks associated with specific properties. While these predictions are imperfect, the growing availability of risk information allows individuals and markets to make more informed decisions.

Just as financial markets price the riskiness of corporate bonds, housing markets are increasingly beginning to price climate risk. Better information allows households to invest in mitigation, encourages innovation in protective technologies, and helps markets allocate capital toward safer locations.

Adaptation Progress

The damage caused by extreme weather depends not only on physical conditions but also on incentives, institutions, and innovation. Markets, regulations, insurance contracts, land-use policies, and technological progress all influence how vulnerable societies are to disasters. In other words, climate damages are not fixed constants. They are endogenous outcomes shaped by human decisions.

This book therefore focuses not only on disasters themselves but also on the institutional rules that shape how societies adapt to them. For centuries, people and nations have wrestled with extreme weather and natural disaster shocks. Such individuals have attempted to forecast the weather to give them better predictive information about what might happen next. The possibility of climate change makes it even more important to make progress predicting emerging trends. We can adapt to what we anticipate.

This is an optimistic adaptation book. You should stop reading now if optimism does not interest you! There is no "climate crisis" as measured by deaths from disasters and economic growth and family flourishing if we allow markets to operate and to signal emerging risks. Disasters represent extreme events and they always have occurred and they will continue to occur. We have an ever expanding capacity to adapt to disasters when we allow markets to operate. This is the reason that I never use the words "climate crisis".

Lessons from the 2020 COVID Disaster Shock

In considering the costs and benefits of adapting to natural disaster risks, it's helpful to reflect on our harrowing experience with COVID-19 in 2020. Many people tragically lost their lives, particularly older individuals, and the impact was devastating. However, many economists, myself included, observe that the market system demonstrated remarkable resilience in the face of this shock, allowing people to continue their daily lives. Before February 2020, I had never heard of Zoom. Like many other professors, I used to conduct

face-to-face lectures. However, once the crisis hit, I was able to pivot seamlessly to using Zoom. While it was not a perfect substitute for in-person interaction, I could still perform my duties. I connected with students who had left the Baltimore area, held virtual office hours, and engaged with them remotely. I also participated in virtual conferences and encountered people I had never met before. I attended keynote talks by prominent economists that I could have only caught in person had I traveled to another city.

What I want to emphasize here is the significant silver lining that emerged as we sought new ways to interact when face-to-face interactions became risky due to the threat of infection. This COVID-19 experience demonstrated how our economy could reorganize itself. We all had fundamental goals: to interact, to learn, to network, and to fulfill our work responsibilities, all while minimizing our risk of infection.

The economy largely continued functioning without disruption until the government required it to stop. People voluntarily continued to trade with one another. Companies like DoorDash facilitated food delivery, and billion-dollar companies kept connecting buyers and sellers. Various businesses, including Amazon and Uber, adapted from their original services. For instance, Uber pivoted from providing rides to delivering food with Uber Eats.

These companies did an exceptional job, driven not by charity but by self-interest, to thrive during a stressful time. Their actions provided a silver lining; our economy continued to operate amid hardship. Without the rise of these apps, the sharing economy, and technologies like Zoom, the situation could have been much worse.

It's important to note that restricting access to healthcare and education during the pandemic caused long-lasting damage. Children were unable to attend public schools, which disrupted their early development and impacted their health, learning, and mental well-being.

Another critical point pertains to how firms engaging in face-to-face interactions, such as supermarkets, acted during the COVID-19 pandemic. For-profit firms had strong incentives to minimize disease risk in their establishments. If a reputation for spreading illness developed, and customers traced a sickness back to a specific store, it would harm the business's reputation and result in lost customers.

Thus, the motive for profit drove business leaders in the U.S. to adapt their operations. They implemented measures such as providing hand sanitizer, adapting protocols to minimize

disease risk, and screening workers. If someone appeared sick, they might be compensated to stay home, ensuring they weren't spreading the infection.

A Disaster Resilience Recipe Book?

Why should you bother reading this book about the economics of disaster resilience? You won't have any new ideas about a possible Hollywood Blockbuster movie from reading this book. A future Bruce Willis will not star in the screen version of this manuscript. Instead, I want readers to appreciate the boring tactics that are needed so that future possible disasters do not play out. The CIA always pats itself on the back saying the public is never aware of the national security threats its James Bonds thwarted. While this is a convenient statement, it interests me.

In this book, I will sketch out a set of "rules of the game" that will greatly protect us from disaster risk. Given that we know that we do not know the probabilities of certain disasters such as wildfires, the possibility that we can significantly reduce our disaster risk should be very valuable to the many risk averse people in the United States and the rest of the world.

I see an opening for a thought provoking disaster book. We have books on labor economics, environmental economics, and international trade—to name a few. Yet, for better or worse, very few books have explicitly focused on disaster resilience in the United States. When I mention disasters, I'm not referring to historical events like the Great Depression; I'm talking about contemporary events such as the wildfires in Los Angeles, hurricanes, and major floods. We don't have a book on how to take uncertain, ambiguous risks and make them manageable. One can almost think of natural disaster risk as similar to a diabetes diagnosis. Given our current knowledge, how do we configure a regimen so that we manage this condition?

The Climate Change Question

My justification for writing this book—stems from a growing concern. There is a belief that we now face more billion-dollar natural disasters than in the past. For those who take climate change seriously as a significant threat, pervasive rhetoric—found on social media, in

the New York Times, and on various cable news channels—suggests we will experience more natural disasters. This uptick is attributed to climate change and the locations where we have chosen to build our cities and live our lives.

When a disaster occurs, many media members are quick to attribute the shock to "climate change". These individuals have an incentive to make this causal claim as they try to capitalize on the shock to achieve some political momentum. Climate activists have overstated their doom and gloom as they try to attract attention for their cause. Many of these activists downplay our ability to adapt to new threats because that helps to make the political case for the "urgency of now" as they demand that we radically change our society or face existential risks.

By leaning into the easy explanation that "climate change" caused the wildfire, such analysts gloss over the many other sources of the "kindling". In the chapters below, I discuss how even in highly progressive California the current regulatory incentives introduced by generations of progressive elected officials and regulators have created the conditions that contribute to the risk.

Every time one of these shocks occurs, many discuss the event through the lens of the "climate crisis". To objective observers, the words "climate crisis" embody an important hypothesis namely that people all over the planet face an existential threat posed by climate change. Those supplying this message seek to build a political coalition that will take costly steps to overcome the global free rider problem and hasten decarbonization of the global economy.

At a major University, different sustainability scholars research "the crisis". Some focus on species collapse while others focus on ocean conditions. These scientists are genuinely worried (based on their research) and they are simultaneously entering the politica/public policy arena as they take a step towards advocacy based on their research. As an economist, I know that I do not know how high the level of global CO2 will rise and I do not know what this will do to average global temperatures (the climate sensitivity function) but I do know many things about how economies adapt to emerging and anticipated trends when government rules and regulations do not limit such adaptation.

The conventional wisdom is that natural disasters will be LESS likely to occur if the world decarbonizes. There are plenty of academic economists who have already argued this point. On some level, this causal claim is not an economic claim. While economists can write

down a risk production function, our training does not provide us with any special edge for verifying whether this claim is true.

What an economist knows how to do is to evaluate how explicit and implicit incentives affect people's choices. I will focus on how people respond to new information about objective disaster risks and how they use markets and government services to achieve their goals as they factor in the risks they face from extreme heat, flooding, hurricanes, wildfires and other disaster threats. How does the expectation of such events occurring affect one's time allocation and spending patterns? When horrible events occur, how do people ride out the storm? The novel feature of this book is that I focus on how the economics of adapting to disaster risk and actual disasters. I emphasize the importance of relying on markets to help us here. Since, we have such great potential to adapt to threats, I reject the words "climate crisis". My critics counter that climate change will increase the intensity of disasters faster than we can adapt to them. I will return to this theme in the conclusion.

High Anxiety?

Many factors compete for our focus, including our parents' health and children's well-being, alongside current affairs such as inflation, international conflicts, and violence. When we layer disaster risk on top of existing anxieties about our jobs and relationships, the question arises: does this compounded stress overwhelm some individuals? How do people respond to stress? Some individuals may overestimate low-probability events, mainly when the media frequently discusses them.

Modern economics has an ongoing debate regarding how information impacts our decision-making and whether we can become overwhelmed by its sheer volume. When faced with the constant messaging about a "climate crisis", people may experience grief and anxiety, wondering if the end is near—and whether the world will end in 12 years!

In this sense, environmentalists may create a sense of urgency that can lead to overreaction. If one believes that climate change will destroy the planet, then the impending sense of hopelessness may lead individuals to not take actions that could protect them. In this

sense, a horrible irony arises that fear of a deadly future may lead to inaction today that contributes to one facing greater risk because one views the world to be “hopeless”.

On the other hand, some people may over-invest in precautionary investments. For example, if you excessively protect your children (literally bubble wrap them!), they might be safe but struggle to develop self-esteem and independence. This idea highlights the necessity of balancing disaster risk management with living life. If we seek to eliminate all risks, we may be unable to engage with the world around us.

It’s essential to consider our limited resources—time, money, and attention—and determine where to focus our efforts. If we worry about everything, what enjoyment can we derive from life? Critics might argue that focusing solely on enjoyment could lead to ignorance of real threats, which is a valid concern.

Economists focus on tradeoffs and we recognize that people differ in their ability to cope with risks. In general, people are risk averse and are willing to pay to face less risk. Increased awareness of emerging threats can foster innovation. Firms that manufacture products—such as air conditioners or flood-resistant materials—often seek to meet the evolving needs of consumers. As more people become aware of risks, they may respond proactively, seeking solutions to their challenges.

For instance, residents and businesses in fire-prone areas like Pacific Palisades will look for affordable products to reduce their fire risk. This creates a significant market for innovators worldwide, encouraging them to develop and sell solutions for disaster resilience. Thus, a globalized market for safety and preparedness can help accelerate the availability of protective products, which is promising for reducing future disaster costs.

What Can Incentive Theory Teach Us About Disaster Resilience?

People are making a bet on where they live. Recent events, like the January 2025 Los Angeles wildfires and the flooding in North Carolina in 2024, demonstrate that these once-rare disasters are becoming more frequent. As a concerned individual and social scientist, I want to

understand what is happening. Why are we suffering when these shocks occur? What does economics teach us about the extent of this suffering?

It's important to emphasize that the damage caused by a disaster is not a law of physics. The main theme of this book revolves around how we can set up incentives and rules of engagement that allow us to enjoy the benefits of freedom in choosing where we live while also making prudent and cost-effective investments to reduce our risks.

There are often high-impact, low-cost opportunities to lower our risk exposure. For example, clearing brush in fire-prone areas is a worthwhile investment. When we observe that we have failed to make these types of investments, allowing conditions to become even more hazardous, economists must investigate why.

Economics is a rational social science, and when we witness significant damage, especially when it seems that we could have mitigated that damage with relatively small upfront investments, it becomes even more crucial to understand the motivations and decisions behind these failures. As the saying goes, "We won't be fooled again."

To an economist, it ultimately comes down to incentives. Why do some shocks lead to disasters while others do not? This is what I aim to understand in this book. Shocks occur every day—people experience heart attacks, trees fall on the street, cutting electric wires, and car crashes. But when does a shock escalate into a disaster?

Throughout this book, I will emphasize that empirical economist who studies disasters plays the role of a modern Paul Revere. Our statistical research highlights emerging trends that may be too subtle for busy people to realize. It is our job to rigorously document these facts and then to explain them to the general public. As our findings diffuse through social media and blogs, the public becomes informed and can use both private and public strategy to satisfy their demand for change. Throughout this book, I will focus on the conditions such that the public sector's actions accentuate the private sector's ability to improve our lives. I will focus on how to harness market incentives and determine the proper role of government to enhance market efficiency. Our goal is to reduce the likelihood of a shock becoming a disaster and establish rules that minimize suffering and allow for quicker recovery.

I will examine what the government is doing, what it isn't doing, and the unintended consequences of existing regulations. If we, as economists, can identify more cost-effective rules to facilitate adaptation, we must ask why these rules have not been adopted. Who are the

interest groups that benefit from maintaining the status quo? Or do you reject that claim and argue that there is simply inertia in the system?

A Rorschach Test

If the following example bores you, then you shouldn't read this book. After the LA Wildfires, The New York Times has published pieces complaining that insurance companies are demanding that victims itemize their losses. The Times reporter views this to be cruel. Is it?



Some Insurers Pledge to Ease Burden on L.A. Fire Victims, but Others Say No

Most insurance companies will not require policyholders to itemize lost belongings, though some major companies, including State Farm, have refused.

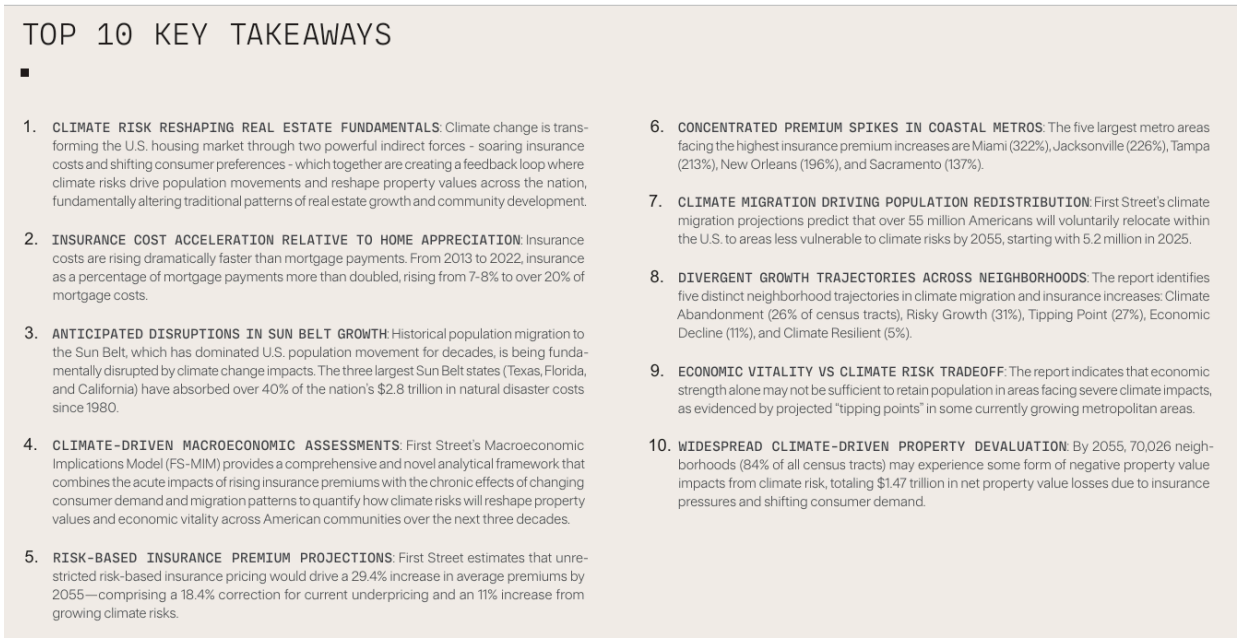
One benefit of the current system, which requires an itemized inventory of lost items and proof of ownership, is that it reduces the risk of fraud. With less fraud in insurance claims, all insurance policyholders can enjoy lower premiums than they would otherwise face. Fraud inflates the costs for insurers who provide insurance services. Although the media often portrays insurers as greedy for this requirement, they are acting in a way that protects future consumers from facing higher prices.

The themes I discuss in this book represent empirical hypotheses that can be rejected if proven false. While I will repeatedly challenge the conventional wisdom on many topics, I will be honest about what evidence could be collected and would convince me to reject some of the claims I make below.

Chapter Two: Calm Days and Horrible Days and the January 2025 LA Fires

On most days, no disaster occurs but the threat lurks and its probability of taking place varies across places and time. Think of the rainy season, the hot season, the earthquake zone, the hurricane season. Anxiety about these lurking events is not pleasant, but the fact that we are aware of them helps us to adapt to them. Unlike birds and other creatures; we have markets and the ability to trade with other people and to learn from them. Most of us are risk averse and are trying to face less risk in life.

A common claim in the popular media is that United States real estate assets may experience large declines in value as disaster risk is priced in. Such asset price dynamics would sharply reduce the wealth of incumbent property owners and could help those seeking to buy property because the purchase price would be lower. One example of such a study was produced by First Street Foundation. In this new study, the authors argue that going forward that insurers will retreat from writing contracts with property owners in parts of the country that face either wildfire or flood risk. The First Street Report claimed that such an insurance retreat would lead to sharply lower home prices in such areas leading to a $1.5 trillion reduction in asset prices. The report claims that climate change is raising the risk in more locations of flood and wildfire risks and that insurers will respond by either raising rates or not being willing to write policies at all. As insurers retreat, mortgage lenders will either make fewer loans in such areas or charge higher interest rates to those who seek a 30 year loan. This higher price for the loan represents a type of risk premium because the lenders worry that the property owner who does not have access to insurance is more likely to default if a disaster occurs.



In this book, I will optimistically argue that this narrative has some truth to it but it ultimately is wrong as it is too pessimistic about how a market economy evolves in the face of an anticipated threat. To preview some of my themes, the owners of these assets have strong incentives to identify risk reduction strategies to protect their home values. This will incentivize entrepreneurs to design such products that mitigate flood and fire risk. Communities who face such common risks will be more likely to work together (out of self interest) to preserve their community's quality. In financial markets (as I discuss below), new financial products will be designed to allow housing markets to function even if traditional market players such as insurers and mortgage lenders retreat from areas they perceive to be "too risky". Capitalism is always evolving and solving the problems that we face. This book takes very seriously that the logic of Free Market Environmentalism can be applied to Free Market Disaster Resilience.

A Salient Shock Caused by Bad Public Policies

The January 2025 Los Angeles fires unleashed death and destruction in my city. I have lived in Los Angeles since 2007. During the days after January 8th 2025, we worried that we would have to evacuate our Westwood homes. The air was filled with the stench of pollution from the fires, and there was a palpable sense of terror across the city as massive fires raged in

the Palisades and Altadena. There was considerable uncertainty about whether the fires would spread. We constantly monitored maps of the fire zone as it approached the freeway and Westwood. However, unlike residents in the Palisades and Brentwood who did evacuate, we did not evacuate from our home near UCLA because we were never in the actual fire zone. In the says after the fire, we measured our indoor air pollution levels and spent no time outside. We ran our air purifier 24 hours a day.

As Los Angeles enters the rebuilding phase, key questions linger. Why did this disaster occur? What new "rules of the game" will lower the probability that this event could reoccur?

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Was this shock a "natural disaster" or a regulation induced disaster? My answer emphasizes regulatory policies that together served as the kindling for this inferno. Yes, this is a dramatic claim. Several policies played a causal role in increasing the likelihood of this disaster.

One factor that contributed to this issue is the California Coastal Zone Boundary rules. Enacted in the 1970s to protect the ocean, wildlife, and creatures near the coast, this land-use regulation sharply limits and controls economic activity within its boundaries. For example, Pacific Palisades, a coastal community, is within the California Coastal Zone Boundary. This

means that property owners face severe regulations on what they can and cannot do with their properties.

Most of the housing stock in Pacific Palisades within the Coastal Commission Zone is over 40 years old. This aging housing becomes kindling during a fire. The question then arises: what type of roofs do these homes have, and what fire-resistant technologies are embedded within them? Additionally, the Coastal Commission imposes further restrictions under the guise of protecting biodiversity and various species, which limits the ability of property owners and communities to engage in brush clearance and other fire mitigation efforts.

In California, various lawsuits have been filed that restrict property owners within the California Coastal Commission's jurisdiction from pursuing their self-interests, such as renovating their homes or clearing their grounds. While these regulations aim to protect nature, they inadvertently increase wildfire risk.

The California Coastal Commission’s rules also have a secondary effect of discouraging the creation of new housing. By discouraging property owners from building larger homes or consolidating lots, the Commission attempts to preserve the area's character. While historic preservation has some appealing aspects, maintaining an outdated capital stock also has a downside. If landowners in the Palisades and within the Coastal Commission had more freedom to manage their properties, they would have a newer, more resilient housing stock because these regulations inhibit them from updating their properties.

Another significant aspect of California law that slows adaptation is Proposition 13. Proposition 13 lowers the growth of an incumbent home owner’s property taxes. As California home prices have gone up, longtime residents pay less on property taxes than recent home buyers because longtime owners are assessed based on their initial purchase price. This creates a lockin effect such that many older people continue to live in their older homes because the tax code provides an incentive to remain there.

If California didn't have Proposition 13, homeowners would tend to sell their homes at a younger age. This could lead to renovations that improve home quality or even the construction of new homes. Therefore, without Proposition 13, California would have a newer and higher-quality housing stock, with younger homeowners generally more proactive in maintaining their properties. These younger homeowners might also be more knowledgeable about risks, such as fire hazards.

The insurance industry in California is highly distorted due to government regulation. One reason the Los Angeles fires have caused so much damage is that many homeowners in the Palisades have opted for the California Fair Plan. This is a state-subsidized insurance plan designed for homeowners in high-risk areas. The Fair Plan is the insurer of last resort.

In California, private insurers have been charging higher premiums or not offering premiums at all in high risk areas. The state's Department of Insurance places price ceilings on what insurers can charge. For-profit insurers often charge high premiums, leading homeowners to seek alternatives. The Fair Plan provides weak incentives for these homeowners to take wildfire precautions to reduce risk. If the insurance industry were privatized, homeowners would face the choice of going without insurance or contracting with a for-profit insurer. The premiums would reflect the objective risk of the property, and insurers would only provide coverage if homeowners paid a high premium or took verifiable steps to mitigate their risk. The existence of the California Fair Plan allows homeowners in risky areas to avoid this reality by implicitly subsidizing their insurance costs. If no wildfires occur, the homeowners face no consequences. Still, when a wildfire does strike, the rest of Californians end up shouldering the financial burden since those on the Fair Plan benefit from a system that doesn't encourage preventive measures.

Another policy that has hindered adaptation to climate change is the imposition of price ceilings on insurance premiums by California and other states. When insurers classify certain areas as risky but can't charge adequate premiums to ensure profitability, they may stop offering insurance entirely. This leads homeowners in high-risk areas, like the Pacific Palisades, to rely solely on the California Fair Plan, which lacks the price signals and incentives that for-profit insurers would provide to encourage adaptation. A for-profit insurer could incentivize homeowners to invest in protective measures.

If insurance rates are high enough in risky areas, economic development would move away from such areas and concentrate in relatively safer areas. Due to progress in climate science, we now better understand which locations are particularly vulnerable to heat waves, wildfires, and flooding. Identifying more temperate areas that face lower risks would allow us to change local land use regulations, encouraging development in those regions. This could improve adaptation to flood and fire challenges. This point highlights that the insurance industry can be the "adult in the room" if regulators do not impose artificial constraints on the

market. The amount of economic activity that can move to relatively safer places hinges on land use regulations in these areas.

Local land use regulations have also contributed to the Los Angeles disaster. Much of the city is zoned for single-family housing, limiting land use. Although there is land in lower fire-risk areas, such as Santa Monica, much of it near the beach is designated for single-family homes. Without such zoning regulations, some property owners might sell their land to developers who would construct multi-story apartment buildings. This could provide affordable housing options and allow more people to live in safer areas. However, the restrictive zoning in Southern California's beach areas diminishes these development opportunities.

During the wildfire crisis in Los Angeles, there were also issues related to the fire department's access to water and the placement of water resources. Water is often perceived as a free good when we turn on the tap, but during the crisis, critical reserves were low due to maintenance work on a key reservoir. This situation raises broader questions about property rights related to water resources. If California's farmers have the property right to purchase cheap water, why can't they sell some of it to communities such as the Pacific Palisades so that these communities have the resources to fight wildfires?

Disaster Adaptation

If we can understand what caused the 2025 LA Wildfires, we can reduce the chances of history repeating itself. One of my goals is to illustrate the consequences of seemingly independent policy choices that impact our ability as individuals and businesses to cope with new risks.

It is time to reconsider phasing out certain subsidies and regulations that contribute to these outcomes. Phasing out these rules is easier said than done, as they have created winners—like farmers who benefit from access to cheap water. These beneficiaries will strongly resist any attempts to change the status quo. We need to understand the unintended consequences of the current rules and regulations, which hinder our ability to adapt to weather risks.

I explore what set of incentives promote proactive adaptation to natural disaster risks. In any economic setting, building up skill facilitates making progress. If more of us can develop the skill to be proactive and aware of emerging risks then this helps us to adapt to such risks. While we always face some risk, if we develop resilience skills then this lowers the risk that we face great danger from flooding in North Carolina or wildfires in Los Angeles from recurring. By altering the microeconomic incentives for adaptation, we can break the cycle of history repeating itself.

Econ 101 theory and recent empirical findings help to convey when and why government policies often backfire and hinder our resilience to extreme weather. Throughout this book, I will examine the unintended consequences of government rules and regulations. I contribute to the debate on the proper scope of government in daily life. One can question government intervention without veering into endorsing anarchy! The free market environmentalism perspective acknowledges that there are public goods such as weather data collection and there are economies of scale in creating a knowledge database for informing private sector choices by firms and households. Ideally, government actions are complements (not substitutes) for private markets. I will return to this theme repeatedly below.

If climate change is exacerbating such extreme weather conditions, then it is even more important to consider policy reforms to unleash market forces to help us prepare for enhancing our individual and collective resilience. In his 2018 Nobel Prize lecture, William Nordhaus explicitly models the economics of climate change. He introduces a mathematical model that includes an equation representing the world's dynamics of greenhouse gas emissions released. He then relates this dynamic variable to the warming of the world (Global Warming). In the final mathematical equation, he introduces the climate damage function such that as the world warms, our global per-capita income declines. In his statement of the problem, this climate damage function never shifts. It is an immutable "law of physics". I reject this claim.

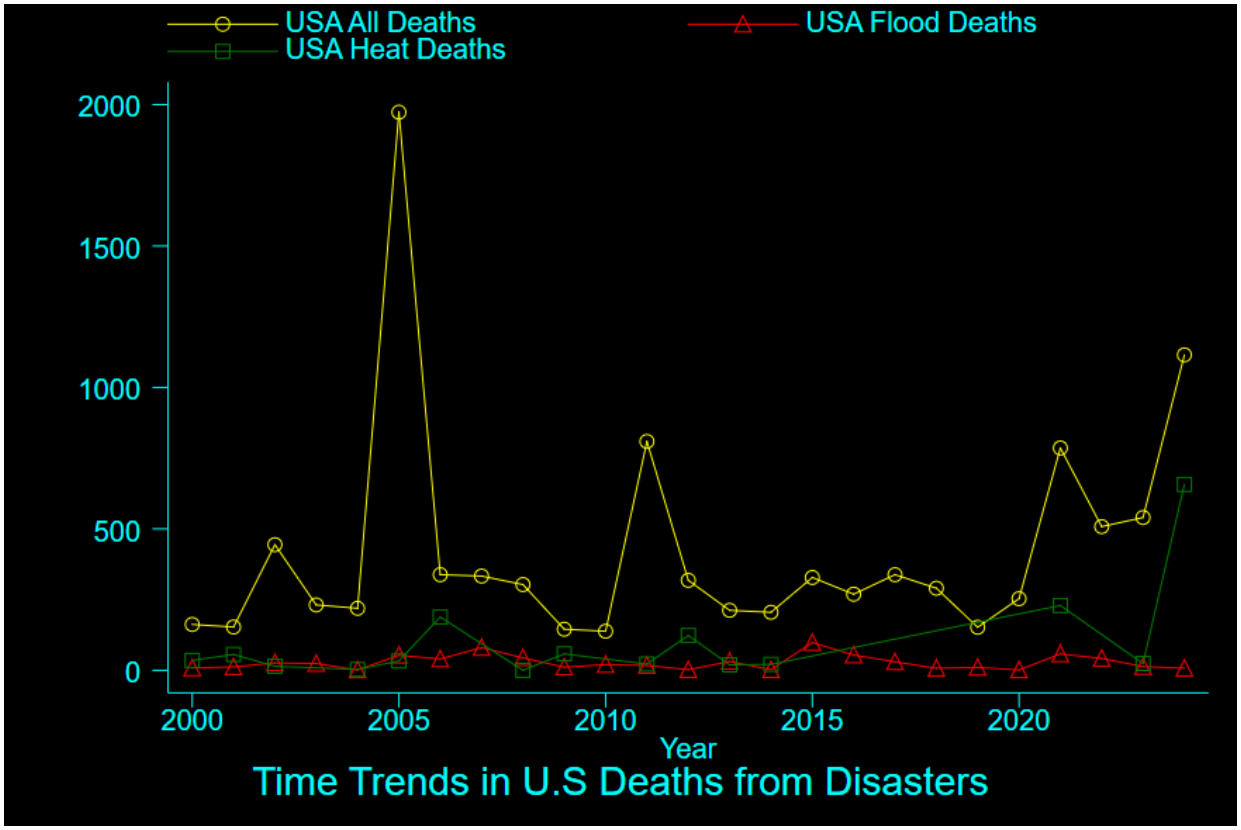
Throughout this book, I will argue that the damage caused by extreme weather to our health, productivity, quality of life and to our economic productivity hinges on what rules and regulations are in place and set by government. If market price signals are allowed to freely operate without the muffling effect introduced by government, then the risks from extreme weather will sharply decline.

Chapter Two Disaster Risk Exposure Time Trends

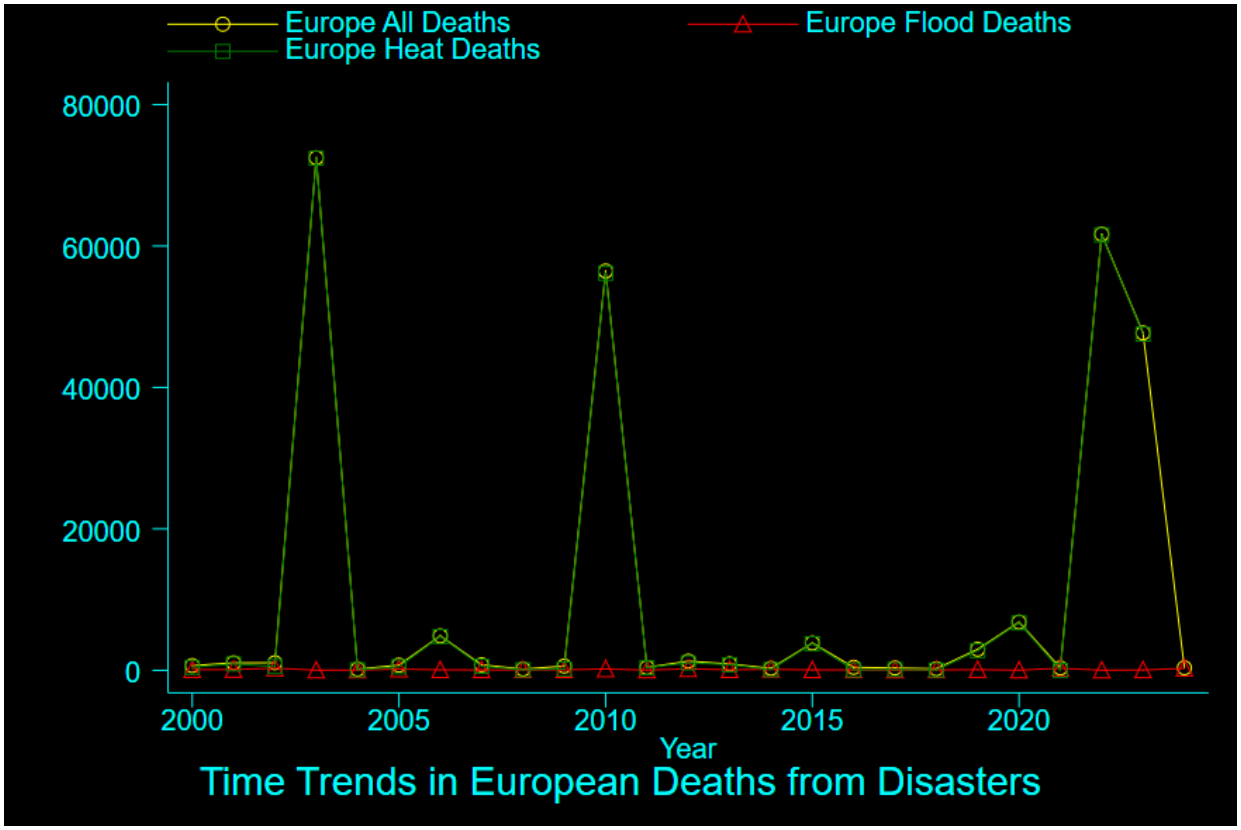
Time trends in the count of events and the overall death toll from extreme weather events offers a type of Rorschach Test. For over twenty years now, I have been researching the costs of disasters both measured in terms of death risk and the costs to property owners, businesses and local governments such as cities that are hit with a hurricane.

In one of my earliest projects on disaster adaptation, I documented the significant reduction in the death toll from natural disasters. I argued that economic growth in the United States and globally plays a causal role in this decline, both in absolute numbers and when adjusted for the population at risk. More prosperous nations have better protective infrastructure, more effective disaster relief, improved healthcare, and healthier populations that are more resilient in the face of shocks. Rich people benefit from better housing and access to modern technology, which enhances their awareness of impending disasters. For instance, the 2004 Asian Tsunami resulted in hundreds of thousands of deaths. However, in recent years, advancements in emergency alerts and the widespread ownership of cell phones have greatly improved our capacity for learning about impending disaster risks in real time. We are now informed several days before imminent disasters, allowing us to take protective measures.

In the following Figure, I use data from EM-DAT to present the U.S death count from natural disasters for each year since 2000.



In a nation with roughly 340 million people, fewer than 1000 people died in each year from natural disasters. Contrast these trends with time trends across Europe.



Note the difference in the scale of deaths with more than 50,000 deaths taking place in 3 different years.

While the overall death toll from disasters is decreasing, catastrophic events still impose significant economic costs, as evidenced by the Los Angeles fires, Hurricane Sandy, and recent storms in North Carolina. When researchers assess events like these more soberly, they reference the "bulls eye effect." In areas such as Los Angeles, the total value of the real estate stock is over $1 trillion dollars. We have built up a huge amount of capital in locations that face disaster risks. When shocks occur, they do injure this capital stock. The extent of this injury depends on how much capital we invest and the quality of the capital we invest and the incentives we have collectively introduced to protect that capital.



See the work of Stephen Strader and Roger Pielke.

We are choosing to live our lives and invest our capital in areas that face risks. Consider Los Angeles County. The median home's value in March 2025 is roughly $900,000 and there are millions of homes in the area. Zillow provides the time trend in home prices in Los Angeles County. Using basic algebra, if 1 million people live in an area that faces a 1% risk of destruction each year and each home is worth .5 million each, then the expected loss from disasters each year equals; 1 million*.01*.5 million = 5 billion per year.

Over time, as economies grow, people are richer and they invest more in real estate. These assets do face place based weather shocks. As more people own more valuable real

estate, the ex-post damage caused by a wildfire or a hurricane can rise. It is important to note that research has documented that the ratio of damage/local value of capital is declining over time. This is evidence of increased resilience.



source:

A shock that knocks out 1% of the structure value will thus have an enormous price tag. Note that in this picture that in the aftermath of the Los Angeles Fire, that home prices have so far remained at their trend level. People continue to bet that Los Angeles has a bright future and

the decrease in the housing supply in certain neighborhoods that experienced the fire has only led to higher local home prices in the short run.

Playing Defense

When we hear about storms causing damage in Los Angeles, Miami or North Carolina, the social scientists ask “why”? In this book, I argue that much of these costs stem from existing regulations. These rules have perverse effects that slow down our adaptation efforts, it is essential to recognize the overall trend: society is improving in its ability to adapt to risks despite some misguided federal, state, and local policies.

As we grow richer we are increasingly willing to pay for safety. Every society grapples with how much safety individuals genuinely desire and what sacrifices they are willing to make to achieve a given level of safety. For example, if you have a child, do you "bubble-wrap" her to ensure she never gets hurt? Or could that approach inhibit her development? Should she wear mittens to avoid touching a hot stove? Determining the optimal amount of safety to invest in has a Goldilocks element—most people are risk-averse and seek protection, which they are willing to pay for. This can be seen based on revealed preference evidence such as when people invest in security measures like alarms or personal defense classes or even buying a gun. Individuals might avoid going out at night if they perceive an area as dangerous. We regularly make costly decisions as we balance our desire to live freely against the need to ensure our safety.

Similarly, when it comes to adapting to risks from natural disasters, a question arises: how much risk are you willing to accept? If you want to ensure your house never burns down, do you spend more to build it out of fire-resistant materials? Numerous choices are available to protect against hurricane winds and flooding, but such events do not occur on most days. Of course, we want it all—we wish to live comfortably while minimizing risks but we also hope that somebody else pays the bill of us. We want a “free lunch”! In the real world, there are no “free lunches”, thus we constantly confront having to ascertain the probabilities of severe

scenarios, and the need to plan for these contingencies. This prompts the question of what steps we take to protect ourselves.

Our Rising Demand to Face Less Extreme Risk

We aspire to live long, happy lives. Natural disasters presently claim relatively few lives. Still, in a wealthy nation, we have built up our assets in areas susceptible to flooding, fires, and hurricanes. While these disasters can inflict substantial damage, it is often relatively small compared to our annual Gross National Product (GNP) of $22 trillion. If a disaster causes $10 billion in damage, that may sound enormous. However, considering our $22 trillion economy, that damage is merely a drop in the bucket.

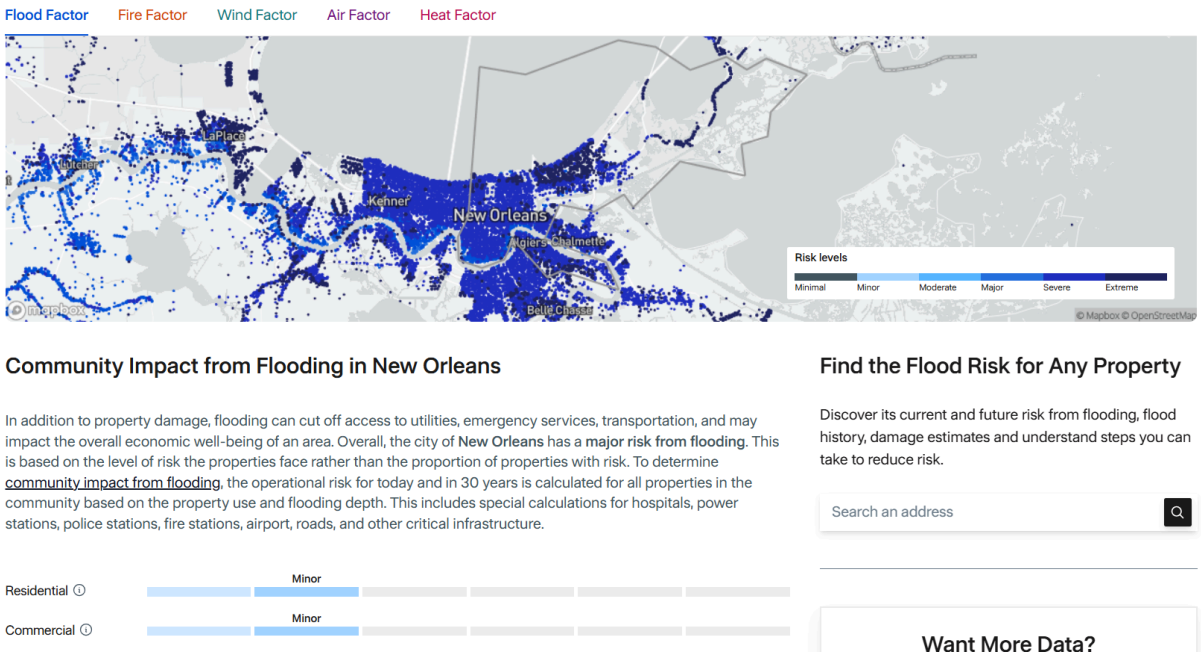
Some of us are risk-takers. In Las Vegas, for example, people fly in to gamble, demonstrating that not everyone is risk-averse. Some individuals are risk-neutral, while others are risk-loving. A risk-neutral person is indifferent between receiving $200 for sure or having a 50% chance of being paid $400 and a 50% chance of being paid $0. Both have an expected value of $200. A risk-loving person and their family might think, "Statistically, there are 99 good days in Miami for every one day with a terrible hurricane. So, I won't invest much in protecting myself from these risks."

A major time trend is that per-capita income continues to grow all over the world. This increase in prosperity increases our demand for safety and resilience and increases our ability to pay for such strategies. In my 2003 work with Dora Costa, we have documented that people are willing to pay more for safety as they become wealthier. This relationship is significant; for instance, if a nation's GNP increases by 20%, the average willingness to pay to avoid risk can increase by more than that, potentially by 32%. We used data from 1940 to 1990 and documented that U.S workers who work in industries with greater fatality risk (think of mining and construction) are paid a higher wage over time to attract them to do this work. This is the equivalent of finding that "combat pay" is rising over time at a rate faster than national GDP growth.

Due to progress in climate science, we have an increased understanding of where these risks are concentrated and can map these. So, just as you can make a map of which areas have

plentiful sunshine and which areas have good golf courses that have a lot of rain, we have an increased understanding of which areas face flood and fire risk.

For example, here is a spatial flood risk map for New Orleans provided by the First Street Foundation.

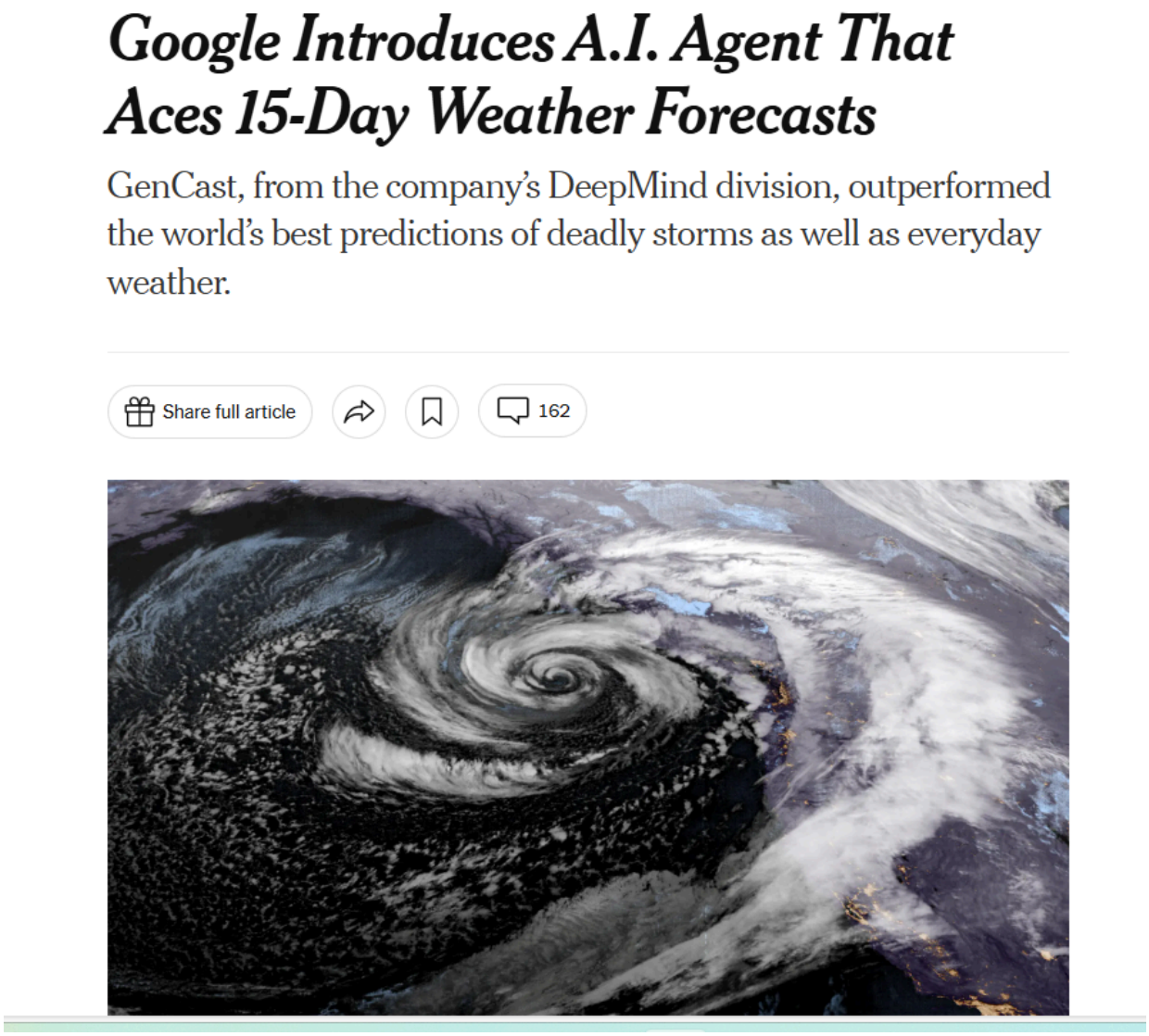


I post this map in this Trends chapter because an emerging trend is our increased understanding of the spatial risks we face. It is important to recognize that First Street's map is based on a statistical model and there are inherent uncertainties associated with any prediction. If First Street's map is correlated with objective reality and if people recognize that these maps are not perfect, then this type of information informs decision making and facilitates resilience. Nobody can claim these days that they are unaware of the risks they are choosing to face when they buy a property in a given location. Buyer Beware!!

Individuals can make better decisions regarding where to live and what type of roof to have on their homes if they know the emerging time trends in tornado risk. If higher-quality forecasts are developing due to advances in weather science, individuals considering a move to a tornado-prone area in Georgia, who recognize their lack of knowledge about potential risks, will be better informed moving forward because of these scientific advancements.

The Rise of AI and Spatial Data Collection Fosters Disaster Resilience

A major resilience trend now playing out is the improvement in data collection, and computing and the personal skill to use these inputs to make ever improving weather forecasts.



Google Introduces A.I. Agent That Aces 15-Day Weather Forecasts

GenCast, from the company's DeepMind division, outperformed the world's best predictions of deadly storms as well as everyday weather.

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We have been assessing risks for millions of years. In the distant past, Neanderthals had to predict which areas had predators, like lions, that could eat them. Smaller dinosaurs were also attempting to determine where to go to avoid a T-Rex. If you encountered a T-Rex, how

could you avoid being eaten by such a gigantic creature? We have always engaged in threat assessment and updating our awareness of threats; to thrive, we must survive.

Even before we had artificial intelligence and complex data algorithms, we were forming probabilities about where the risks lie, identifying safe routes, and strategizing how to survive amidst a crisis. This serves as a preamble to discuss the Big Data revolution. We have been forming real-time expectations in our heads for a long time.

For example, at the start of a chess game, you might think that winning is a 50/50 proposition. However, the situation becomes more apparent as the game progresses and the moves play out. If White is up by a knight, it suggests that White is likely to win, and this probability assessment will influence how Black plays its next moves. Black might adopt a more offensive strategy because, under normal circumstances, a defensive play will simply lead to a loss.

In the case of disaster resilience, a necessary condition is being aware of the actual threat. You are less likely to adapt if you are blindsided by a situation you never anticipated. A classic example is the Titanic hitting an iceberg. It would have changed course if it had seen the iceberg in time. If it had anticipated before setting sail that it could sink due to an iceberg, it would have had more lifeboats available. This is a basic example of resilience, which involves planning or noticing challenges midway through and adjusting accordingly. We live in an age where more data is being collected than ever, thanks to the proliferation of cheap sensors. We have satellites deployed and sensors measuring weather data in real time.

There is a critical question regarding who is responsible for collecting this data, how it gets processed, and how the predictions made from these models are shared with stakeholders. For instance, consider a city in a tornado zone. If the mayor in this place had access to a trusted prediction model that indicated the probability of a tornado striking the town was over 2% in the next two weeks, he would have a strong incentive to alert the community. Residents could take personal precautions, and emergency responders could be prepared. If a tornado were to materialize, which remains a variable, it would result in less damage if the town anticipates the threat.

Contrasting Coffee Quality and Weather Forecasts

This is an example of how local leaders, whether they be mayors, CEOs of firms in tornado-prone areas, or homeowners wanting to fortify their roofs and windows, all seek updated probability assessments. People often desire certainty in their lives. They are willing to pay for high quality, real time information. Will the market supply such services? If people seek high quality risk information but unscrupulous individuals supply low quality weather risk forecasts, then there could be disastrous consequences.

If Starbucks ever tried to sell you low-quality coffee for an inflated price of $4, you would immediately feel ripped off. The coffee wouldn't taste good, and it might even give you a stomachache. You would recognize the low quality right away and never return. Market competition works effectively in situations like this, where customers can frequently assess a product. If a company dared to sell an inferior product at a high price, it would quickly be caught. Such a company would suffer damage to its reputation. Firms aiming to maximize their long-term profits understand that selling low-quality products at high prices may generate short-term gains, but they would ultimately lose their reputation. Poor reviews on platforms like Yelp would deter future customers from returning to a store known for ripping them off.

Now, let's consider climate forecasting. Does the same optimistic logic apply? The optimistic view holds that competition among firms results in high-quality products and relatively low prices for that quality. I envision a similar competition in the realm of weather modeling—just as coffee shops compete with one another. I want transparency from weather modeling companies. Those predicting severe weather events, such as heat waves and tornadoes, should communicate their methodologies. This transparency would allow objective academic scientists to critique their models' raw inputs and provide predictions.

A New Super Bowl Tournament!

I propose a "Super Bowl" where weather prediction firms compete, judged by outside experts from institutions like MIT or Stanford. These models will be compared to see which delivers the most accurate forecasts over a set period. This type of competition would eliminate chance and ensure that the models are genuinely effective. For example, imagine a competition where, over five years, modelers predict the number and severity of extreme weather events in different geographic regions. A random coin flipper might make some correct predictions, but with enough events to predict and rigorous criteria for spatial and temporal forecasting, the

probability of success simply being due to luck approaches zero. This process communicates the accuracy of the models, allowing the best model to emerge victorious, much like the winning team in a Super Bowl. High-quality data, fast computers, and intelligent analysts would lead us to better predictive models.

The value of a better prediction depends on the counter-factual or the “what if” Without this modeling, what probability distribution would decision-makers—whether they are mayors or business leaders—have? Did they have a uniform probability distribution? With a model in hand, do they see spikes in space and time, indicating risk for specific events? This brings us to the concept of Bayesian Updating. The value of disaster risk information hinges on one’s baseline beliefs about the world. How does new information inform your worldview, and how do your decisions rely on that worldview?

Type 1 Versus Type 2 Prediction Errors

Will you be ready when Mother Nature strikes—such as when a tornado strikes South Carolina in March 2026? Considering the uncertainty involved, did you take the necessary and sometimes costly steps in preparing for disasters? There are two key points to consider. We wish to live in a world where, if a tornado is approaching, the at-risk entity anticipates it, perceives the risk accurately and is prepared. We also hope to live in a world where, if the model predicts that no disaster is forthcoming, that prediction holds. This notion resembles a "Santa Claus classification" because, in such a scenario, the firm or entity won't engage in unnecessary preparations, like declaring a town emergency when there's none required.

However, decision-makers operating under uncertainty often make Type I and Type II errors. A Type I error is assuming that everything is safe when, in fact, there is an approaching risk. This is akin to a court trial in which a suspect is falsely declared innocent while being guilty. Conversely, a Type II error occurs when an innocent person is executed. As such, decision-making under uncertainty raises the question: Do you prefer to make Type I or Type II errors? The value of information serves to help you better classify scenarios into high-risk and low-risk categories while also preparing for the possibility of making mistakes. Especially regarding natural disasters, there is likely to be an asymmetric loss function among leaders and

public-sector bosses. They may prefer to over prepare—building taller bridges, making investments, or stockpiling sandbags—because under-preparation can be costlier.
This leads to our final topic: accurate information is necessary to prepare for disasters. Returning to models and knowing when a risky scenario emerges is crucial.

Improvements in data collection and data analysis through the rise of Machine Learning are synergistic with our own skills in stating hypotheses and imagining different scenarios. A powerful imagination helps us to adapt to disaster risk because it helps us to anticipate scenarios that we have never experienced before. In this sense even Science Fiction helps us to become more resilient. I see a synergy here between improved data collection, data analysis and the rising educational attainment of the population.

A more educated populace is more sophisticated in analyzing risks. As a professor, I believe that education has a causal effect on improving problem-solving abilities. For a time, there was an old belief that obtaining a degree, such as an MBA from Harvard Business School, signaled intelligence. However, the alternative view suggests that education enhances one's problem-solving skills. Given that weather trends indicate an increase in extreme weather events, being better problem solvers—whether as family members, employees, or in everyday life—will help us adapt to these risks at a lower cost.

Concerning Time Trends

There are concerning trends that hinder our ability to withstand extreme weather events. First and foremost, the U.S. population is aging in almost all nations except for those in Africa. An aging population faces resilience challenges on several fronts. Older individuals are generally more frail and many are experiencing cognitive decline. They are at an increased risk of morbidity and mortality during extreme shocks such as flooding, hurricanes, extreme heat, and pollution outbreaks.

Additionally, older people tend to be more set in their ways. Studies show that people's willingness to migrate within and across states declines with age. As a result, an older population is more vulnerable to extreme weather events and less inclined to take proactive measures to protect themselves from such shocks.

While many older adults have family and friends who care about them and look out for their well-being, the reality is that the responsibilities of life make it challenging for these networks to provide constant support, especially in a large nation like the United States. Consequently, older people may be at heightened risk during extreme weather events. Factors such as mobility issues and the possibility of not having a driver's license make it even more difficult for some older adults to evacuate or seek safer locations.

In the U.S., the rise of conditions like Alzheimer's, hypertension, and type 2 diabetes among senior citizens further compounds this issue. A growing group of seniors with pre-existing health problems will have trouble adapting to the challenges posed by extreme weather and are more likely to remain in their current locations rather than migrate to safer areas.

Some Overlapping Generations Optimism About Finding "Higher Ground"

When studying demographics, researchers often categorize generations as young, middle-aged, and old. In an overlapping generations model, today's youth will become middle-aged, and the subsequent generation will eventually grow old. As we look ahead to 2025, we see that the older population in America, comprising individuals born between 1925 and 1955, is significant and continually growing. What is particularly interesting to economists is that there is always a new generation of young people who have yet to establish roots.

If certain parts of the United States face significant weather challenges—and especially if these areas fail to adapt due to factors such as topography or governance—it is likely that young people will choose not to move there. Moreover, young people already residing in those regions may decide to relocate elsewhere. While elderly individuals are often stuck in place due to their established social networks, younger generations, including recent college graduates and immigrants, are just starting their lives and have the flexibility to choose where they reside. If young people systematically seek out relatively safer locations, then over time more people will live in safer parts of the United States. New housing will be built in such places. In this sense, self interest motivates young people to factor into their location decisions their disaster safety. Just as people seek out low crime neighborhoods, they also have an increasing incentive to seek out lower disaster risk areas.

Since the United States is geographically vast and faces different challenges across its regions, declining quality of life in certain areas will become common knowledge. Such areas are likely to see fewer immigrants moving in and young residents moving out. Returning to essential supply and demand principles would lead to decreasing demand for housing in regions that do not adapt to emerging weather trends, ultimately causing rents to decline. In this scenario, there will be winners and losers. Renters who remain in these areas may experience a decline in quality of life, but they could be partially compensated by paying lower rents. Long-time homeowners, such as senior citizens who own property in these locations, may lose property value as demand decreases.

People versus Places

Throughout this book, I focus on how disasters affect people and firms. I am well aware that disasters strike places such New Orleans or Pacific Palisades and thus they affect people if they live there or have family who lives there or are thinking of moving there. In my past work, I have studied how shocks affect places. Here is one paper, we published in the Journal of Urban Economics.

Journal of Urban Economics
Volume 134, March 2023, 103516

Local public finance dynamics and hurricane shocks ☆

Rhiannon Jerch [a], Matthew E. Kahn [b c], Gary C. Lin [d]

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Abstract

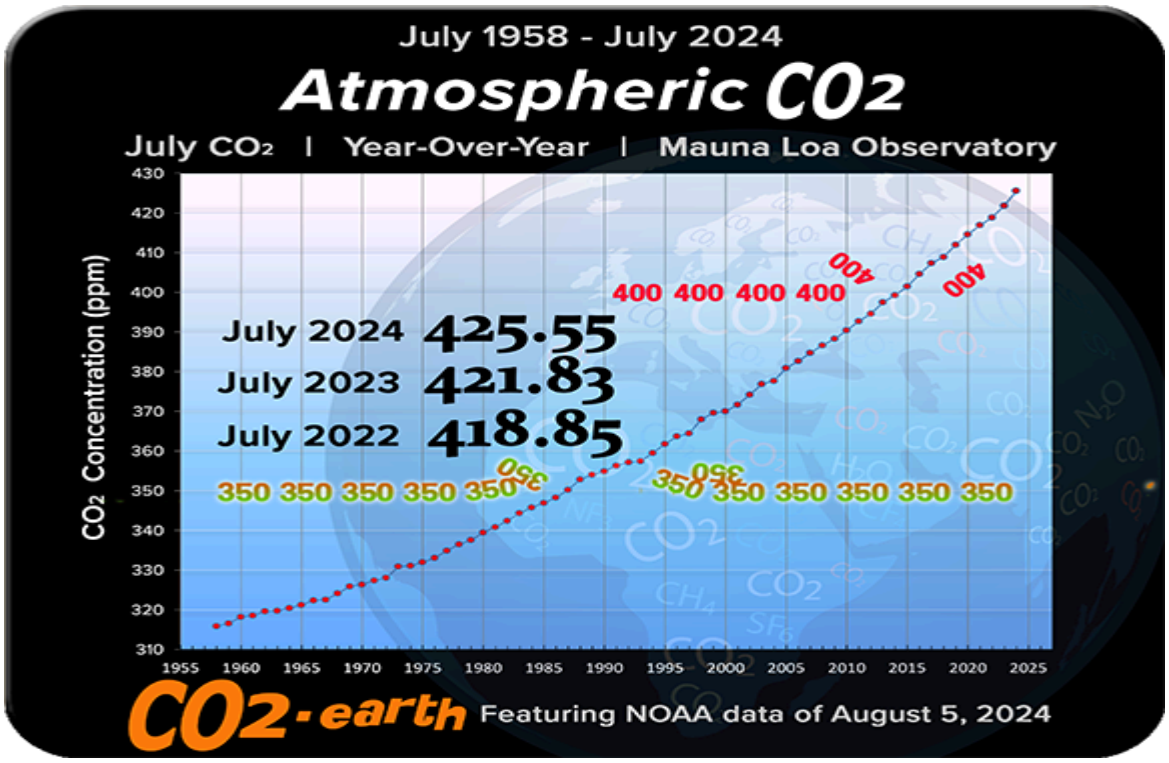
Since 1980, over 2,000 local governments in US Atlantic states have been hit by a hurricane. We study local government fiscal dynamics in the aftermath of hurricanes. These shocks reduce tax revenues, public expenditures, and debt financing in the decade following a hurricane. Hurricanes create collateral fiscal damage for local governments by increasing the cost of debt at critical moments after a strike. Municipalities with a 1 standard deviation-above-average racial minority composition suffer expenditure losses more than 2 times larger and debt default risk 8 times larger than the average municipalities in the decade following a hurricane strike.

source

We find that poor Minority cities suffer more from disasters and recover more slowly. Our work raises the issue of when a disaster strikes a shrinking city such a shock accelerates the downward decline of such a city. A type of self-fulfilling prophecy may emerge as expectations about the place's decline influence investors who are thinking of investing in the place. If they do not invest and if skilled young people move away then this accelerates the shocked cities decline.

The Climate Change Challenge

It is a fact that greenhouse gas concentrations continue to rise over time. The next Figure shows an almost linear relationship over the last 70 years.



Despite all of the excitement around the decarbonization of the U.S economy, global growth in population and per-capita income has caused ever rising greenhouse gas emissions levels. What we do not know is how these higher concentration levels translate into a greater quantity and ferocity of natural disasters. In the next chapters, I will argue that the production of risk from future wildfires and storms and heat waves depends on the market "rules of the game" that cities, states and the Federal Government adopts. The same extreme weather event causes much less damage if we have invested to prepare for the shock.

Chapter Three: Fat-Tail Economic Risk

On most days, nothing terrible happens.

Economic analysis often focuses on the rhythms of ordinary life: waking up, sharing breakfast with loved ones, heading to work or school, completing daily obligations, and carving out time for family, friends, or leisure. We have only twenty-four hours in a day, and every decision involves tradeoffs. Sleeping an extra hour, enduring a longer commute, or paying a premium to live near the beach or in a vibrant city neighborhood all require sacrificing something else—time, money, or convenience. Most of life feels predictable and manageable.

Disasters remind us that this sense of stability is fragile.

In Chapter One, we examined the Los Angeles wildfires, and we will return to them throughout this book. Disasters—whether natural, economic, or man-made—are rare events, but they are never absent from the background. Wildfires, floods, hurricanes, financial crises, wars, and terrorist attacks occur infrequently, yet when they strike they can impose enormous costs. They threaten lives, destroy property, disrupt communities, and create losses that dwarf the concerns of ordinary days.

Because disasters occur so rarely, economists once paid relatively little attention to them when explaining everyday behavior. That has changed. One of the most important developments in modern economics has been the recognition that the possibility of rare but catastrophic events can influence decisions long before those events occur.

Consider one of the field's most famous puzzles: the equity premium. Historically, diversified stock portfolios have earned average annual returns of roughly 7 percent, while relatively safe government bonds have earned only 2 to 3 percent. This persistent gap of roughly five percentage points has puzzled economists for decades.

The arithmetic is straightforward. If an asset rises in value from $100 to $107 over a year, its return is 7 percent. Over long periods, stocks have indeed generated substantially higher returns than bonds. The mystery is why investors have demanded such a large premium. Standard models of risk and return predict a much smaller difference because year-to-year fluctuations in stock returns do not appear large enough to justify the observed reward.

The leading explanation focuses on disaster risk.

Investors are not concerned only with ordinary fluctuations in asset prices. They also worry about the possibility of rare economic catastrophes. A severe depression, financial collapse, or geopolitical shock may occur only once or twice in a century, but when it does, stock prices can fall dramatically while safer assets retain much of their value. Investors therefore require compensation today for bearing the possibility of those extreme future losses. Historical episodes such as the Great Depression or the stock market crash of 1987 illustrate the type of downside risk that investors fear. Asset prices reflect not only what usually happens, but also what might happen in the worst states of the world.

This observation raises a deeper question. How do people form beliefs about rare events?

Individuals differ dramatically in their perceptions of risk. Some behave as if the probability of disaster is effectively zero. Others—the proverbial Chicken Littles—see danger around every corner. Most people fall somewhere between these extremes, updating their beliefs based on personal experience, media coverage, expert forecasts, and conversations with others. Economists and psychologists have long studied whether people systematically under- or overestimate low-probability, high-consequence risks.

One influential explanation is the salience hypothesis. After a vivid disaster such as the Los Angeles wildfires, images of destruction dominate the news, conversations focus on the event, and physical evidence of the damage remains visible for months or years. As a result, the probability of another disaster feels much higher than it did before the event occurred. Residents of communities such as Altadena or Pacific Palisades may temporarily overestimate the likelihood of another major fire in the near future simply because the recent disaster is so easy to recall.

In the context of natural disasters, this tendency can sometimes be beneficial. Overestimating wildfire risk may encourage homeowners to clear vegetation, purchase insurance, harden their homes, or support investments in resilience. These precautions are costly, but they also reduce vulnerability. Underestimating risk, by contrast, can leave households and communities dangerously exposed—especially if climate trends are increasing baseline hazards over time.

The opposite mistake may be even more consequential. If people treat disaster risk as negligible, they will concentrate in precisely those locations that are most attractive and productive yet also most vulnerable. Coastal communities, riverfront properties, and homes located at the wildland-urban interface often offer valuable amenities that attract residents and businesses. When disaster risk is ignored, more people move into these "bull's-eye" locations, increasing the potential damage when a disaster eventually occurs.

Fortunately, advances in information technology are making it increasingly difficult to ignore risk. Private forecasting firms, satellite monitoring, machine-learning models, and social media have dramatically expanded access to real-time information about weather and climate hazards. While no forecast is perfect, better information reduces the likelihood that large populations systematically underestimate the risks they face.

This chapter explores how societies assess, price, and adapt to rare disasters. We will examine why low-probability events play such an important role in economic decision-making, how individuals form beliefs about extreme risks, and why public policies sometimes reduce resilience rather than enhance it. Throughout, a central theme will emerge: disaster losses are not determined by nature alone. They depend on the incentives, institutions, and expectations that shape human behavior long before disaster strikes.

The O-Ring Hypothesis and Lessons from Japan

I would like to link natural disasters to economic disasters by briefly discussing this paper.

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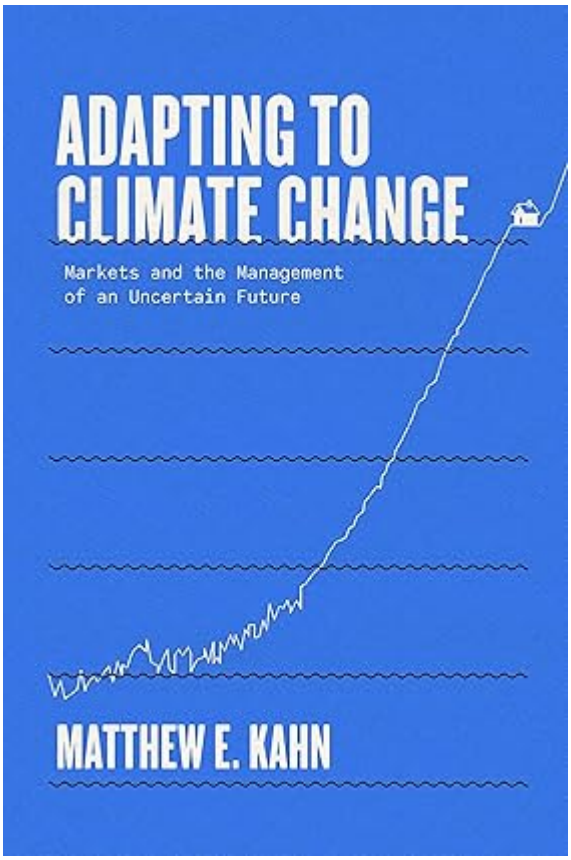
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Abstract

Exploiting the exogenous and regional nature of the Great East Japan Earthquake of 2011, this article provides a quantification of the role of input-output linkages as a mechanism for the propagation and amplification of shocks. We document that the disruption caused by the disaster propagated upstream and downstream along supply chains, affecting the direct and indirect suppliers and customers of disaster-stricken firms. Using a general equilibrium model of production networks, we then obtain an estimate for the overall macroeconomic impact of the disaster by taking these propagation effects into account. We find that the earthquake and its aftermaths resulted in a 0.47 percentage point decline in Japan's real GDP growth in the year following the disaster.

This paper highlights the O-Ring idea from economics that posits that there are cases where a production network is only as strong "as its weakest link". Consider a case of an Apple iPhone factory that relies on a single provider of computer chips based in Taiwan to make the iPhone. If a storm destroys that factory, then Apple cannot make the iPhone. It made the mistake of being completely reliant on one factor in a given location. It did not have a spatially diversified supply chain. This saved it money in terms of not having redundant input suppliers but it created rare disaster risk for the firm. The paper from Japan finds a similar finding that Japan's macroeconomy was injured by a place based shock (the Earthquake) because of how the nation configured its supply chains. This paper documents that even regions within Japan that did not experience the shock were injured by the shock if they relied on receiving key inputs from regions that were affected by the shock. While I find this paper to

be very interesting, I do not believe that it has important implications for the U.S economy. Major firms can hold inventories and can diversify their spatial supply chains to reduce their O-Ring risk. In fact, the expectation that disaster risk is rising actually gives such firms an incentive to make precautionary investments in resilience that lower their ex-post disaster risk exposure. Permit me to give an example. Suppose that Google relies on a data center in Idaho and there is a 1% chance that it will be destroyed each year by a disaster. Suppose that by paying $100 million dollars, Google can build a 2nd data center in New Mexico. If the probability that the Idaho data center is destroyed increases to 2% (perhaps because of climate change), then Google is **more likely** to build the New Mexico data center. The probability that data centers are knocked out = .01*.02 = .0002 and this is a very small number. This example highlights how the fear of disaster triggers forward looking investors to invest in resilience and this protects them from future disasters. This is the microeconomic logic of adaptation! If this interests you, read my 2021 book!



Will the Trump Administration DOGE Cuts Increasing Rare Disaster Risk?

The Trump administration has reduced funding for NOAA, the National Oceanic and Atmospheric Administration. This cut was part of a broader initiative aimed at increasing government efficiency, prompted by the perception that NOAA was overly focused on climate change, leading some to label it as "woke." Advocates for NOAA argue that basic satellite data and weather information represent a public good. The private sector may free-ride on these services, underinvesting in essential public goods, which creates inefficiencies. It may not be necessary for multiple private-sector companies to operate their satellites, as we could tax these firms and maintain a single set of satellites for this purpose.

Going forward, will we face greater rare disaster risk because of the defunding of NOAA? An optimist would argue that private sector firms can work together to form a climate information club to launch private satellites to collect weather data and to then process the data and sell predictive models to the public. Just as we expect to pay for a Starbucks coffee, in the near future we may have to pay a fee to have access to weather forecasts to help us anticipate that a storm may occur in the next week or two.

A Calm Look at Rare Disasters

The death toll from natural disasters has fallen sharply in the U.S. Hurricane Katrina was awful but this event is the exception in recent years. When extreme events take place, fewer and fewer people die. Yes, shocks cause billion dollar losses but we have to remember that the U.S is a $22 trillion dollar economy. With this denominator, even these shocks seem small. Of course, if you lose your house and your life is upended then this is a major loss. The question arises concerning how our market economy both offers opportunities to upgrade assets so that they suffer less when shocks occur, how we create land use incentives so that more economic activity migrates to “higher ground” and when bad things happen to good people how do insurance markets and financial markets allocate capital so that vulnerable people who have purchased insurance receive their payments so they can start their rebuilding process. A vibrant market economy figures out how to supply goods that people want. If people want “peace of mind”, then entrepreneurs will help them with adaptation solutions. Of course, people want the

“free lunch” of not paying for precautions and not buying insurance and then when a shock occurs, they want a government check. An economic and philosophical question that we will discuss throughout this book is what is the social contract. What are people’s rights to disaster relief if they choose to not buy such insurance using their own resources?

Chapter Four The Free Market Perspective on Achieving Optimal Disaster Resilience

Under my proposed “rules of the game” for increasing our economy’s resilience in the face of natural disaster risk, people use markets with established rules, and courts enforce property rights. There are certainly cases when one neighbor can make a choice that impacts one’s nearby neighbors. For instance, if I plant a beautiful tree, my neighbors benefit. Conversely, if I put up a piece of art that I like but others find unsightly or detrimental to the neighborhood's character, my action imposes costs on my neighbors. I proceed by embracing the logic of the Coase Theorem that given that property rights are defined and enforced and that neighbors can communicate with each other, mutually beneficial transactions will take place.

With that framework in mind, let's consider how a free market economy can optimally invest in resilience in the face of risks such as hurricanes and wildfires. I want to divide this discussion into three phases:

1. **Before a disaster occur**s: If a community, such as Pacific Palisades, is aware of wildfire risks, or if certain areas in Georgia face tornado or hurricane threats, what proactive steps can be taken to mitigate the costs of such events?

2. **During a disaster**: I want to examine how markets contribute to protecting lives and stabilizing families amid disruptions, such as the fires ongoing in Pacific Palisades, starting in the first week of January 2025.

3. **After the disaster:** This phase involves rebuilding both the private capital stock and rebuilding impacted infrastructure. Ideally, there is also a reconsideration of the current rules and regulations so that in the future disaster shocks are less severe and cause less damage to life and property. This “silver lining” of disasters crucially depends on the lessons that people take from the salient shock.

As an economist, I find the interplay between these ex-ante (preventive) and ex-post (reactive) decisions exciting. Should we address disaster threats proactively by investing in infrastructure and encouraging individuals to move to safer locations or adopt sturdier construction? Or do we take our chances and rely on disaster relief to help us recover if a disaster strikes? Similar questions arise in the context of military threats. Should we build a robust military to prevent invasion or attack? If an attack does occur, what is the plan for recovery?

The moral hazard challenge arises when individuals believe that excellent post-event recovery plans are in place; this may lead them to invest less in avoiding potential challenges in the first place. The same issues are apparent in healthcare: Should we take proactive steps, such as exercising, quitting smoking, losing weight, and maintaining a healthy diet, to avoid health challenges? Or do we wait until we experience a health crisis, like a heart attack or stroke, before seeking the best doctors and recovery plans?

Before the Disaster

Some people with active imaginations are "all in" regarding investing in survival skills and other resilience investments. Here is a long quote from a March 2025 piece published in the New York Times by J. Wortham (a survivalist).

> "The word "prepper" usually brings to mind a bearded white man in head-to-toe Realtree camo, anticipating the next civil war while hunkered in a bunker, surrounded by automatic weapons, pallets of Dude Wipes and dehydrated meals. But over the last few years, the idea has drifted in from the margins: People with all sorts of ideological backgrounds are making plans for confronting an uncertain future.

“Today, a third of all Americans say they spend some part of their household budget on prepping. An analysis of FEMA data recently suggested that around 20 million Americans identify as “preppers.” About 7 percent of all households, roughly double the number from 2017, are “actively working on self-reliance.” Fear is now big business: They call it the Doom Boom. There are disaster consultancies, dozens of prep schools, guides and podcasts and YouTube channels where you can learn how to build a shelter from forest debris or tan a hide. A “timeshare” in a survivalist fortress (where you can vacation until the apocalypse comes) can be had for $20,000. If you’re ultrawealthy, you can make your own preparations: Sam Altman, the chief executive of OpenAI, has been stockpiling guns, gold, antibiotics, batteries, water and gas masks and says he has “a big patch of land in Big Sur I can fly to.” Mark Zuckerberg and Rick Ross are among the tycoons and celebrities who are building multimillion-dollar compounds — the kinds with indoor pools, wellness centers and underground escape tunnels that double as go-kart tracks.

My own awakening to prepping came in 2012, after Hurricane Sandy hit New York City. The weeks that followed were marked by extended power outages, flooded subways and fuel shortages. I volunteered with a group taking supplies and water to Red Hook residents who were stranded at the tops of housing projects. On Halloween night, two days after the storm hit, a friend and I crossed the bridge into a powerless, eerily silent Lower Manhattan, where people were cooking

over fires and congregating in candlelit bars. It was enough to prompt me to sign up for a workshop where a former firefighter in paramilitary gear taught me the basics of building a bug-out bag and how to escape the city by foot.

In the years since, I've taken self-defense classes, sewing classes, fermentation classes. I've trained in bystander intervention strategies and participated in mutual aid. I learned to sail, not only because I love being on the water but in case I ever needed to escape by sea. My mother, who kept a generous garden to supplement our pantry, taught me basic growing, composting and preservation techniques. I brushed up on my herbalism and learned about septic systems, carpentry and electric wiring. But even after years of study, basic skills eluded me: I had no idea how to make fire, find food and water, build shelter. I spend most of my time in New York, where nearly all the amenities of modern life are accessible on a nearby corner or through an app. "

This quote highlights how people can invest their time and effort to build up resilience skills and this helps them to prepare for anticipated risks.

Let's begin with the disaster anticipation stage. Suppose a family owns a home in Georgia that is known to have a tornado risk. There may be no government regulations determining the type of home they can build or the roofing materials they must use. Still, there are legal liabilities for any damages caused by their property. They are liable if something from their property flies away and damages a neighbor's house.

In such a scenario, the homeowner faces a decision: should they gamble on building a cheap home with a flimsy roof, knowing that if it flies off in a tornado, it could cause significant damage to their house and potentially injure a neighbor's property? The homeowner must consider the risks and the probability of an extreme tornado occurring next year. If the national probability is nearly zero, but it is 2% per year in their Georgia county, they would be incentivized to explore strategies for protecting their structure.

Investing in resilient strategies will incur costs, and homeowners must face trade-offs. They could spend nothing on preventive measures, saving money in the short run. However, if a disaster occurs, they could face hefty penalties: substantial damage to their home and liability for injuries or damages caused to adjacent properties.

Therefore, homeowners would have strong incentives to research any emerging risks continuously. This demand for information would create competition among providers to inform decision-makers. Homeowners who recognize the risks in their areas—whether from wildfires, air pollution, or storms—would seek market solutions to mitigate these threats. They would conduct their research, leveraging the internet and trusted consumer reports to find cost-effective risk mitigation products.

Over time, as seen with various products—such as color televisions replacing black-and-white models or the rise of cell phones and personal computers—sufficient demand drives innovation and improvement in solutions for mitigating risks.

During the Disaster

Amid a disaster, whether it’s a flood or a wildfire, people are caught up in the moment and focused on survival. They are part of families and are concerned for their own safety and for protecting children, relatives, and elderly parents. Information technology is crucial during a crisis because it facilitates real-time coordination and communication through social media. It helps individuals stay updated on important issues like the location of floodwaters or wildfires and where higher ground may be found. This real-time information saves lives, and fosters hope by providing a clearer understanding of the challenges and their timing for families who have survived the initial shock.

In the immediate aftermath of a disaster, individuals face urgent questions about what assets to grab from their homes while coping with the shock. There are also issues regarding using mobile money for those who are cash-constrained. It's important to differentiate between the immediate impact of the disaster—surviving and accessing resources—and the subsequent dislocation to one's life, which raises additional concerns. Questions arise, such as where to sleep the following nights, what to eat, how to access necessary medications, and how to respond to others asking if they are okay.

In such challenging circumstances, people need basic necessities: to reunite with their families and access food, shelter, and medical care. There is often an interplay between individuals using their own funds—such as electronic bank accounts or credit cards—and friends wiring money to help. Government intervention during the crisis can help poor people by transferring cash to them through mobile money to allow them to buy essential goods.

People need access to electricity during a disaster and in the case of extreme weather or a wildfire the grid may be knocked out. For example, in the event of a wildfire, grid operators may shut down the electricity supply to prevent sparks that could ignite a fire. This raises concerns about the short-term costs imposed on those who rely on electricity for their daily lives and for businesses to operate.

Going forward, products such as the Tesla Powerwall and its competitors will enable individuals seeking access to decentralized backup power to purchase these solutions at a lower cost and with reduced local environmental impact. In the past, people typically relied on dirty diesel generators that contributed to significant local air pollution. In contrast, individuals can now charge battery packs.

Furthermore, people are more likely to own these batteries and install them in areas prone to power shutdowns. If the risk of power outages and an unreliable grid increases, individuals and businesses invest more in self-protection. In this context, one self-protection resilience strategy is to invest in battery storage. When individuals own batteries, they not only generate power for themselves but can also envision scenarios where communities jointly invest in batteries. Alternatively, a person with a large battery at home may sell excess electricity to others through a system that helps charge smaller batteries, allowing others to benefit during times of grid failure.

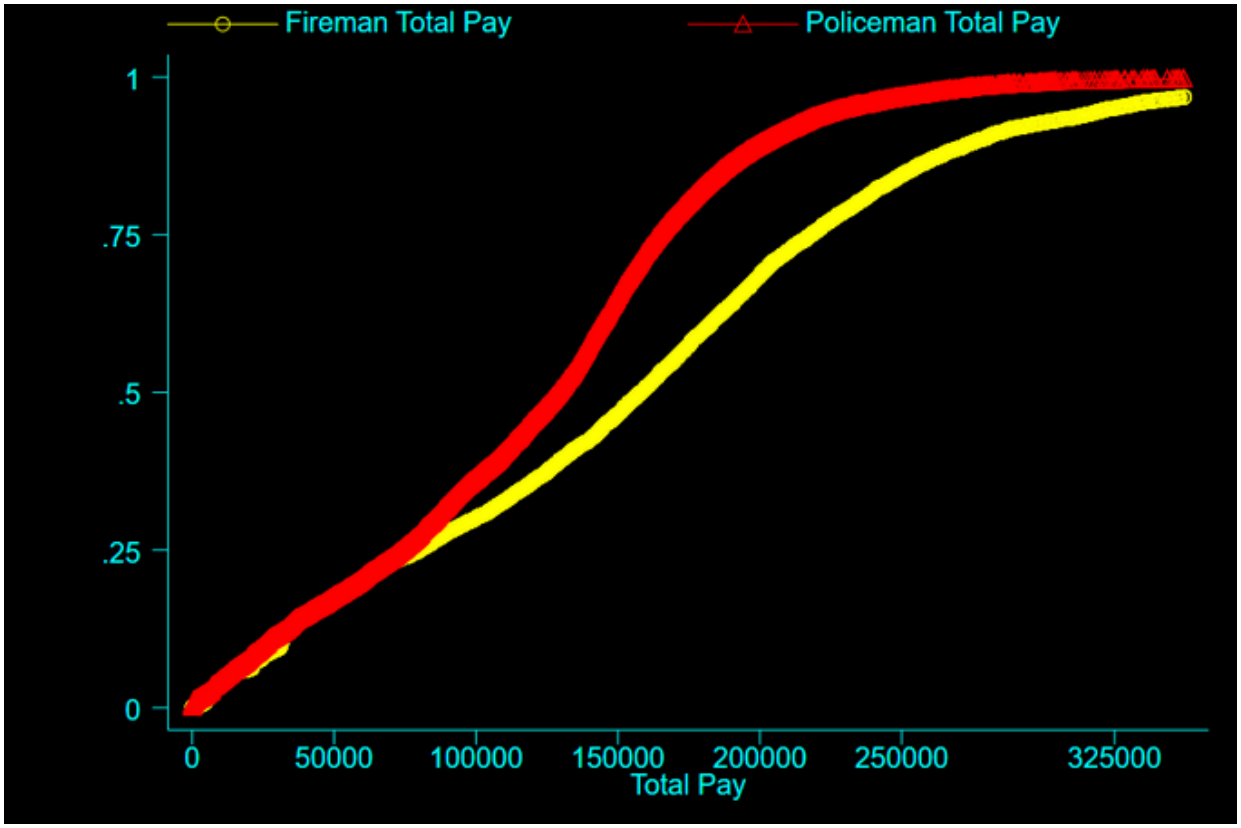
Households and firms will be more likely to invest in battery storage if the power grid charges dynamic prices for electricity. Dynamic pricing means that prices can soar during times when demand is high and supply is low. During those hours, an electricity consumer can save money by using one's electricity stored in one's own batteries. Note that this is a classic "make versus buy" decision. If you can tap into your own power supply during times when power is expensive, then you will do so. Turning this around, you are more likely to invest in battery storage if you anticipate that buying from the grid can be expensive! Introducing dynamic pricing for electricity increases battery demand.

As more people and firms invest in batteries, more Americans have reliable access to power. This increase in aggregate demand for batteries provides entrepreneurs with an incentive to invest more time and effort in producing higher quality batteries.

This discussion about batteries connects to two aspects of disaster preparedness. First, it illustrates how individuals prepare for anticipated disasters, and second, it emphasizes that during a disaster—specifically when the grid goes down—the impact on families greatly depends on their access to battery technology.

An Expensive Public Sector!

During a disaster, government officials such as the police and firemen play a central role in addressing the challenge. If these workers are cheaper to hire, then the government can hire more of them. Here I present some evidence that in Los Angeles that hiring firemen and police is quite expensive. I use 2023 data at the employee level and make a graph of the cumulative earnings distribution including overtime pay.



According to these 2023 data from the City of Los Angeles, more than 50% of firemen earn more than 150,000 dollars per year and 25% of firemen earn above $225,000 a year. High home prices in Los Angeles contribute to this high pay as the City must offer higher salaries to allow workers to afford housing somewhere in the general area. In addition, these workers have powerful public sector unions negotiating their pay. These high salaries actually reduce the area's resilience because the city hires fewer of these workers because the salaries are so high.

Price Gouging is Good!

During a disaster when displaced people seek housing, hotels may hesitate to raise prices during this time to avoid being labeled price gougers. However, from an economic perspective, rising prices—often viewed negatively—are a natural response to increased demand when all else remains equal.

Critics of free markets often highlight issues like price gouging in the short run, where prices rise as demand increases faster than supply. After a disaster, individuals will search for housing. If many people try to relocate to the same area, a shortage of available housing will occur, especially if part of the housing stock has been destroyed. Economists refer to this situation as an inelastic supply curve, where the housing supply remains nearly vertical. Consequently, housing rents will likely rise when demand increases after a disaster.

In a well-functioning economy, individuals may have nearby friends with whom they can stay or those who have vacant rooms in their homes that they could rent out if incentivized. Therefore, allowing markets to operate in the immediate aftermath of a disaster can reduce overall suffering. Higher prices act as signals, indicating to individuals what they can substitute and their least undesirable alternatives. Additionally, these higher prices motivate the supply side, encouraging people to rent out available rooms. Ultimately, allowing markets to function during a disaster enables more people to adapt, helping to alleviate the crisis's impact.

Ultimately, allowing markets to function during a disaster enables more people to adapt, helping to alleviate the crisis's impact. For example, suppose a firm store's canned goods, such as canned tuna fish. Their business model revolves around the idea that, while they don't know exactly when a disaster will occur in Southern Florida, one disaster will likely happen in a given month. An entity that owns a large stock of canned tuna can profit by price gouging when the inevitable disaster occurs. They have all these cans of tuna in stock that they can easily deliver. In fact, with the emergence of a drone economy, providing these goods is becoming even easier.

If a pessimist argues that road floods will prevent transport, that's not entirely true. Allowing food speculators to charge higher prices after a disaster reduces the risk of starvation. It improves the likelihood of maintaining a healthy diet, as these businesses have cans of tuna for distribution. Tuna is just one example; this could also apply to first-aid kits or insulin for diabetics who have been cut off from their supply.

For those in need—whether it's for calories, dialysis, or essential medicines like insulin—one can rely on self-interest and the pricing mechanism. This represents an alternative type of emergency responder. We typically think of emergency medical technicians as nonprofits who help individuals with injuries to get back on their feet. However, I am discussing the important role of the private sector immediately after a disaster, assisting individuals in returning to normalcy. This assistance isn't driven by altruism; it is motivated by self-interest. Just as one can walk into a Starbucks and order coffee after a disaster, individuals have precise needs that can be better served by relying on the private sector rather than the public sector for these goods.

Competition between firms seeking to sell products to people living in the disaster-stricken area protects these consumers from "price gouging". Multiple speculators will invest in tuna and insulin, recognizing that there will be high demand for these products when a significant event occurs in Florida. People need food, and those with diabetes need insulin. Speculators will be prepared to sell at the market price when the event happens. In a free society, no single person holds a monopoly. Others can enter the market, but they would only do so if society allows them to charge a higher price during a crisis. Speculators need to cover costs related to purchasing tuna and insulin, holding these items in cold storage, and bearing the risk that a disaster may not happen at all. Therefore, society needs to reward these speculators for taking on the responsibility of purchasing these crucial supplies.

Critics of free markets often highlight issues like price gouging in the short run, where prices rise as demand increases faster than supply. After a disaster, individuals will search for housing. If many people try to relocate to the same area, a shortage of available housing will occur, especially if part of the housing stock has been destroyed. Economists refer to this situation as an inelastic supply curve, where the housing supply remains nearly vertical. Consequently, housing rents will likely rise when demand increases after a disaster. However, from an economic perspective, rising prices—often viewed negatively—are a natural response to increased demand.

What I've outlined here illustrates how markets can effectively respond to a disaster. Yet we've seen criticism, such as the New York Times piece during COVID-19 that targeted an individual in the American South for purchasing a large supply of hand sanitizer.

Back during the COVID crisis, the New [York Times published this piece.](#)



This person owned thousands of bottles and was often viewed as a villain. The prevailing logic portrayed him as a greedy opportunist capitalizing on a finite hand sanitizer supply, essential to reduce infectious risks during COVID-19. He was perceived to be cornering the market and was accused of intending to sell at exorbitant prices. However, this perspective ignores the supply-side reaction. In my mental model of market dynamics, individuals can decide whether to purchase hand sanitizer. This individual took the risk of buying what others could not secure. Amid a disaster, whether it's a flood or a wildfire, people are caught up in the moment and focused on survival. They are part of families and are concerned for their own safety and for finding children, relatives, and elderly parents.

The Cell Phone Fuels Resilience!

Information technology is crucial during a crisis because it facilitates real-time coordination and communication through social media. It helps individuals stay updated on important issues like the location of floodwaters or wildfires and where higher ground may be found. This real-time information not only saves lives but also fosters hope by providing a clearer understanding of the challenges at hand and their timing for families who have survived the initial shock.

In the immediate aftermath of a disaster, individuals face urgent questions about what assets to grab from their homes while coping with the shock. Cell phones allow individuals to access mobile money and to receive emergency injections of funds to their electronic account to allow them to buy goods and services they need. Elon Musk's Starlink technology allows for 24 hour access to the Internet and this enables adaptation.

With access to a functioning cell phone, people can access the app economy that connects buyers and sellers, whether in the housing, transport, or labor markets. In this sense, the internet economy lowers search and transaction costs, facilitating quicker transitions for displaced workers. The market economy here (not altruism or the Red Cross) fuels resilience. Consider this Tweet!

Matthew E. Kahn
@mattkahn1966

Market charitable donations. @Airbnb has created a way for strangers to donate $ to help those in LA who are homeless because of the fire to pay for housing. Internet platforms reduce search frictions and this is crucial during a crisis.



From airbnb.com

7:34 PM · Jan 13, 2025 · **486** Views

View post engagements

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[Source]

airbnb.org

Get involved

Join more than 60,000 hosts who provide emergency housing in times of crisis.





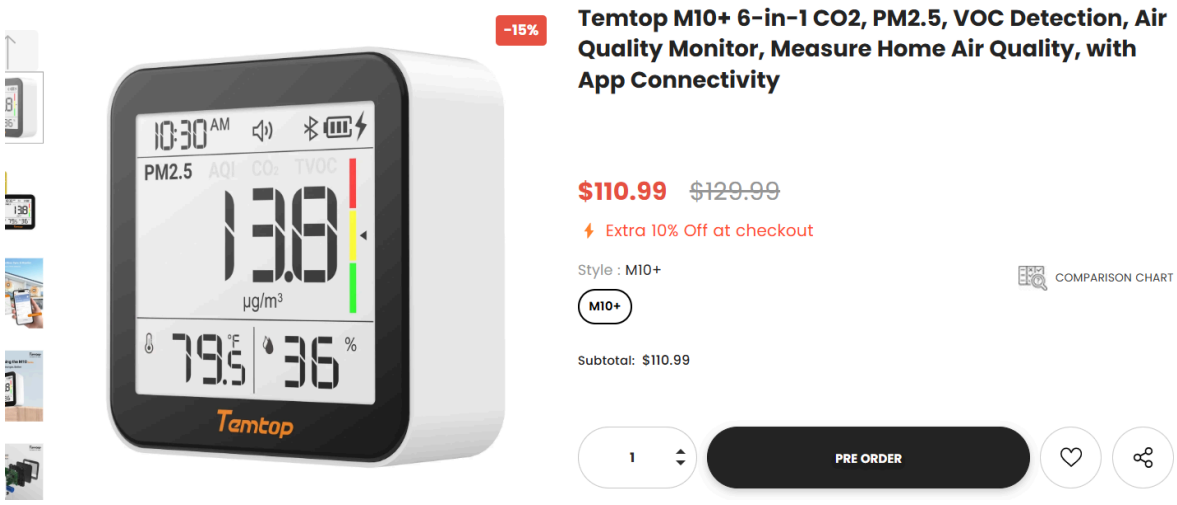
Must it be charity; charge $ as platform; transaction and search costs

Passive Victims? An Optimistic Example of Avoiding Wildfire Smoke

In this age of Big Data, social scientists have published many important papers using natural experiments to study how disasters, such as wildfires, affect our well-being. Wildfires produce smoke plumes that drift with the winds and settle in the communities exposed to this wildfire smoke.

During wildfire events, PM2.5 air pollution levels can skyrocket. Economists and public health researchers have investigated the consequences for downwind people, as this smoke can travel for hundreds of miles. For instance, there have been cases where forest fires in Canada have raised PM2.5 levels in the Midwest. The damage caused by wildfires has two dimensions. If wildfire smoke drifts into a city like Chicago, millions of people can be affected, mainly if such an event has never occurred. Individuals who have never experienced this shock may be unprepared for its effects.

In contrast, areas in Oregon that routinely experience PM2.5 spikes may have a more prepared local populace. Even though these areas may face more extreme PM2.5 spikes, especially among more affluent households, residents are likely to have invested in self-protection technology, such as windows that block smoke, indoor air purifiers, and monitors. Measuring indoor air pollution has become increasingly affordable. The Amazon Platform lists many affordable monitors;



Researchers are examining the spatial distribution of these spikes and whether they are predictable or appear random based on wind patterns. Adaptation becomes challenging when circumstances are unpredictable. If wildfires occur in similar locations, the winds blow consistently in particular directions, and wildfires happen during specific months, it becomes easier to predict where PM2.5 concentrations will be highest. When the threat from wildfire smoke is predictable, people have better opportunities to adapt.

The good news is that climate data scientists have been investigating cause and effect. They analyze how much hospitalizations for respiratory issues increase in the days following wildfire smoke from an upwind location. These estimates are crucial for understanding the impact of wildfire smoke and its short-term consequences.

These findings serve as a modern-day warning system akin to Paul Revere. The improved understanding of this cause and effect indicates that when wildfires burn in Canada,

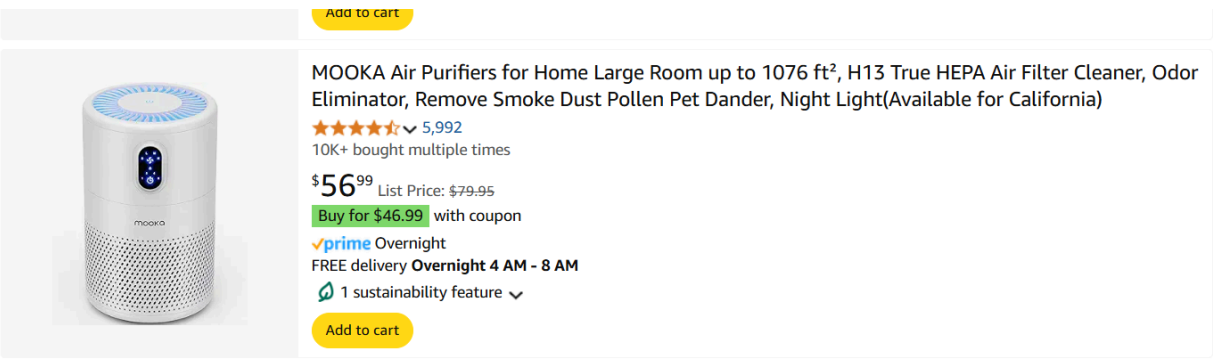
air pollution levels can rise in Ohio, depending on wind direction. This information is invaluable for helping people adapt. We are not passive victims; individuals, firms, and families can increase their understanding of risk exposure based on the time of year. For example, are they situated downwind of major forests that have not been cleared of combustible materials? Being informed enables these individuals to take proactive measures rather than remain passive in the face of such threats.

Capitalism to the Rescue!

Researchers have documented the correlation between wildfires and air pollution, noting that smoke generated upwind can drift downwind into communities. If people continue their usual activities without taking precautions, they will be exposed to this pollution, which can harm their health, happiness, and productivity. However, they receive timely warnings about the pollution drifting their way.

Amazon and other e-retailers now offer various options for monitoring indoor and outdoor air pollution. These monitors are becoming increasingly affordable, and there is a growing set of strategies to reduce your family's exposure to air pollution. During the recent LA fires, we operated our air purifier, which we purchased for around a hundred dollars, continuously for two weeks until the smoke cleared. It was effective in reducing our exposure to indoor air pollution. Wildfires can be considered a disaster, especially when they are severe enough, as the smoke generated can pose serious health risks to vulnerable individuals, potentially leading to morbidity, increased risks, and a lower quality of life.

Many people and firms have purchased indoor air purifiers that help to reduce indoor air pollution levels.



The aggregate demand for such products increases the incentive for entrepreneurs to compete to design these products to sell them to informed people and firms who seek to limit their indoor air pollution exposure. This is free market adaptation taking place!!

A recent economics experiment in England, titled "Making the Invisible Visible," involved randomly assigning households to treatment groups using a coin flip. Those assigned to the treatment group received indoor air pollution monitors, which reduced the cost of being aware of the pollution they faced. With this information, they were empowered to make more cost-effective choices to reduce their indoor air pollution.

A key aspect of not being a passive victim during a threat is being aware of the strategies available to cope with it. The essence of markets is that for-profit firms always look for new ways to make money. If more people in downwind areas are concerned about air pollution and seek to protect their families, this will incentivize firms to take action. Therefore, I am confident that wildfire smoke will result in less damage to our health in the future. However, let’s step back and revisit the situation before a disaster occurs.

Individual Adaptation: Migration as a Response to Natural Disasters

In the wake of a natural disaster that destroys homes and disrupts lives, affected individuals and families face immediate challenges. Homeowners may experience a sudden loss of wealth, compounded by delays in insurance payouts—if insurance is available at all. Families must secure short-term housing, often while dealing with the disruption of children's schooling, the loss of personal belongings, and the psychological strain of upended daily routines. These short-run adjustments are fraught with anxiety and uncertainty.

Over the medium term, however, families confront a pivotal decision: whether to use the disaster as an opportunity to re-optimize their circumstances through migration. Economic research has revealed a counterintuitive pattern—forced relocations often lead to improved economic outcomes. For instance, in the aftermath of Hurricane Katrina, many New Orleans residents relocated to Houston, where tax data showed significant increases in their earnings. This uplift stems from migrants' incentives to select destinations with stronger job markets, better alignment between local economies and personal skills, and overall growth potential. Similar findings emerge from other contexts, such as a volcanic eruption in Norway that displaced families and ultimately enhanced the well-being of their children by exposing them to superior labor markets. It is crucial to clarify that this does not imply natural disasters are beneficial; rather, it highlights human resilience. When pushed to relocate, individuals apply economic reasoning and common sense to seek out places offering greater opportunities.

Migration, however, is not without costs. Displaced individuals forfeit social capital—ties to community, culture, and networks that made their original location a good fit. Children must adapt to new schools, while adults rebuild friend groups and familiarize themselves with new environments. Financial barriers also loom, including moving expenses, upfront deposits for housing, and the costs of transporting belongings. To address these liquidity constraints, economists have proposed the concept of a "mobility bank," which could provide short-term loans or assistance to cover relocation costs, enabling faster recovery and adaptation for those without immediate resources.

Place Recovery: Rebuilding and Economic Fundamentals After Disasters

The recovery trajectory of a disaster-struck location hinges on whether and how it is rebuilt, a process deeply influenced by its underlying economic fundamentals—such as natural beauty, productivity, or strategic advantages. Places like Malibu, with its scenic coastal allure, or Manhattan, with its unparalleled economic vibrancy, are likely to rebound strongly due to these inherent strengths.

A potential silver lining in such recoveries is the acceleration of capital replacement. Many structures in established areas are durable but outdated, persisting for decades without incentive for demolition. Disasters that damage or destroy these buildings can prompt the construction of modern, cutting-edge replacements incorporating advanced technologies,

provided the area's fundamentals remain robust. This can enhance the overall quality and efficiency of the built environment.

In contrast, disasters in declining regions—those with weakening economies, poor amenities, or ongoing population outflows—can trigger a "death spiral." Out-migration accelerates, making rebuilding unprofitable and further eroding the local tax base and services. For example, in vulnerable parts of Louisiana with frequent disasters and weak fundamentals, shocks may hasten depopulation.

Policy responses often involve federal subsidies to rebuild, but economists generally caution against such place-based interventions. Instead, they advocate for a market test: if an area is truly desirable, residents and newcomers will invest in its revival organically. Subsidizing failing places risks inefficiency. A more effective approach is to provide vouchers or direct aid to affected individuals, empowering them to decide whether to stay or relocate. This people-centered strategy aligns incentives, as sustained population supports local businesses and economies. Ultimately, places must compete to attract and retain residents and jobs; even in high-risk areas, strong fundamentals are essential to counterbalance disaster threats and ensure long-term viability.

Accelerating the Recovery Process

Places Versus People

An exciting development in applied microeconomics is the increasing amount of research examining the consequences of natural disasters. Our joint research constructed a 90-year, county-level database and coded indicators for U.S. counties. The United States has approximately 3,000 counties that have experienced major natural disasters, as declared by the Red Cross or FEMA. We utilized census data to study the consequences of these significant disasters at the county level.

Several interesting findings emerged. First, counties that experienced major disasters lost their populations. Studying population dynamics at the county level raises the question of whether the residents of the afflicted county left or if potential new residents chose to move

elsewhere. An increase in outflows and a decrease in population inflows can lead to a net population loss compared to a counterfactual scenario in which the disaster did not occur.

We also found that, on average, the poverty rate increased in counties that experienced one of these shocks. When we initially conducted this research, we were excited that our dataset covered several decades, including periods in U.S. history when the federal government was not as large or active. We were interested in testing the hypothesis that as the federal government has grown over time and redistributed more funds, this would crowd out private efforts to self-protect. However, we lacked a convincing method to test whether the population was more responsive to disasters during periods with a smaller federal government and less spatial redistribution.

My friend Wes Miller has examined the consequences of Hurricane Harvey in Texas. A novel aspect of his work is his attention to detail. In my previous discussion, I mentioned that our analysis focused on counties. We investigated what happened to county-level aggregates, such as poverty and population dynamics, when a natural disaster hit a county. Wes, however, documents that exposure to a disaster is much more localized. Thanks to the detailed geographic information system (GIS) data he used, Wes was able to identify flood damage at the property level. He documented significant variations in flood impact even within census tracts, which are neighborhood data covering roughly 4,000 people. This point is crucial because poor data quality has led researchers to assume a uniform risk distribution—that everyone within a county or zip code affected by a disaster is equally impacted. In contrast, Wes's analysis of Hurricane Harvey reveals that within the same census tract, some homes, due to their location or topography, experienced little to no flood damage, while others, often situated at the bottom of a hill, suffered extensive flooding.

This distinction is important from a statistical perspective. Wes argues that prior researchers have not accurately measured the intensity of the shocks that homes experienced. To illustrate this, a famous professor at the University of Chicago started his lectures by saying, "If your head's in the oven and your feet are in the fridge, on average, you're okay." His point was that averaging people's experiences can often obscure the reality individuals face. Wes's work highlights this contention.

For example, consider a community with ten homes. Three are below sea level and flood, while the other seven remain untouched. This discrepancy in experiences underscores the

necessity of accurate analysis in the aftermath of disasters. The researcher implicitly assumed that all the homes in the census tract experienced some flooding. However, 30% of the homes were directly affected, while 70% of the homes—7 out of 10—were above the peak flood line and did not flood at all.

Wes Miller studied the impact of such shocks that force individuals to move and incur costs. For example, someone who owned a condo or house below the flood peak likely suffered damage to their property. West documented that this damage can lead to a greater propensity to migrate away from the affected areas. Notably, many of these individuals subsequently moved to better neighborhoods. This aligns with literature discussing the potential positive outcomes of disasters; Wes's work suggests that despite suffering a loss, these individuals experienced what can be described as a real wealth effect.

Insurance may not have covered these losses, but the individuals still moved to improved neighborhoods. This concept is somewhat related to a study co-authored by Steve Levitt, which examined the victims of Hurricane Katrina. When Hurricane Katrina struck New Orleans, it resulted in significant hardships, particularly for many Black families. However, using Internal Revenue Service tax data, Levitt and his co-authors documented a silver lining to this disaster. They found that many displaced individuals moved from New Orleans—a city known for its charm but also for its lack of economic productivity—to nearby Houston, which offers better job opportunities and higher wages. This displacement ultimately led to increased earnings for many individuals. In this sense, the Hurricane Katrina shock inadvertently improved income levels for some people. But why didn't these residents move from New Orleans to Houston without the crisis? Why did they need such a strong impetus to relocate?

Economists explain this phenomenon through two concepts. First, there is a selection effect, which means that people do not randomly choose to live in New Orleans. Many are drawn there because they love its culture or because they have family ties in the area. They may stay even if the local economy is struggling. Second, economists point to a concept called duration dependence. The longer you stay there, the more friends you make, and you develop strong social networks and attachments to local establishments, such as your favorite restaurants and bars. Consequently, even if nearby Houston presents better economic opportunities, the costs associated with moving may deter residents from leaving. It typically takes a significant shock, like the destruction caused by Katrina, to push individuals to relocate.

Research on disasters at the macroeconomic level shows that typical disasters do not slow down a nation's economic growth. However, over the last 30 years, some catastrophic events have had substantial long-term financial implications for affected countries. This idea parallels my paper on local public finance, which indicates that natural disasters can exacerbate the decline of certain U.S. cities. If an event disrupts infrastructure and diminishes the quality of life, it can accelerate the outmigration from these areas, creating a downward spiral.

This brain drain decreases the tax base, lowers local real estate prices, and contributes to a poverty magnet effect—where struggling cities retain poor populations due to a surplus of housing and diminishing demand for those homes. Another notable study examined the consequences of natural disasters through an economic history lens, focusing on the Dust Bowl. The Dust Bowl, which occurred in the American Midwest during the 1930s—particularly in areas like Oklahoma—was characterized by extreme weather conditions that made it challenging to grow agricultural products.

Research conducted by Rick Hornbeck distinguishes between affected places and affected people. For example, in a certain area of Oklahoma during the peak of the Dust Bowl, both quality of life and economic opportunities in these agricultural areas sharply declined because of adverse weather conditions. Using census data, Hornbeck tracks the geographic regions and the individuals living there. He examines the same counties in Oklahoma, counting the population, the value of farms, and farm output. The analysis reveals that these areas suffered significantly from the Dust Bowl shock.

A challenge arises concerning the control group. Ideally, we want to identify similar Dust Bowl counties occupied by similar populations that did not experience the shock. Of course, it’s challenging to effectively approximate that using existing data. Nevertheless, Hornbeck shows that the counties affected by the Dust Bowl, when compared before and after the event, clearly experienced significant hardship.

Unexpected Contingencies

I have focused on recurring events, such as structures catching fire and earthquakes damaging buildings. These are events that we have experienced before. An actuary, equipped with data and knowledge of the geography of the building at risk, can calculate the probability

that a building will be damaged or destroyed within the next year. If there is competition in the insurance market, that policy will be priced in a way that creates mutually beneficial outcomes for both the buyer and the seller.

More interesting cases arise when unexpected events occur. For example, UCLA is a major university situated in an earthquake zone, with students living in dormitories. The university's leadership is aware that students could be at risk in the event of an earthquake. While they have, of course, ensured that buildings conform to safety codes, they must also consider the aftermath of a potential earthquake. If an earthquake forces an evacuation of dormitories on campus, the university may incur significant costs. After such an event, it may take some time for building inspectors to evaluate whether a building that is still standing is structurally sound. From an outside perspective, it may seem that the building has survived the earthquake, leading a naive observer to believe that everything can return to normal. However, a more nuanced view is that the earthquake could have destabilized the building in ways that might result in future collapse. Building inspectors have the challenging task of examining each structure to determine its continued safety.

In the short run, the need for evacuation creates a displacement effect. UCLA has a fiduciary duty to find alternative housing for displaced students. Given that housing in West Los Angeles is expensive, accommodating these students in hotels or Airbnbs around the Westwood campus could quickly lead to costs in the hundreds of thousands of dollars. This scenario is an example of what insurers are now willing to cover.

For instance, if a hospital needs to evacuate patients due to an earthquake, considerations must be made about where to relocate the patients, especially those who require similar care. Additionally, questions of who is responsible for the costs associated with moving these individuals arise. As long as a customer can articulate a scenario they are concerned about, insurers can begin to create coverage for such contingencies. Ultimately, this reflects the importance of ingenuity and foresight. Our ability to anticipate and prepare for unexpected contingencies fosters the creation of mutually beneficial contracts that account for these surprising scenarios, which economists refer to as "states of the world."

Government to the Rescue?

Idealists assume that government actions help a shocked economy to recover. A more nuanced observer focuses on what is government actually doing? As government officials issue rules and give press conferences, when do they add to the "fog of war" as people and firms are even more uncertain about the future holds for them and the shocked area? Economists refer to this as "political business cycles" as elected officials can disagree with each other at a point in time or flip flop as they replace each other in the aftermath of elections. The net effect is that this political uncertainty reduces the likelihood that private sector investment takes place because private investors reason that there is an "option value" to delaying making a decision until the "smoke clears".

In the aftermath of disasters such as the Los Angeles fires, too many jurisdictions and political units are involved in the rebuilding process. Such overlapping jurisdictions can create a type of policy paralysis as nobody is "in charge".

There are overlapping political jurisdictions. We have fire zone jurisdictions, environmental districts, and various political units whose spheres of influence intersect. Consequently, numerous stakeholders—politicians, and regulators—play significant roles in what happens in these communities. It's important to note that these individuals are not enemies; some may inadvertently work at cross purposes. For instance, if an environmental entity in the Palisades conducts thorough chemical analyses of the soil to ensure the safety of animals and children, their essential work could inadvertently frustrate eager real estate developers and homeowners trying to rebuild. While the environmental specialists are genuinely focused on minimizing health risks from soil contaminants, their thorough investigations can lead to significant delays in the rebuilding process. Each stakeholder pursues its objectives, and the cumulative effect can result in years of delays before developers receive the green light to start construction, prolonging the return to normalcy in the Palisades.

Do Recover "Czars" Help or Hurt the Healing Local Economy?

The free market economist simply asks for clarity; what are the incumbent property owner's property rights. What can they do and what can't they do with their properties? Once these lists are known, these diverse individuals should be free to choose how they proceed in rebuilding their homes and communities.

During a time of large and active government, many are calling for a "Czar" to rise up and give ultimatums. In California today, there is some delicious irony as many progressives are implicitly embracing the benefits of a dictating (dictator?) Czar!

In economics, there is literature on investment under uncertainty, which teaches us about option value. When uncertainty regarding whether a project can move forward, it often makes sense to delay taking action. This can manifest in various ways, such as postponing hiring architects or submitting building permits to City Hall because individuals aren't sure what regulations will ultimately be enforced or what types of roofs or fire mitigation measures will be required.

As a result, we may see a "wait and see" approach where investors in the Palisades and Altadena gradually start their rebuilding plans due to significant uncertainties surrounding what different regulators will allow. Suppose a builder approaches one of these jurisdictions to ask about their plans. In that case, they might receive specific information, but if several other regulators are involved, getting approval from one does not guarantee alignment with the others.

This scenario is why media outlets, including the Los Angeles Times, desire more certainty and advocate for a designated leader—a "Czar"—to streamline the process. The concept of a Czar is somewhat paradoxical; we are a democracy and typically wary of dictatorship. However, following disasters, individuals often look for a strong leader. For example, after the September 11 attacks, many looked to Mayor Rudy Giuliani as a stabilizing force. While he wasn't a Czar, he served as a calming presence during a crisis, providing essential information and reassurance through press conferences.

A theme in this book is that if we expose people to the correct prices, they will make the right choices. This is a very different model than what a Czar would represent. Imagine a rebuilding Czar who states, "Here are the game's rules; go forth." This raises an interesting

question: If this Czar announced that from this point on, we would commit to using market price signals to provide incentives, and you are free to choose your investments, then I would support such a Czar as an economist. In this scenario, the Czar is not merely issuing mandates arbitrarily; he is creating a precedent—a time-consistent framework. This would signal that even the progressive state of California plans to use market-based mechanisms to guide resilience investments.

However, that's not what a California Czar would do. Instead, I fear that such a Czar might flex their muscles and dictate policies, saying, "Here are the rules. You have to do it this way." This approach would involve rigid building codes and materials, providing a black-and-white development plan without room for tailoring.

While it might be tempting to assume the role of such a Czar, how can this person know how to do their job if they don't have a Ph.D. in "czarring"? We might wish for a powerful and omniscient figure to lead us, but such a person does not exist.

This brings to mind Milton Friedman's famous example of the creation of the pencil. He demonstrated how a pencil comes to be through competition and trial and error, despite none of us knowing how to make one ourselves. Implicit in the hope that California will appoint an all-knowing Czar is a rejection of Milton Friedman's concept.

The residents of Altadena, Pasadena, and other fire-affected areas want to recover quickly, but believing in an all-knowing authority that can magically set everything right is almost like believing in Santa Claus.

For this system to work, the Czar must acknowledge, "I have thought carefully about how to rebuild. We are committing to this pricing system." They must admit, "I don't know what those prices are, but we will use a competitive pricing system and incentives to rebuild safer communities in Altadena and Pacific Palisades."

This would represent a humble leader who understands the limits of their knowledge. Yet, while there is a demand for a Czar, I'm unsure who can credibly supply the necessary skills. I would feel more comfortable with the concept of a Czar if they were humble enough to rely on market price signals and decentralize decision-making. This way, we can collectively and individually learn how to become more resilient by adopting market incentives.

FEMA to the Rescue?

After any major natural disaster in the United States, the Federal Emergency Management Agency (FEMA) steps in to coordinate various aspects of recovery. Initially, crucial operations focus on searching for survivors after the disaster. It's essential to help those directly affected cope with the stress and anxiety that follows such events. Once the immediate shock has subsided, proactive logistical steps must be taken to clean up the affected area.

For example, in the aftermath of the Los Angeles fires, one significant issue is the presence of burnt debris. This debris must be cleared away before any rebuilding can commence. FEMA faces numerous challenges during a disaster, especially when a hurricane lasts several days, as they strive to ensure the safety of lives and property through search and rescue operations. FEMA's efforts are evident after every major crisis. Typically, the President of the United States visits the affected area alongside the state's governor and FEMA personnel as part of the recovery efforts.

The key question for debate here focuses on the roles of the private sector, household choices, and the responsibilities of state, local, and federal governments in encouraging proactive adaptation measures to reduce the likelihood of disasters versus relying on government support after the fact. After any major natural disaster in the United States, the Federal Emergency Management Agency (FEMA) coordinates various aspects of recovery.

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Overall, there is a critical discussion to be had about the roles of the private sector, household choices, and the responsibilities of state, local, and federal governments in encouraging proactive adaptation measures to reduce the likelihood of disasters, versus relying on government support after the fact.

The Politicalization of FEMA

As a professor at USC, I teach great students. One of my former students is Eunjee Kwon. She has co-authored an important paper that is relevant to the discussion here.

The Unintended Consequences of Post-Disaster Policies for Spatial Sorting

MIT Center for Real Estate Research Paper No. 22/08

136 Pages • Posted: 5 Oct 2022 • Last revised: 24 Jan 2025

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Date Written: September 03, 2024

Abstract

We provide new empirical and theoretical evidence on the spatial consequences of public policies driven by electoral motives. Using exogenous variation in the timing of natural disasters, we show that hurricanes occurring close to Election Day in the United States lead to increased local post-disaster efforts. These electorally motivated measures lead populations to sort into hazard-prone areas. To comprehend the aggregate implications of this sorting pattern, we introduce the relationship between electoral cycles and public policies in a spatial equilibrium model. These electorally motivated policies generate considerable productivity and output losses without being compensated by aggregate welfare gains.

Keywords: Natural Disasters, Electoral Cycles, Fiscal Policies, Spatial Sorting

JEL Classification: H7, H84, P48, R12, R13

Suggested Citation:

Source

Eunjee and her co-authors find that when a disaster occurs just before a November election date that the Federal Government is extra generous relative to when disasters occur in earlier months or December. These spatial subsidies encourage more people to live in such risky areas. Moral hazard lurks when Government uses "other people's money" to redistribute!

A Tangent on Moral Hazard Effects Based on the Cookie Monster

Suppose people enjoy eating a lot of cookies and know that indulging excessively could lead to weight gain, which may result in health problems. If there were no effective medical treatments for obesity, people would understand this. While eating cookies might be great in the short run, it would harm their health in the long run. This awareness would be a disincentive—or tax—against eating too many cookies.

In this scenario, the expectation of lacking easy solutions for obesity would lead people to adapt their behavior by eating fewer cookies, even though it might be costly for them in the short term. Let's consider a situation where obesity surgery becomes cheaper and more effective.

If cookie lovers realize that they can undergo surgery after gaining weight, this access to post-obesity solutions essentially subsidizes the act of eating more cookies. Knowing they can rely on such options encourages them to take more significant risks—i.e., eating more cookies—because the potential consequences appear manageable. Economists refer to this effect as a "moral hazard."

Eliminate FEMA?

When people anticipate that post-event insurance or strategies will help them in a crisis, they exert less effort upfront to mitigate their risk exposure. With this economic principle in mind, I want to discuss FEMA and President Trump. While President Trump has made many statements, he recently mentioned ending federal FEMA. Let's engage in a thought experiment: what would happen if President Trump were to eliminate federal FEMA? This change could help reduce the federal budget deficit.

I want to discuss the incentive effects this would create, particularly suggesting that it might reduce moral hazard. To focus the discussion, let's consider California, specifically the January wildfires in Los Angeles, and how this scenario could play out with Gavin Newsom and the Mayor of Los Angeles.

Imagine a world of "tough love" where each state is responsible for disaster relief. In this scenario, the state would be responsible for the disaster payments if disasters like Hurricane Katrina hit New Orleans, Hurricane Sandy struck New York and New Jersey, or the Los

Angeles fires occurred. The rest of the nation would not need to provide financial assistance, meaning each state would manage its situation.

Just as when you go out to dinner, you don't ask your neighbors to cover your bill; the same principle applies to states. I wouldn't label this approach as ruthless capitalism; instead, it acknowledges that we are responsible adults facing budget constraints. Of course, I wish my neighbors would pay for my dinner, but that's not how reality works. The rules dictate that you earn income and make spending choices after taxes, all within your budget limits.

Returning to the California example, Gavin Newsom and local mayors would need to understand that they couldn't simply turn to the President for financial support in the event of a disaster like wildfires. Instead, they could seek engineering solutions from the President's team. Under this proposed system, the federal government would gather data and develop national expertise, learning from various local experiences. It would share best practices in disaster management gleaned from other states and across the globe, serving as a public consulting firm to educate the states.

California would have a heightened awareness of wildfire risks, particularly during dangerous periods like the Santa Ana winds. The Governor and local mayors would recognize that if a disaster occurred, resulting in billions of dollars in damages, they would need to raise taxes or cut spending from other programs to cover disaster relief costs.

Such a structure would ensure these officials have more "skin in the game." If Gavin Newsom, as the Governor of California, understood that he would need to use state funds to offset disaster damages, he would be strongly motivated to prioritize risk mitigation measures. This could involve clearing vegetation, increasing water reserves, bolstering fire department resources during high-risk seasons, and encouraging community preparedness among homeowners.

Returning to the cookie example, suppose people enjoy eating a lot of cookies and know that indulging excessively could lead to weight gain, which may result in health problems. If there were no effective medical treatments for obesity, people would understand this. While eating cookies might be great in the short run, it would harm their health in the long run. This awareness would be a disincentive—or tax—against eating too many cookies. Under this scenario, the expectation of lacking easy solutions for obesity would lead people to adapt their behavior by eating fewer cookies, even though it might be costly for them in the short term.

Let's consider a situation where obesity surgery becomes cheaper and more effective. If cookie lovers realize that they can undergo surgery after gaining weight, this access to post-obesity solutions essentially subsidizes the act of eating more cookies. Knowing they can rely on such options encourages them to take more significant risks—i.e., eating more cookies—because the potential consequences appear manageable. Economists refer to this effect as a "moral hazard." When people anticipate that post-event insurance or strategies will help them in a crisis, they exert less effort upfront to mitigate their risk exposure.

In California, local mayors and governors are more accountable for the consequences and costs of disasters. The more effort they put into precautionary measures, the better their cities and states will be for extreme weather conditions—heavy rainfall or severe droughts, like the Santa Ana winds.

Los Angeles was unprepared for the severe weather in January, and the city faced the repercussions. If the rules had been different and there had been no federal FEMA assistance, Los Angeles and the surrounding region would have been better prepared. This outcome aligns with the basic logic of incentives.

Some Irony

There is a certain irony that progressive governments are using the risks of natural disasters to justify growing government expenditure and regulation! Consider this example.



[LAUSD sets aside $2.2 billion to rebuild burned campuses, make schools more resilient - Los Angeles Times]

Chapter Five: Housing Demand and Household Disaster Risk Exposure

We choose where to spend our lives, but we do not choose among locations on the basis of disaster risk alone.

I was born in Chicago because my parents chose to live there. Later, our family moved to New York City for my father's job. The first location I consciously selected for myself was Hamilton College. After graduation, I moved to Chicago again for graduate school, joined the faculty at Columbia University, and lived in subsidized university housing near campus. Marriage took my wife and me to Boston. In 2007 we moved to Los Angeles when I accepted a position at UCLA.

Like millions of Americans, we evaluated places based on a bundle of characteristics. We wanted a reasonable commute, good schools, attractive neighborhoods, pleasant weather, and a community where we could imagine building a life. We looked seriously at homes in Pacific Palisades. The neighborhood offered stunning ocean views, cool breezes, and a village-like atmosphere that felt removed from the congestion of Los Angeles. Ultimately, however, the daily commute along Sunset Boulevard convinced us to settle elsewhere.

At the time, wildfire risk played almost no role in our decision. We were aware that fires occasionally occurred in Southern California, but we did not fully appreciate the magnitude of the tail risk facing communities built along the wildland-urban interface. Looking back after the 2025 Los Angeles fires, I realize that we were evaluating a bundle of amenities without fully understanding the bundle of risks attached to them.

This bundling problem lies at the heart of housing economics and disaster resilience. People are drawn to places because of their desirable attributes—beautiful scenery, access to jobs, excellent schools, favorable climate, or proximity to friends and family. Yet these same locations often carry hidden vulnerabilities. Coastal communities face hurricane and flood risk.

Mountain communities face wildfire risk. Riverfront properties face flooding risk. The challenge is that amenities and risks are often inseparable.

For most American households, the stakes are extraordinarily high. A home is not merely a place to live. It is usually the largest asset a family will ever own. Retirement security, intergenerational wealth, and long-run financial stability often depend on the value of a single property in a single location. Unlike investors who diversify their stock portfolios across hundreds of firms and countries, homeowners typically place a large share of their wealth into what I call a "one place-based egg."

When disaster strikes that location, both the financial and emotional consequences can be severe.

This simple observation places housing markets at the center of natural-disaster economics. A house simultaneously provides consumption benefits and investment returns. It delivers shelter, comfort, access to schools and jobs, and proximity to valued amenities. At the same time, it represents a long-lived capital asset whose value depends on expectations about the future.

Natural disasters threaten both dimensions. A wildfire can destroy the structure itself. Flooding can undermine foundations and damage neighborhoods. Hurricanes can devastate entire communities. Extreme heat can reduce the attractiveness and productivity of a location. As new information emerges about these risks, households, lenders, insurers, and investors update their beliefs. Housing prices adjust. Migration patterns change. Developers redirect investment toward locations they perceive to be safer.

Economists refer to this process as spatial sorting. Households do not passively absorb risk. They respond to information. Some relocate to safer areas. Others invest in protective technologies. Developers alter where and how they build. Over time, these individual decisions reshape entire metropolitan areas.

Yet risky places rarely empty out.

Many households knowingly remain in locations exposed to significant disaster risk because the benefits are substantial. The beaches of Southern California, the waterfronts of Florida, the

mountain communities of Colorado, and the urban opportunities of New York continue to attract residents despite well-known hazards. Housing decisions therefore involve a constant balancing of rewards and risks.

The central question explored in this chapter is straightforward: Do markets and institutions provide the right incentives for households to make resilient location and investment decisions? Or do existing policies distort those choices in ways that increase society's vulnerability to disasters?

Homeowners as Amateurs

During our working life, we become experts in the tasks that we choose to specialize in. A surgeon becomes better at operating through practice. An economics professor gives better lectures through the trial and error process. In contrast, home owners are amateurs. Such individuals do not take a class in high school or college focused on how to be a cost-effective home manager. In contrast, real estate professionals can take courses at business schools on how to operate real estate assets. If real estate faced few volatile shocks, then it would not really matter that a decision maker doesn't have the training to navigate difficult situations.

The economic perspective on acquiring skill focuses on the expected flow of benefits and costs of this investment. Learning to be an effective real estate manager of one's own home requires upfront time and effort. These are certain short run costs while the benefits of this investment are likely to be enjoyed in the future and the magnitude of these benefits is a random variable.

Behavioral economists downplay the human capital model of skill formation and posit that some people have a fixed trait that limits their ability to plan and achieve their life goals. This mindset provides a justification for a benevolent paternalism by the government to protect people from their own actions. The field of behavioral economics presents a series of predictions that cast doubt on many homeowners' ability to adapt to natural disaster risks. One key point relates to risk perception. Some individuals systematically underestimate risks, which may be due to cognitive dissonance or reliance on historical data to form expectations about the future. This tendency leads some to believe that since disasters have never occurred in their area

before, they're unlikely to happen in the future. As a result, these individuals can be blindsided when unexpected events, like a flood in a previously unaffected area, occur.

Those who underestimate risks are less likely to take proactive steps to prepare for such events, which can lead to severe consequences when rare disasters happen. In these situations, they are often the first to demand government bailouts. Behavioral Economists may argue that these individuals deserve assistance because they were unaware of the risks that ultimately materialized, suggesting that the appropriate response is to rebuild their homes and communities using taxpayer dollars.

I reject this view. I embrace the human capital perspective that posits that everyone has the potential to learn and develop skills. If people realize there's no safety net ("no Santa Claus"), they will have stronger incentives to consider the risks they face, consult with experts, and research the potential hazards associated with their specific properties, be it related to crime, air pollution, wildfires, or floods.

I question whether individuals who make significant financial investments in a property can be considered victims if adverse events occur. These are adults making informed choices. If their property value increases, they celebrate, but if disaster strikes, they must face the consequences of their bets. A stronger and more resilient economy will emerge when individual investors take responsibility for the risks they undertake.

Home owners could hedge their location specific risks by engaging in housing partnerships, so they are not solely responsible for a whole property. They could also invest in assets that are negatively correlated with their homes to maintain a diversified portfolio.

Government policy increases risk taking by both subsidizing homeownership and by subsidizing risk taking by homeowners. If the Federal government reduced its subsidies for homeownership and its subsidies for protecting vulnerable areas (such as flood zones) and reduced its after-disaster transfers to afflicted areas, economics predicts that fewer people would live in risky places and they would be less likely to own assets located in these places. Government policies create a moral hazard effect and by creating the expectation that the government will step in to protect people inadvertently foster a mindset where investors act like children, evading accountability for their decisions.

When individuals are not held accountable for their investment decisions, they are less likely to invest their time, effort, and resources into "doing their homework" researching

consequential decisions as they anticipate that the government will provide assistance if bad events occur. This mindset creates detrimental incentives. The field of behavioral economics offers an intellectual justification for activist government because its insights can be exploited by interest groups to justify subsidies for practices that undermine resilience.

To summarize this discussion, a coin has two sides. Investors should not be allowed to flip "one-sided coins." This means that if positive outcomes occur, they can keep their capital gains from investing in a valuable asset. Conversely, if their investment, such as in their home, turns out to be a bad bet, they should not be allowed to nationalize their losses or seek a bailout.

The Resilience Gains from Renting

The majority of American adults are single-family homeowners. Consider an alternative setup where more of us are renters, and renters would be renting from professionals who have a more significant incentive to do their job because if they do a terrible job managing the property. They're going to collect less rent, and they're going to have more excellent vacancies. Their expected profits will be lower. That's a critical point.

These homeowners may lack the knowledge and experience to handle such risks effectively and face liquidity constraints. For example, the costs of annual household repairs following hail damage or flooding can escalate to hundreds of thousands of dollars if homeowners lack savings or cannot secure repair loans. Such damage can deteriorate the asset or lead to issues like mold. In the case of flooding, properties suffer from depreciation due to deferred maintenance. Single-family, middle-class homes experience more deferred maintenance because many were built long ago. These homes tend to deteriorate faster than properties managed by professional companies, which can promptly identify issues, utilize economies of scale, and bring in specialists with better materials to address problems more effectively. In contrast, a single-family homeowner might let issues fester, lacking the expertise to mitigate these challenges properly. As we confront new and uncertain threats like climate change, it becomes crucial to determine who is best equipped to manage these problems.

Unknown Unknown Locations Risks?

Behavioral economics suggests that people make mistakes and struggle to process information.Ideally, individuals considering a move to an area susceptible to hurricanes and tornadoes would recognize their uncertainty about the probability of these events and actively seek information. They might use Google, consult experts on platforms like YouTube, or gather opinions from knowledgeable individuals before deciding to buy a home there.

People who know that they do not know a location's risks are incentivized to do their research before making such a significant investment. However, the field of behavioral economics posits that individuals are not always very sophisticated; they may not know what they don't know. One perspective is that individuals exhibit myopia, asking themselves whether a particular area has experienced hurricanes or tornadoes over the past 20 years. They might wrongly extrapolate that such events are unlikely if the answer is no.

This backward-looking model of expectations is a concern. Behavioral economics suggests that decision-making can be costly, and people often cling to familiar worldviews, seeking information confirming their beliefs. This hypothesis is intriguing but also somewhat pessimistic regarding individual and familial resilience. It implies that people are frequently caught off guard and overconfident, failing to recognize emerging risks. This viewpoint is also laden with hubris, portraying individuals as blissfully unaware and unsophisticated about these risks.

The good news regarding resilience is that the trend in generating and disseminating higher quality climate risk data is accelerating through efforts such as the one launched by First Street Foundation. I discussed these themes in a previous chapter.

In 2024, we released an academic paper titled; Expecting Climate Change: A Nationwide Field Experiment in the Housing Market that explores how home buyers on the Redfin real estate platform respond to this climate risk information. Here is our paper's abstract;

Climate change presents new risks for property in the United States. Due to the high cost and sometimes unavailability of location-specific property risk data, home buyers can greatly benefit from acquiring knowledge about these risks. To explore this, a large-scale nationwide natural field experiment was conducted through Redfin to estimate the causal impact of providing home-specific flood risk information on the behavior of home buyers in terms of their search, bidding, and purchasing decisions. Redfin randomly assigned 17.5 million users to receive information detailing the flood risk associated with the properties they searched for on the platform. Our analysis reveals several key findings: (1) the flood risk information influences every stage of the house buying process, including the initial search, bidding activities, and final purchase; (2) individuals are willing to make trade-offs concerning property amenities in order to own a property with a lower flood risk; (3) the impact of the flood risk information on behavior is more pronounced for users conducting searches in high flood risk areas, but does not differ significantly between buyers in Republican and Democrat Counties; and (4) the information resulted in changes to property prices and altered the market's hedonic equilibrium, providing a new finding that climate adaptation can be forward-thinking and proactive.

I interpret our paper's findings that the typical home buyer is looking for more information about location specific risks and is updating his/her beliefs and investment decisions based on these data.

Renters as Voters

As homeowners, we become place-based interest voters. We vote to have others subsidize the protection of our area and may oppose new construction, even if we reside in a relatively safe location from climate risks. In contrast, if voters are primarily renters, there's a greater incentive to encourage construction. This influx of new housing can lower local rents by shifting aggregate supply. When we view our national portfolio as our wealth, we are more inclined to advocate for pro-growth policies, ultimately reducing national poverty.

Americans' costs associated with climate change would be significantly lower if we were all renters. Real estate owners would compete to attract us to their properties. If housing is deemed unsafe, rents would decline, prompting property owners to upgrade their assets to avoid losing revenue. These housing entrepreneurs would be motivated to innovate in construction and architecture to address the serious risks we currently face.

The Supply of Rental Housing

Property owners are more likely to rent out space when rents are higher. They are also more likely to rent out space when they can be confident that they can easily evict renters who fail to comply with the rental contract. Of course, renters would prefer to live in an housing unit for free but if property owners anticipate that they cannot evict renters who do not pay their rent then the rental market unravels. During the COVID crisis, new rules were passed making evictions much more difficult and this led to more renters failing to pay their rent. As property owners anticipated this dynamic, they were less likely to rent their units out. With the rise of AirBNB, such short term rentals are even more attractive if long term renters are less likely to pay their contract agreed upon rent. One puzzle about rental housing is why such contracts are only 1 year contracts. In the case of commercial real estate, the leases can be more multiple years.

The Case for Encouraging the Creation of Private Equity Partnerships

An alternative to renting is to buy a home with a private equity partner. If these homes had been owned by professional management companies who turned around and rented them to people who wanted to live in these areas, they would have invested more money to protect these assets. Then, when terrible storms and Santa Ana winds occur, these events would cause less damage to these assets, requiring less of a bailout of these areas. I am claiming that if more properties were owned by professional management companies who have the knowledge, the data, and the access to capital to finance adaptation investments. Then, the same physical risks caused less damage and required less of a government ex-post bailout.

When properties are owned by amateur homeowners who are middle class and don't have a lot of savings, they have not invested much in upkeep or taken location—specific actions, such as better roofs and fire zones and better flood protection in flood areas. Then, when terrible natural disasters occur because homeowners have underinvested in self-protection, the disaster causes outstanding amounts of damage. An enormous Federal bailout is required, and that's another round of inefficiency because money doesn't grow on

trees and other taxpayers in safer locations and other renters, including poor people. Their taxes will be used to bail out these amateur homeowners who underinvested to prepare for the punch.

We can even go another step further. If amateur homeowners living in risky places, such as wildfire and flood zones, underinvest in self-protection to reduce their location-specific risks, like in a wildfire zone, Suppose homeowners have not invested in clearing vegetation or having a better fireproof roof, similar to flood zones. In that case, most properties are owned by single-family homeowners, and they don't demand adaptation solutions. Then, there are only weak incentives for capitalist entrepreneurs to invest in risky research and development to develop solutions.

Let me give a cute example. If there are a hundred million bald men, but none want Rogaine or a solution to grow back hair. Then pharmaceutical companies will not do the basic research to discover, create, and mass produce anti-baldness medicine. In contrast, if and let me move away from my baldness example. Now. Suppose more real estate in wildfire and flood zone areas were owned by professional management companies looking for solutions to reduce their fat tail risk. Most of the time, properties don't experience a full-force hurricane or a wildfire. But sometimes, as we've learned in the Los Angeles fires, something terrible can occur.

If the property owners are management companies aware of this point, searching for solutions, and willing to pay for them. Now there is an incentive for entrepreneurs to compete against each other. Just as Tesla entered the market, it created a high-quality electric vehicle, a close substitute for a race car. You're going to see something similar in wildfire zones and flood zones. If professional management companies own more of those properties, they would want to buy them in beautiful areas that have bundled in these risks. In this case, if we reform the tax code on the dimensions we've spoken about, more people would be renters. They would rent from professional management companies. These professional management companies would recognize that they face wildfire and wildfire zones, flood risks, and flood zones. And these professional managers, with their deep pockets and ability to imagine what fat tail risk they could face. If they don't make these investments in new and improved ways to adapt, they will seek out new solutions. They will travel the world and visit places that have faced fire risk, maybe in Japan or Portugal, and learn from these countries, but they'll also seek engineering

schools like MIT and Berkeley. They will seek to meet professors there and entrepreneurs affiliated with those schools to design new strategies.

This professionalisation of risk management stands in contrast to our current status quo rules that implicitly subsidize home owners and thus create moral hazard effects. Most homeowners are not trained to handle the risks involved in adapting to extreme events such as a hurricane. If they choose to underinvest in resilience, then the shock can greatly injure their assets. After the fact, these individuals will demand that the federal government step in and transfer money to them to protect them and bail them out. Why are these investors victims here? They took this gamble!

While this is an awkward point, investors lose money every day on Wall Street and those who lose money do not ask the government for a refund. The day after the Super Bowl, those who bet on the losing team do not seek a bailout. Why are major disasters a different category? The answer is that many people simultaneously suffer and the salience of seeing such group suffering and the political clout of place based elected officials helps these individuals to receive a transfer from the American Taxpayer.

How Safe is Safe?

Consider building resilience to natural disasters such as earthquakes. It is well-known that California faces a risk of earthquakes, with certain parts of the state experiencing more risk than others. Furthermore, many people, including those in the field of earthquake science, have a limited understanding of the actual earthquake risks they face, leading to significant concern. Media reports often highlight that we are not prepared for "the big one," despite ongoing advancements in earthquake science.

Consider a scenario where a part of the population is aware of the lurking risks, which could lead to significant building destruction and loss of life. Earthquakes can trigger fires when natural gas pipelines are severed, creating a chain reaction that can result in many fatalities. This raises interesting questions when considering how much we should invest in adapting to earthquake risk.

For instance, at UC Berkeley and UCLA, numerous buildings have undergone earthquake retrofitting, costing tens of millions of dollars. It is crucial to analyze whether this

expenditure is justified. If a severe earthquake does occur, retrofitted buildings have a higher chance of survival and are less likely to collapse.

The more challenging question is: how safe is "too safe"? How much money should be invested upfront to ensure that a building is ready for an earthquake? For example, if quakes could be predicted an hour in advance, buildings could be evacuated, reducing casualties even if the structures collapsed. This is preferable to the catastrophic situation of a packed building filled with students and professors during an earthquake.

Early warning systems are key considerations; we need to examine whether they can be developed and whether they are credible and effective. If reliable early warnings are available, they may substitute for constructing perfectly safe buildings against earthquakes.

Moreover, regarding the severity of earthquakes measured on the Richter scale, how safe is safe enough? Can a building withstand a magnitude six earthquake versus a magnitude 7? This scale is logarithmic, and in any economic evaluation, it's essential to consider how much risk reduction is desired and the costs associated with achieving that goal.

For instance, if the probability of a significant earthquake damaging the Economics building at UCLA is 1 in a million, would retrofitting reduce that risk to 1 in a billion? With such low probability events, is this expenditure justified?

We face budget constraints. If California allocates excessive funds for earthquake retrofits, it may lack resources for other important initiatives, like building housing for the underprivileged or improving air quality. There are many different potential uses for money beyond earthquake retrofitting.

In a risky world where we all face many different types of dangers ranging from crime risks to health risks, the efficiency criteria pushes us to allocate scarce funds to those risk reduction investments that offer the greatest “bang per buck”. For example, should more funds be directed toward enforcing speeding laws to encourage safer driving on roads, which could save lives? This approach may offer a more immediate benefit compared to funds spent solely on earthquake retrofits.

The Adaptation Rebound Effect

A final complication is that successful adaptation can create its own unintended consequences. Economists sometimes refer to this as a risk-compensation effect or, in the context of disaster resilience, an adaptation rebound effect.

Suppose engineers develop dramatically better earthquake-resistant construction techniques. New buildings are less likely to collapse, insurance premiums decline, and lenders become more willing to finance projects in earthquake-prone areas. These are all positive developments. Yet the resulting increase in safety can also make risky locations more attractive. More households move in. Developers construct more housing. Businesses invest more capital. Over time, the population and asset base exposed to earthquake risk grows.

This creates a paradox. The probability that any particular building is destroyed may fall substantially, yet the total value of people and property located in the risky area rises. As a result, when a major earthquake eventually occurs, the aggregate damage can remain surprisingly large. The city has become safer, but it has also become more densely populated and more capital-intensive.

Los Angeles illustrates this logic. Improvements in earthquake engineering have undoubtedly reduced the vulnerability of individual structures. Yet those same improvements have helped make Southern California an attractive place for millions of people to live and work. The result is that an earthquake striking Los Angeles today would threaten a vastly larger stock of homes, businesses, infrastructure, and human capital than it would have fifty years ago.

The broader lesson is that adaptation is not a one-time solution that permanently eliminates risk. Successful adaptation changes incentives, and those changing incentives alter where people choose to live and invest. This does not imply that adaptation is undesirable—far from it. Rather, it reminds us that resilience is a moving target. As safety improves, people respond. The challenge for policymakers and private decision-makers is to recognize that reducing individual risk can simultaneously increase aggregate exposure. In disaster economics, safer places often attract more people, and more people create larger stakes when rare disasters occur.

Specificity

To reduce one's risk exposure requires location specific investments. During a time when the American West faces more wildfire risk. There are many homes in wildfire zones. An entity called IBHS is researching cost effective strategies to reduce wildfire risk. Here I list some to highlight the specificity.

Key lessons include:

- **Structure Separation and Density Management**: Greater spacing between buildings (ideally over 30 feet) significantly lowers damage risk, with each additional 10 feet increasing survival odds by 7-13%. In suburban settings where this isn't feasible, the report stresses community-level actions to reduce overall density and connective fuels, preventing "weak links" that allow fires to cascade. This supports your book's point on how government rules (e.g., zoning) can either hinder or enhance resilience by influencing private choices.
- **Connective Fuel Reduction**: Keeping combustible vegetation and items (e.g., mulch, trash bins, decks) below 25% coverage in Zone 0 (0-5 feet from the home) and Zone 1 (5-30 feet) cuts damage likelihood by 24-29%. The report notes that even partial reductions yield big gains, underscoring that wildfires exploit unmitigated pathways sequentially.
- **Home Hardening with Resilient Materials**: Structures with multiple fire-resistant features (e.g., noncombustible siding, Class A roofing, 1/8-inch mesh vents) had a 54% chance of no damage, versus 36% for those with fewer. This systems approach aligns with your optimism about market innovations, as it shows how incremental investments in products like ember-resistant vents can bend the "loss curve" downward without heroic efforts.

Costs to Adopt

Adoption costs vary by scope but are generally modest:

- **Fuel Management (Zones 0-1)**: Clearing vegetation might cost $500-2,000 for a typical parcel, often DIY or via local services. Ongoing maintenance (e.g., annual trimming) adds $200-500/year.
- **Home Hardening**: Vent screens or noncombustible mulch: $100-500. Full retrofits (e.g., siding, roofing): $5,000-20,000, depending on home size, but phased implementation keeps it accessible.
- **Community-Level (e.g., Spacing)**: This is trickier for individuals but could involve zoning changes; costs are shared via HOAs or grants.

Research entities such as IBHS are providing a very useful service by educating the public about what are the strategies for reducing wildfire risk. This type of research **does not** educate a specific property owner on how much risk is reduced by each of these investments. Individual home owners may also differ with respect to how much they dislike the cosmetic implications of making these resilience enhancements to their home. For example, some homeowners may view these changes as yielding an ugly property. Such a mindset would lower the likelihood that such a property owner makes these changes.

Chapter Six The Unintended Consequences of Federal Home Ownership Subsidies

Too many Americans are homeowners. Of course, there are benefits to homeownership, but there are also costs from homeownership. Federal housing policy rules subsidize home ownership. The justification for these rules is that they create strong communities through creating local stakeholders and they generate wealth through acting as a commitment device as people invest in their home and this asset appreciates in value over time.

In an increasingly risky world, where we know that we don't know what climate change will do to local risks of flooding, hurricanes, and wildfires. The tax code encourages you to make this bet. This chapter explores the idea that our tax code subsidizes homeownership and this means that there are many middle-class people who would have been renters if they hadn't gotten this subsidy. These amateurs at protecting property are at increased disaster risk because of the tax code.

The downside of homeownership is betting all of your life savings on a single point of the map. We're in an increasingly risky world. In places that face genuine risks, there are amateurs managing these assets. When horrible events occur, and while, of course, these are low probability events, these probabilities are rising. They looked to the State and Federal Government to bail them out, and all the other taxpayers had to pay in.

Specifics

The federal tax code subsidizes homeownership through allowing people to deduct mortgage interest from their income and through not requiring homeowners to pay tax on their imputed rent. Most Americans do not buy their home with cash. Consider a person who buys a $600,000 home. Most Americans do not buy a home using cash that they have in their bank account or that a parent gives them as a gift. Instead, people tend to use a year fixed rate mortgage. Suppose the buyer of the $600,000 home pays with $200,000 in cash and borrows $400,000 from a bank. Over the course of 30 years, the borrower will face an amortization

schedule that determines how large the monthly payments must be in order to pay back the downpayment and the interest on the loan. At any point in time, part of the monthly mortgage payment is paying interest on the debt and part is paying down the principal.

The United States tax code allows homeowners to deduct their mortgage interest payments from their income and to pay taxes on the difference. For example, if a person makes $100,000 in 2025 and paid $14,000 in mortgage interest payments then this person's taxable income is $86,000. If this person faces a 33% marginal rate then this deduction saved this person roughly $5,000 per year in money not sent to the government. This is an incentive to own versus rent.

The second incentive in the tax code that encourages homeownership is when you own a house; you're implicitly renting from yourself. When you own a home, the opportunity cost of living in your home is that you could have rented out your home and collected a rental payment. When you live in your own home, you're effectively paying yourself rent, but you're not paying taxes on that income. Imagine a case where an owner of a home lives in that home. Suppose he turns around and rents that out to somebody on Airbnb or signs a yearly rental contract. In this case, the owner must declare that earnings on his income tax and get taxed on that income. The fact that owner occupied residents do not pay taxes on the imputed rent represents a second tax code-induced incentive for people to buy and live in their homes. Incumbent homeowners celebrate these tax perks and they vote for elected officials who will maintain these rules of the game.

Mortgage Market Distortions Introduced by Government

Imagine an economy where there are no government regulations over property loan lender behavior. Banks that offer 30-year loans to borrowers are taking a considerable risk. The banker might say, "Home buyer, here is X dollars. You must repay this principal plus interest over the next 30 years. If you fail to do so, we will take your house." This represents an open-ended wager in an economy facing unpredictable climate risks and various other threats to a home's location. The bank is also placing a bet on the borrower: Will she remain financially stable? What is her health status? What are her household finances and job prospects likely to

be? Home buyers are not randomly assigned to properties. Do risky buyers (in terms of default risk) choose to live in dangerous homes? What additional synergistic risks arise from such self-selection?

Banks compete for business as they seek out deposits and they make loans. Such firms would have lower demand for their services if they charge too high of a price or if they provide low quality service. Lenders issuing a 30-year fixed-rate mortgage would have strong incentives to thoroughly assess both the borrower's and property's risks. This is crucial because if the borrower encounters difficulties—such as illness or job loss—or if local home prices start to decline, the homeowner can default on their loan.

If a borrower defaults, the bank, as the lender, takes ownership of the home, which serves as collateral for the loan. In this scenario, the bank has two potential outcomes: it can either receive mortgage payments and interest over the 30-year loan term or, if the borrower defaults, repossess the home.

Without government regulation, banks would be motivated to investigate the default risk posed by the borrower and the risk associated with property values. If home prices were to decline in the area where a home is located, this would further increase the bank's risk.

However, government-sponsored enterprises (GSEs) like Fannie Mae and Freddie Mac can potentially distort the mortgage market. When lenders, such as Bank of America, issue conforming loans—defined as loans below a certain limit—they have the option to sell these loans to GSEs. This practice allows lenders to cleanse their books effectively by offloading loans.

To illustrate this, consider a mortgage lender that cannot sell its loans to any other party. This lender would have strong incentives to carefully assess the risks associated with potential borrowers and the properties in their locations. If someone applies for a loan in 2025 that won't be fully paid off until 2055, the lender would need to invest in loan evaluators to analyze the borrower's likelihood of default and recognize that this risk depends on future property values.

In an environment where lenders cannot cheaply securitize loans, they likely invest more in due diligence and employ more skilled analysts to scrutinize loan applications. Lenders today do not have to hold loans on their books indefinitely, as government intervention allows them to sell off some of their conforming loans—primarily to GSEs like Fannie Mae and Freddie Mac. In an actual free market scenario, banks could sell loans to private investors, who

would then have strong incentives to assess the risks of those loans. If the initial lender made risky loans and the investors recognized that risk, they would purchase them at heavily discounted prices.

In this ideal market setting, lenders would face economic consequences for approving too many risky loans—whether to borrowers with poor credit or for properties in precarious locations—resulting in lower profits. For instance, while a lender might approve a loan for a home in Malibu, it could charge a higher interest rate or require a larger down payment, thus reducing the loan-to-value ratio and lowering the default risk. These measures would provide a buffer in case home prices fell.

Given the government implicit guarantee of Fannie Mae and Freddie Mac, if they experience financial distress, the government will bail them out. Wall Street is aware of this implicit promise. Consequently, while the GSEs aim to make homeownership more affordable, this can also lead to unintended consequences in the mortgage market. One of the subsidies comes from Fannie Mae and Freddie Mac's willingness to buy loans at inflated prices compared to what Wall Street would have paid for them if these entities did not exist.

The implicit Federal Government backing of the GSEs mean that the buyers of their securities do not worry about mortgage loan defaults. If MBS security buyers do worry about defaults and thus reward MBS producers who produce low risk securities, then these screening agencies would invest more resources in developing the skill to screen disaster risk. In this sense, the Federal Government's implied bailout creates a moral hazard effect for the GSEs. Consider a specific example. Suppose that older homes in Malibu do have a higher probability of burning down in a wildfire. In this case, a MBS security that has several Malibu home loans in the portfolio has a higher default risk. If there wasn't the Federal bailout guarantee, the mortgage lender would have been given a stronger incentive to nudge the Malibu owner of that old home to invest in a modern less fire-prone roof.

The Role of Contract Design In Facilitating Disaster Resilience

If the loan lender could collaborate with an insurer, the insurer could provide property-specific tailored terms encouraging the home buyer to invest in precautions to mitigate flood and fire risks. Affordable drone flyovers could verify these conditions. The insurer could

even address health issues and local unemployment rates to minimize income risk without introducing moral hazard. This integrated approach would lead to reduced default risk.

A crucial point to consider is that, in the presence of regulatory price ceilings on insurance rates, the integrated lender-insurer could set the insurance price at the regulatory cap for high-risk properties while charging a higher interest rate on the mortgage. The home buyer would then choose to opt for a cheaper mortgage without insurance or purchase the bundled product from the integrated lender insurer. (It is worth noting that homeowners may prefer the state's subsidized insurance, but this option is expected to diminish shortly.)

The key takeaway is that integrating the lender and the insurer results in a safer asset, which is particularly beneficial if the home is located in areas prone to fire or flood risks. How does this occur? The insurer can employ non-linear contracts to encourage the asset owner to invest in precautionary measures, such as clearing shrubs, elevating the structure, and using sandbags. This reduces the likelihood that the homeowner will default on the loan during extreme weather events. If the integrated entity did not exist, the insurer would overlook how its actions affect mortgage loan default probabilities. This concept is analogous to a firm that sells lamps and light bulbs.

An empirical prediction based on this hypothetical merger of insurers and mortgage lenders. Suppose that in America there are Z different homes, and at any given time, 10% of them have owners who hold a loan and mortgage from the same integrated firm. We can refer to this 10% subset as "the treated" homes. A data scientist would look for natural experiments, such as significant fires and floods, to test the hypothesis. The empirical test for whether this new contractual regime—allowing for the merger of insurers and lenders—facilitates climate change adaptation is to observe whether the "treated homes" (the 10%) suffer less damage per home compared to the 90% of homes in the same affected areas that have their mortgage and insurance provided by separate firms.

Resilience Challenges for Minority Home Buyers in Minority Neighborhoods

One justification for generous Federal subsidies for home ownership is that this helps minorities to accumulate wealth. Homeowners differ in their ability to handle unexpected financial shocks. For instance, a family with access to capital, little debt, significant savings, or supportive family members to borrow from can better withstand surprises, such as a damaged roof or flooding in their home. While these situations are inconvenient, the genuine concern lies in the short-term bills that can amount to tens or even hundreds of thousands of dollars for repairs following disasters, such as major hurricanes, tornadoes, or fires.

It's important to note that Black and Hispanic households typically have less wealth, which leaves them more vulnerable when extreme shocks occur. This highlights a significant issue, especially considering ongoing efforts in U.S. policy to encourage Black homeownership. Many members of Congress, including figures like Maxine Waters, have emphasized the importance of owning a home to generate wealth.

There is an intriguing hypothesis that the historic racial wealth gap could be narrowed by promoting homeownership, supported by explicit federal policies that subsidize it. These subsidies can manifest in various ways, including favorable loan terms and the involvement of government-sponsored enterprises that purchase loans, all aimed at facilitating homeownership, particularly for Black families.

However, it's crucial to recognize that any homeowner is essentially betting on a specific location. Financial economics generally advises diversification—"don't put all your eggs in one basket." Yet, when homeowners purchase a property with cash or a loan, they often bet on a particular point on the map.

Adding to the risk for minority households, especially Black Americans, is the reality that many tend to live in predominantly Black neighborhoods. For example, areas like Altadena in East LA are majority-Black communities, which are often located in regions that face higher vulnerabilities due to a history of racial segregation. These neighborhoods have frequently emerged in flood-prone areas, as seen in New Orleans, where they occupy parcels of land that other groups were not inclined to inhabit. If these areas continue to face significant risks today, policies that encourage Black homeownership could inadvertently render this group disproportionately vulnerable, as they are more likely to purchase homes in these at-risk locations.

Let's revisit this logic for clarity. If Black people tend to live in Black neighborhoods, and if Black communities tend to be vulnerable to disaster risks, then policies that encourage ownership in these areas differentially increase Black investor exposure to these risks. Why? Suppose government policy subsidizes purchasing assets in these places. In that case, this group is doubling down relative to white Americans, who have more choice over where they live because there are many more white neighborhoods across Los Angeles or in other cities.

Current public policies encourage minorities to buy properties in minority neighborhoods that face disproportionate risks, which is like holding an extra undiversified portfolio. Black people tend to live in black neighborhoods, and now we have place-based risks, which further compound the challenge. Going forward, there's going to be a debate about what the American dream is. Why is homeownership part of it versus a different model of being able to sign long-term rental contracts and investing some of one's money, such as in REITS that feature greater spatial diversification?

My claim is that Black homeowners face disproportionate risks due to the locations of Black neighborhoods in cities like Los Angeles and New Orleans. This is a testable hypothesis. An empiricist could investigate this by mapping black neighborhoods in every major American city and superimposing that map with the flood, wildfire, and tornado risks those areas face compared to other neighborhoods in the same town. I assert that, for historical reasons and due to permanent income disparities, black neighborhoods experience more significant risks. This is essentially a shift-share hypothesis. If I am correct that black neighborhoods face heightened disaster risks, then policies encouraging middle-class black individuals to purchase homes in these areas could be exacerbating this risk for that group.

Here are two papers that I've written on this subject.

REAL ESTATE ECONOMICS

ORIGINAL ARTICLE

Racial and ethnic differences in the financial returns to home purchases

Matthew E. Kahn

First published: 22 January 2024 | https://doi.org/10.1111/1540-6229.12475 | Citations: 3

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Abstract

The racial and ethnic composition of home buyers varies across geographic locations. Since home prices grow at different rates across counties and within counties, these place-based bets yield different average rates of return for different demographic groups. I estimate these differential returns by combining micro data from Home Mortgage Disclosure Act (HMDA) with zip-code-level data from Zillow. Based on this index of housing returns from 2010 to 2022, I find that at the national level that Asian buyers earn higher returns than other groups. For California buyers and for Los Angeles buyers, Black people earn roughly the same average rate of return but face a higher standard deviation in returns than other groups.

source

In my research, I have also explored the alternative of renting. Renters typically have more neighborhood options because renting involves lower fixed costs. A black family with a fixed income or a middle-class or upper-income household can often rent an apartment or a house in a more desirable neighborhood than buying a home. When purchasing a home, families lock-in and typically require a larger down payment. Therefore, there is a trade-off if a family's goal is to live in a better neighborhood—based on factors such as schools, crime rates, commuting distance, and less disaster risk. The same household, facing the same budget constraints, can afford a better neighborhood if they rent rather than buy.

REAL ESTATE ECONOMICS

Measuring Neighborhood Investments: An Examination of Community Choice

Denise DiPasquale, Matthew E. Kahn

First published: 22 September 2003 | https://doi.org/10.1111/1540-6229.00778 | Citations: 17

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Abstract

Community choice is a very important household decision, since it represents an investment in community attributes that can have a significant effect on the quality of life of all household members, particularly by influencing the future prospects of children. In this paper, we examine the housing and community choices of migrants to and within Los Angeles County identified in the 1990 5% public-use sample of the Census. Controlling for income, we find that expenditures on housing structure are quite similar across races. However, controlling for income, black and Hispanic households consume significantly less in community attributes than white households.

source

Chapter Seven: Local Land Use Regulations Often Hinder Disaster Resilience

Zoning is a crucial state and local regulation that determines how land is used in counties. For instance, in Los Angeles County, approximately 75% of the county's land area is designated for single-family housing. These regulations aim to ensure that land uses are compatible with one another. Decades ago, in a city like Chicago, there were heavy manufacturing operations and slaughterhouses where animals were processed for food. As cities serve multiple functions, it made sense to create a physical separation between residential neighborhoods and industrial areas.

Zoning creates a physical barrier between industrial activities and residential communities, enhancing the quality of life by reducing externalities such as air, water, and noise pollution. For example, consider O'Hare Airport in the suburbs of Chicago: should housing be built near the airport? A physical separation from residential areas can minimize noise exposure for nearby people.

Land use rules determine the physical distance between people. For instance, living close to a prestigious university like Harvard can provide access to culture and attract interesting visitors. In such cases, it might be beneficial to allow more housing to be developed near the university. Conversely, if we examine a map of Beverly Hills within Los Angeles, we notice that very little of the area is zoned for industry. Instead, certain parts are designated for commercial real estate along Rodeo Drive. However, you won't find a Starbucks on some upscale residential streets. A Starbucks cannot operate there due to zoning restrictions.

Urban Planners Are Not Omniscient

People need places to sleep, children require spaces to learn and play, and workers need offices for their jobs. A city also has connective elements, such as its transportation network, essential infrastructure for managing water—both for sewage and distribution—and energy, including natural gas and electricity. Roads connect to airports, facilitating various functions

and land uses within the city. Therefore, it's essential to consider how land in a town should be allocated for these different tasks.

The issue with zoning laws is that they often assume that the town's planners have perfect foresight. The original planners of a city cannot predict how it will evolve. For instance, many U.S. cities, such as Pittsburgh, Chicago, and Baltimore, were historically zoned for heavy manufacturing. However, as deindustrialization has occurred, even cities like Los Angeles and San Francisco now require less land for industrial purposes.

This raises the question of how quickly zoning codes can adapt and modernize as new land uses emerge and as new risks and opportunities emerge, such as urban agriculture or data centers. Land can always be repurposed for different tasks, but we must also consider when zoning codes become restrictive and limit profitable development opportunities. At times, these codes can hinder our quality of life.

Too Much Land is Zoned for Single Family Housing

In Beverly Hills, many areas are zoned explicitly for single-family housing. Even if you own the land, you couldn't construct, for example, a four-story building there. This brings us to the key topic of this discussion. Much of the United States, particularly in our major cities outside of New York City, is facing a significant issue with zoning. New York City is one of the few superstar cities with substantial multifamily housing. On the other hand, there is multifamily housing in downtown Los Angeles and Santa Monica. Still, in many large sections of Los Angeles, the area is predominantly zoned for single-family housing.

The greater Los Angeles area is grappling with at least two land use challenges. First, the region is experiencing rising temperatures. As you move east of Los Angeles, the heat intensifies, while coastal areas like Santa Monica remain considerably cooler. If more of Southern California's desirable coastal communities were zoned to allow multifamily housing, we would see the construction of taller buildings. Real estate developers could buy older single-family homes—particularly those built before the 1980s—and combine adjacent properties to create more significant developments. For instance, if two homes selling for

around $4 million each were purchased, the developer could demolish them and construct a four-story building with 12 to 15 units, potentially selling each for $1 to $2 million. Of course, the developer would only pursue such a project if they expected a positive return on investment. However, consider what has changed from the perspective of housing supply. Under the current single-family zoning rules, only two homes are on that property. Assuming an average of three people per home, that area accommodates six residents. However, if those homes are replaced with a four-story building containing 12 units (with two residents per unit), the total number of residents could increase to 24.

This simple example illustrates the impact of zoning policies. If localities in cooler areas, less prone to fire risks, shift away from restrictive single-family zoning to allow for the construction of multifamily housing—even as modest as four-story buildings—they can significantly increase housing supply and affordability. This change would enable more individuals to access housing in desirable neighborhoods rather than limiting it to only those who can afford a $4 million home.

Desirable areas such as Malibu, Berkeley, and Santa Monica in California are predominantly zoned for single-family housing. This zoning intentionally restricts opportunities for more affordable housing options, limiting the number of people who could live in these areas if zoning laws were altered.

A Policy Reform Proposal

My modest policy proposal is to upzone these desirable cities, enabling the construction of four- or five-story buildings. This change in zoning would make more efficient use of scarce land by increasing its intensity of use and substituting capital for land. As a result, more housing units could be built, which would generally be smaller and more affordable.

The new housing would likely be constructed with modern technology, enhancing its quality. Moreover, management companies that own these properties would have more significant incentives and capacity to manage them effectively, unlike typical single-family

homeowners, who, as I discussed in a previous chapter, often lack the expertise needed to manage such assets.

The question arises: why aren't cities moving more quickly to implement these changes? There are relatively safer areas within major metro areas such as Santa Monica and Berkeley due to their cooler temperatures and objectively less wildfire risk due to their distance from the wildlife-urban interface. Why isn't there more upzoning within their borders?

Progressive environmentalists are increasingly concerned about a shortage of climate-safe assets. The "doom and gloom" narrative suggests that rising demand for homes in safe areas and limited supply will lead to exorbitant prices. This scenario implies that only the wealthy can adapt to climate change, pushing the middle class and poorer individuals into high-risk zones.

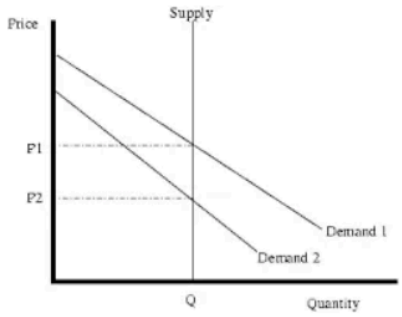
I find this pessimistic view noteworthy but reject it for two primary reasons. First, I am a technological optimist. The middle class is not financially powerless; they have the purchasing power to demand effective market solutions to adapt to their challenges.

Historically, companies such as McDonalds and General Motors have thrived by catering to middle-class demands. In a capitalist market, companies can prosper by creating products that appeal to the middle class. Thus, I do not subscribe to the idea that the middle class is merely a passive victim of these circumstances. Instead, if much of America's cities are predominantly zoned for single-family housing and high demand for desirable housing limits supply, the middle class will inevitably be pushed into areas with higher risks, such as Riverside County and San Bernardino. In response, individuals in these situations will have strong incentives to seek out innovative products to help them cope with their environment.

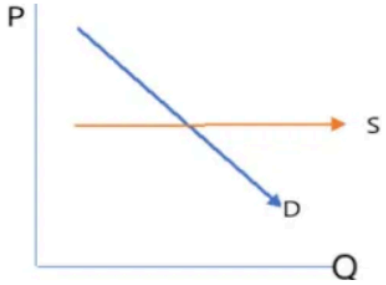
If the single family zoning code changed in low risk cities such as Berkeley and Santa Monica , older properties in these areas would be purchased, existing structures would be knocked down, and replaced with new housing in condo complexes, creating opportunities as more upper-middle-class individuals move into these areas. This would have a synergistic effect, likely attracting better restaurants and fostering more vibrant communities. Younger people would likely be drawn to these units since they are often just one or two bedrooms and

more affordable, leading to a revitalization of the community. Some critics would say that this "gentrification" injures the local poor people as they may be priced out of the neighborhood. On some level this is true but on the other hand, why do they have a property right to live in an area they cannot afford. Why can't they go and earn more money to pay the higher rents? The increase in local rents will be less if the supply of housing sharply increases in these increasingly attractive areas. Let's not forget the fact that rising demand for local housing does not sharply increase local rents if housing can be built in desirable areas!

Contrast these two supply and demand cases. In the first case, more housing supply cannot be built in a built up single family land zoned area such as Berkeley. In this case, rising demand bids up local rents.



Here is the ABUNDANCE CASE!



In this case, increases in demand do not raise market prices. Instead, more stuff gets built!!

Contrast this case with this second case where the supply curve of housing is quite elastic. My point is that upzoning unlocks the abundance case!

Why Haven't Communities in Desirable (Safe) Areas Up Zoned?

If the potential benefits are so promising, one might wonder why Santa Monica hasn't taken the initiative to switch from single-family housing zoning to multifamily housing, such as the proposed four-story buildings. That's an interesting question. One possible explanation is that the community may lack imagination regarding what it would be like under different zoning regulations.

Another reason could be that many older homeowners are comfortable with their established roots in the community. A cliché attributed to Henry Ford suggests all change is bad. On some level, do the older residents in Santa Monica and Berkeley possess enough imagination about what their communities could look like if upzoning were to occur? A further hypothesis is that some homeowners fear an influx of lower-income individuals and are concerned that upzoning could attract them.

While economists might agree that there is some truth to that concern, we argue that real estate developers in these areas will likely build high-quality housing to attract young professionals. These developments could include million-dollar condominiums with relatively few square feet, meaning residents would pay a premium per square foot.

We have reached an impasse, we must build more housing in relatively safer areas. Climate scientists are increasingly identifying the geography of these safer locations. In a previous chapter, I discussed how the insurance industry, through risk pricing, could encourage individuals to seek residences in these safer areas. From a libertarian perspective, I argued that insurers should be free to set any insurance price.In this scenario, they would charge higher premiums for properties in fire-prone zones and lower premiums for those in safer locations. Properties in safer areas are less likely to suffer damage and, consequently, less likely to have insurance claims filed.

The Political Economy of Land Use Reform

What would it take to encourage Santa Monica to allow for upzoning? How much funding would need to be allocated to Santa Monica for the mayor to support a policy of upzoning? From the revealed preference, we can see that, without any monetary incentives, jurisdictions like Berkeley and Santa Monica are maintaining the status quo of single-family housing.

I oppose a "takings". The jurisdictions have the property right to oppose up zoning. Let's consider a hypothetical situation: what if the state of California were to offer Santa Monica $100 million to upzone a specific segment of land within the city as a take-it-or-leave-it offer? This could serve as an experiment to determine which jurisdictions, like Berkeley or Santa Monica, would be willing to change their zoning policies in response to being offered a financial incentive.

Privatizing Public Land?

This chapter has focused on zoning on urban land but there are other land use regulations such as how the Federal government manages its lands. The Bureau of the Interior controls millions of acres of public land. If this land is not properly managed disasters such as wildfires and resulting PM2.5 air pollution spikes occur. The expected severity of a shock depends on what investments governments make. For example, consider wildfires on public lands creating PM2.5 spikes such that this air pollution drifts downwind and lands in urban communities hundreds of miles away. These pollution victims would be exposed to less wildfire smoke if the government had cleared out the underbrush and engaged in controlled burns to reduce the fuel in the forests. In this sense, the management of public lands has important implications for the disaster risk posed by wildfires.

If these same forest lands were privatized, the owner of these lands would have a profit incentive (and perhaps a liability incentive) to invest his funds to prune vegetation that poses a fire risk. If the downwind urbanites have the property rights to clean air, then they would sue this land owner if excessive pollution floats downwind. If instead, the land owner has the property rights to do what he wants with his land then the Coase Theorem predicts that the "victims" downwind would have an incentive to pay him to do the land clearance because they would gain from reducing the smoke production.

Chapter Eight: Government Policy Often Hinders Resilience

In this chapter, I focus on the unintended consequences of state, local, and federal public policies that have hindered those living in and owning property in high-risk areas from taking protective measures that could have reduced the likelihood of harm to themselves and their property.

Insurance Economics 101

Let's start with a practical example related to insurance in a typical contract. Whether it's life, health, or property insurance, people understand that specific scenarios can be verified, such as death or a property burning down. When these events occur, people need financial support. Insurers are profit maximizers; they will only sell insurance if they believe they can profit from the contract.

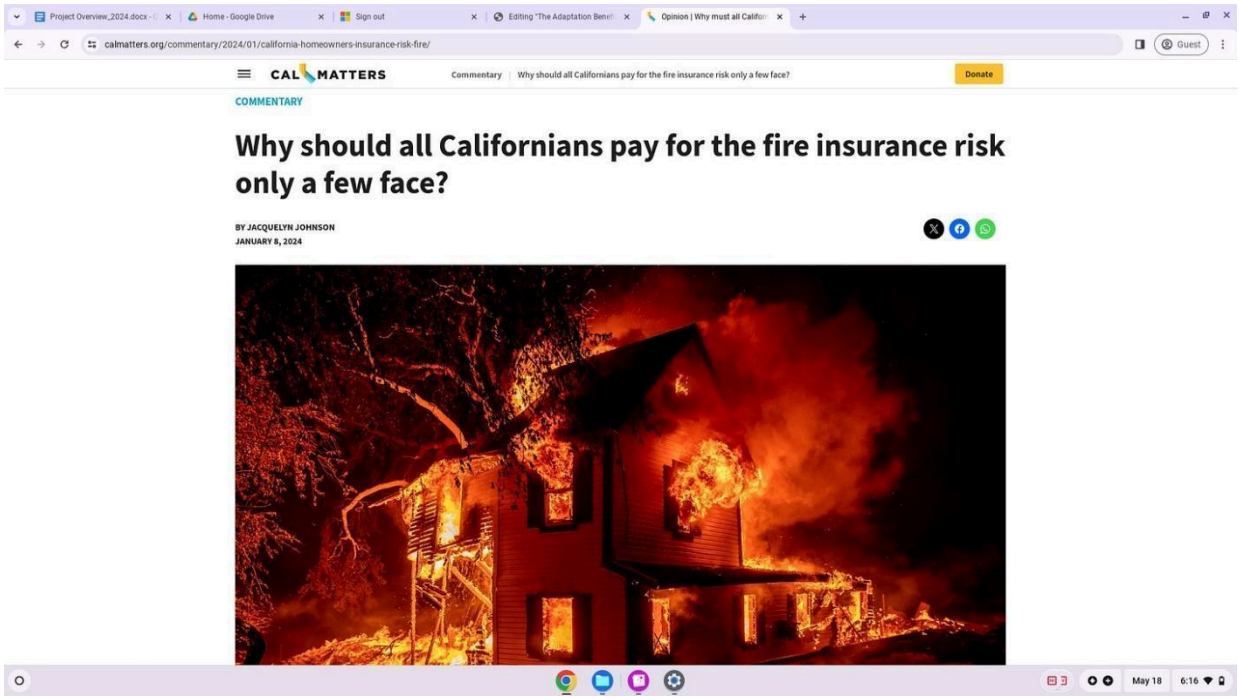
An insurance contract is straightforward: you pay a premium for a year, and in return, the insurance company promises to pay you a payout when an event occurs, such as death or the destruction of a home. If the statisticians working for the insurance industry determine the probability of such an event, they will charge a higher price for the policy. For example, if you want a million dollars worth of life insurance and your probability of dying in the next year is 1%, no insurance company would charge you less than $1,000. The reasoning here is that if there's a 1% chance you will die next year, the expected loss to the insurance company is 0.01 times $1,000,000, which equals $10,000.

The insurance company's profit is calculated as revenue minus costs. Revenue comes from the collected premiums, while expected costs are based on payouts. This is the probability of the event occurring multiplied by the amount of money the insurance company must pay out if the event happens. Thus, no insurance company would offer a policy to someone with a 1% chance of dying, promising their family a million-dollar payout for a premium of just $1,000, as they would incur losses based on that expected value. Various factors can influence the risk of severe events. For example, as a person ages, their probability of dying in the next year increases. This is why life insurance becomes more expensive as one gets older.

In the case of homes in a place like Pacific Palisades, homes can burn down or be destroyed in any given year. The insurance industry pays statisticians to collect data and look at the probability that each house burns down in the neighborhood. There could be hundreds of homes close to each other, like the homes near the Pacific Palisades village. These probabilities of disaster are not independent events. If a fire starts, there is a positive correlation across homes that in a given year, if one home burns down, its neighbors also burn down as the fire jumps from roof to roof. Thus, the actuaries must calculate if they sell policies to a thousand people in Pacific Palisades and if each is insured for a million dollars. Then, they could be on the hook for a billion dollars in payouts if all homes burn down. Since, a thousand times a million is a billion, that's called a fat tail event, and the insurance industry must ensure that it does not get wiped out in any given year. If it loses enough money, such a company could go bankrupt. There has not been a rare disaster of burning homes in most years. If an insurer sells several policies in the same neighborhood, and if there's a terrible event that this triggers, the insurance payment to all of them.

Insurance Regulations and Subsidies

In many states including California, insurance commissioners must balance the desires of home owners in risky places to buy cheap insurance with the goals of insurance sellers who want to earn a profit selling insurance and they must also balance the desires of residents who live in safe places who do not want to cross–subsidize those who choose to live in risky places.



State regulators have limited the ability of insurers to raise rates in risky areas by placing price ceilings on the level and the rate of growth of insurance premiums. Some insurers have responded by exiting such markets as a game of Chicken has emerged.

The insurance industry is highly regulated. So, in other sectors, like selling coffee, the government doesn't get involved in the market for drinking a cup of coffee. Who are the winners and losers when an industry is highly regulated? In the case of the insurance industry, regulation occurs at the State level. In California, there is an Insurance Commission where for-profit insurers like State Farm and Allstate must seek approval from the Insurance Commissioner to increase their insurance rates. In recent years, California has had a price ceiling, preventing insurers from raising rates by more than a certain percentage from the previous year.

Insurers are not required to sell policies; they can choose to exit the market at any time. Recently, national newspapers, including the New York Times, have reported that, as wildfire risks have increased in California, many for-profit insurers opt not to renew policies. Insurance policies are typically year-to-year contracts, meaning you sign up for a one-year term without long-term commitments.

Insurers are aware that wildfire risks are rising in many areas of California. They understand that the Insurance Commissioner does not typically allow significant rate increases. Ricardo Lara is the current Insurance Commissioner, and he faces pressure from existing homeowners in areas susceptible to wildfires. These homeowners want affordable insurance rates and the ability to purchase coverage.

On the other hand, for-profit insurers want the freedom to set prices without regulatory constraints. This puts Commissioner Lara in a difficult position, as he must balance the interests of two distinct groups: current homeowners in wildfire-prone areas and the insurance companies seeking to maximize their profits. If insurance prices rise for homeowners, they may have less disposable income for other expenses due to higher insurance costs. Additionally, they may try to sell their homes in the future. In that case, they may receive lower offers because buyers will know the high insurance costs associated with properties in those areas. Homeowners would prefer access to affordable insurance, as having lower insurance costs would make their homes more attractive to potential buyers.

The situation in California also indicates broader trends occurring in other states. If the insurance industry believes that selling policies in a particular area will result in negative expected profits—because the allowable prices are lower than the anticipated losses—they will choose not to sell policies in that area. In regions where many homeowners own properties at risk of wildfires, such as Santa Barbara and the Palisades in Los Angeles, residents are losing access to market insurance. This loss is mainly due to regulatory constraints that prevent insurers from raising rates sufficiently to cover the risks involved.

The Insurance Commissioner, facing pressure from incumbent homeowners, has restrained the insurance industry from raising rates to what insurers consider actuarially fair levels. As a result, some insurers have decided to withdraw from the market entirely, leaving homeowners in wildfire zones without access to insurance. Many of these homeowners are turning to the California Fair Plan, a state-provided coverage option. It does charge more than typically for insurance, but it is believed that the Fair Plan charges a price lower than what the private market would choose, and thus, in expected value, is losing money. We will see this, especially with California in the aftermath of the LA Fires. The Fair Plan has many homes on its books that have burned down, so the Fair Plan is called adverse selection. The Fair Plan attracts the homes that can't be sold and the homeowners who cannot get insurance from the

insurance industry. So, this is not a random sample of California homes. The risky homes and the owners of those homes are charged higher insurance prices or are offered no insurance at all because of the price ceilings set by the Insurance Commission. They then substitute for a Fair Plan when something terrible happens. California taxpayers have to pay off the deficit because the Fair Plan has made these homeowners a promise.

There are bad incentives embedded here. The riskiest homeowners are being subsidized to purchase insurance from the State. Money doesn't grow on trees, so the rest of the State's taxpayers are renters—people who live in safer places. Part of their taxes goes to paying off these promises. As an economist, I do not view that as fair. If you choose to take the risk of living in a beautiful but risky place like the Palisades, Of course, you want access to cheap insurance, but why do you have a property right to that? That is not in the Constitution. Everybody wants a free lunch. But, if you are a Palisades homeowner in a fire zone, you are offered cheap insurance.

Consider this example. Suppose you purchase a million-dollar insurance policy for a thousand dollars a year. Suppose there's a 2% chance of a fire occurring in any given year. The expected damage to your house is $100,000 if a fire occurs. If your home is damaged, you receive a check for $100,000. Suppose, you pay $1,000 in payments to the California Fair Plan for this policy. In this case, you are receiving a $1,000 subsidy from this plan. Why? The expected cost to California from your plan is $2,000 a year (100,000*.02) while you are only paying $1,000 for this policy. This disparity means you are receiving a subsidy. Ultimately, this expense is borne by everyone else in the State and future taxpayers in California. Why should you have the right to this benefit?

A Case Study: California’s Insurance Market and the Consequences of Price Suppression

California’s homeowners insurance market is claimed to be in crisis. State Insurance Commissioner Ricardo Lara has called it exactly that. Insurers are withdrawing, non-renewing policies, and pushing homeowners into the state’s insurer of last resort. At first glance, this looks like a classic market failure triggered by climate risk. A closer look shows it is something else: the predictable result of price suppression.The root problem is regulatory. Under

California's framework—shaped heavily by Proposition 103—rates must be approved using historical loss data. Insurers, however, must price forward-looking risk. Wildfire danger is rising fast, yet regulators often force premiums to reflect yesterday's losses rather than tomorrow's disasters. When firms cannot charge actuarial rates, expected returns turn negative. Profit-maximizing insurers respond in three rational ways:

- They reduce coverage in high-risk areas.
- They stop writing new policies.
- They exit the market altogether.

This is precisely what has happened in California.The Rise of the Insurer of Last ResortAs private carriers retreat, more households are forced into the California FAIR Plan. Originally designed as a temporary safety net, the Plan is now becoming the primary insurer for thousands of high-risk properties. This shift creates three serious problems:

- It concentrates rather than diversifies risk, loading exposure onto a single state-backed entity.
- It weakens self-protection incentives; homeowners who can obtain coverage regardless of mitigation efforts invest less in clearing brush or fire-resistant upgrades.
- It generates implicit cross-subsidies, forcing low-risk households and taxpayers to bear part of the cost of insuring the highest-risk properties—distorting location choices and encouraging development in vulnerable zones.

Regulatory Lag and Capital FlightEven when insurers file for higher rates, the approval process is slow and politically charged. Insurance is capital-intensive; firms can move capital across states or countries in search of risk-adjusted returns. When California suppresses prices, capital simply flows elsewhere. What appears to be "market failure" is arithmetic: capital goes where it is rewarded.The Political Economy of ReformIf the economics are so clear, why does the system persist? The answer is political. Allowing full risk-based pricing would produce immediate, visible costs concentrated on politically active groups:

- Higher premiums for homeowners in fire-prone areas.
- Declining property values in risky locations.

- Increased migration away from vulnerable regions.

The benefits—more efficient capital allocation, stronger adaptation incentives, and lower taxpayer exposure—are real but diffuse and long-term. As Mancur Olson's logic predicts, concentrated interests lobby harder than diffuse ones. Price controls endure even when they reduce overall welfare.Disaster losses are not fixed by nature; they are shaped by the rules we write. Suppressing risk prices does not eliminate fat-tail risk—it simply hides its cost until the bill comes due.

.Flood Insurance, Selection, and What Health Economics Teaches Us

Flood insurance offers one of the cleanest institutional laboratories for studying how incentives shape disaster resilience. As emphasized throughout this book, disaster damage is not a law of physics; it is mediated by behavior, incentives, and institutional design. Insurance contracts sit at the center of this interaction because they simultaneously price risk, allocate losses, and influence precautionary behavior.

In the United States, flood insurance is dominated by the National Flood Insurance Program (NFIP), which covers roughly 4.7 million policies and carries more than $22 billion in debt. A small fraction of properties—so-called severe repetitive loss properties—accounts for a large share of claims. These properties are repeatedly rebuilt with federal support, often at premiums well below actuarially fair levels. From an incentive perspective, this system exhibits familiar features: moral hazard, cross-subsidization, and political durability.

Recent entrants in the private market, most notably Neptune Flood, challenge the presumption that flood insurance must be publicly provided. Neptune operates as a technology-driven managing general agent, using machine learning and granular spatial data to price flood risk at the individual property level and place coverage with private insurers and reinsurers. Its CEO, Trevor Burgess, has proposed a sharp reform: halt the issuance of new NFIP policies while

allowing existing policies to renew indefinitely, transforming the federal program into an insurer of last resort for the most extreme risks.

Neptune claims that its technology allows private markets to profitably insure up to 95 percent of the existing NFIP portfolio, leaving only the most challenging 5 percent for government coverage. If correct, this would substantially reduce taxpayer exposure, tap global reinsurance capacity, and eliminate political disruptions that periodically suspend NFIP operations.

Critics respond with a concern that should sound familiar to any applied microeconomist: cherry-picking.

Selection Versus Treatment: Lessons from Health Insurance

The central empirical question is whether Neptune's apparent success reflects **selection** or **treatment**. Are private insurers simply attracting lower-risk properties that would have generated fewer claims anyway? Or do private contracts actually change behavior—encouraging mitigation, adaptation, and risk reduction?

This question mirrors, almost exactly, a long-standing problem in health economics.

In their influential *American Economic Review* paper, Einav, Finkelstein, Ryan, Schrimpf, and Cullen (2013) study employee health insurance choices at Alcoa. They show that individuals with higher expected medical expenditures are more likely to select generous health plans, generating adverse selection. At the same time, more generous coverage increases utilization, creating moral hazard. Observational data alone cannot disentangle these forces because high claims may reflect who selects a plan rather than what the plan does.

Their key insight is that **failure to account for selection systematically biases estimates of moral hazard**. If sicker individuals disproportionately choose generous plans, analysts may mistakenly attribute high spending to coverage generosity rather than underlying risk. This leads to flawed policy conclusions—overstating inefficiency and misdesigning optimal contracts.

Flood insurance reform faces an almost identical identification problem.

In the flood context, **selection** appears as cherry-picking: private insurers disproportionately attract lower-risk properties, newer housing stock, or homeowners already inclined to invest in resilience. **Treatment effects** appear if private pricing and contract design actually change behavior—encouraging elevation, barriers, drainage improvements, or relocation.

Without experimental variation, improved outcomes under privatization may simply reflect who exits the NFIP, not whether private markets reduce flood risk.

Why Flood Insurance Is an Even Cleaner Setting

If anything, flood insurance offers an even cleaner setting than health insurance for disentangling selection and treatment effects.

First, flood risk is spatial, observable, and tied to physical characteristics of properties rather than unobserved health shocks. Second, mitigation investments—such as elevating structures or installing flood barriers—are lumpy, durable, and measurable. Third, flood losses are episodic and geographically concentrated, reducing ambiguity about outcomes.

Most importantly, moral hazard in flood insurance runs in the opposite direction of health insurance. In health insurance, coverage may encourage overuse of medical care. In flood insurance, subsidized coverage discourages precaution. When homeowners expect federal rebuilding, they underinvest in resilience. Private insurers claim that actuarial pricing reverses this incentive, rewarding adaptation and discouraging repeated losses.

But once again, without accounting for selection, we cannot know whether observed mitigation reflects incentives or pre-existing homeowner characteristics.

A Randomized Field Experiment in Flood Insurance

To resolve this empirically, I propose a randomized field experiment that explicitly separates selection from treatment effects.

In the first arm, Neptune would select properties for privatization using its existing underwriting criteria. These properties would exit the NFIP and receive private coverage. Outcomes tracked would include premiums, claims, loss ratios, and observable investments in

resilience. This arm captures the combined effects of selection and treatment and mirrors Neptune's preferred expansion strategy.

In the second arm, Neptune would be required to accept a randomized sample of NFIP properties, including a proportional share of high-risk homes. The same outcomes would be measured.

The contrast between these arms allows us to decompose performance differences. If loss ratios decline and mitigation increases even among randomly assigned high-risk properties, this would provide strong evidence of genuine treatment effects—private contracts changing behavior. If performance is substantially worse in the randomized arm, then cherry-picking dominates.

This design closely parallels the empirical strategy in Einav et al. (2013), replacing health plans with insurance regimes and medical utilization with disaster losses. The logic is the same: **without randomization, policy conclusions are unreliable**.

Implicit Subsidies and Political Economy

The experiment also quantifies implicit NFIP subsidies. Private-market pricing for randomly assigned high-risk properties reveals the wedge between actuarial risk and subsidized federal premiums. This makes visible what is currently hidden: the magnitude of taxpayer transfers to specific locations.

Here, Mancur Olson's logic re-enters. Homeowners excluded from private markets—often geographically concentrated and facing large losses—have strong incentives to lobby for continued subsidies. If privatization proceeds without evidence, political backlash is likely. If it proceeds with evidence, policymakers can better anticipate distributional consequences and design targeted transitions.

Why Piloting Matters

Large-scale institutional reforms fail when behavioral responses are ignored. Flood insurance reform reallocates risk, alters land use incentives, and reshapes political coalitions. Once households rebuild, relocate, or lobby, the equilibrium becomes difficult to reverse.

Treating privatization as an experiment rather than an ideology reflects scientific humility. It aligns with the broader theme of this book: markets work best when rules are tested, feedback is incorporated, and incentives are allowed to operate.

Just as health economists learned that ignoring selection leads to bad insurance design, disaster economists risk repeating the same mistake if privatization claims are accepted uncritically. Flood insurance provides a rare opportunity to get the economics right before the next disaster strikes.

The Political Economy of Insurance Subsidy Reform

Public opposition to ending insurance subsidies—whether through the National Flood Insurance Program, California's FAIR Plan, or similar residual-market schemes—has less to do with denial of rising risk than with three deeper concerns: distrust of private insurers, fear of sudden coverage loss, and the conviction that privatization merely reallocates risk rather than reducing it. Many homeowners readily acknowledge that decades of subsidized premiums have encouraged risky development and repetitive rebuilding. Yet they view reform as a direct threat to their property rights. When regulators allow risk-based pricing, property values in high-hazard zones can fall sharply. Owners often frame this as a regulatory "taking"—a government action that diminishes the economic value of their land and buildings without just compensation, echoing Fifth Amendment concerns.

Courts and politicians treat such devaluations as politically radioactive, even when the underlying policy (cheap insurance) itself distorted location choices in the first place.This is not a zero-sum contest between winners and losers; it is a negative-sum game. Affluent households in places like Pacific Palisades enjoy artificially low premiums that shield them from the true cost of living in the bull's-eye. Everyone else—taxpayers, renters, low-risk households, and future generations—bears a larger aggregate cost through higher taxes, distorted development patterns, and elevated economy-wide disaster losses. The subsidies inflate exposure to fat-tail

events, crowd out private adaptation, and ultimately make society poorer.Mancur Olson's classic analysis of asymmetric interest-group pressure explains why these inefficient policies endure. The beneficiaries form a small, concentrated, and highly organized bloc: homeowners and local governments in harm's way who treat subsidized insurance as an inviolable property right.

They lobby intensely to preserve the status quo. The losers—tens of millions of dispersed taxpayers and renters statewide—each lose only a little and face an insurmountable free-rider problem. Organizing to oppose the subsidy is simply not worth any single person's time. The result is policy lock-in long after the economic rationale has collapsed.

The Counterfactual: Life Without the Safety Net

Imagine the FAIR Plan and analogous backstops disappeared tomorrow. Homeowners in wildfire or flood zones would confront three options: pay full market premiums from competing private carriers, self-insure, or relocate. Competition would discipline prices, but coverage would reflect actuarial reality. Without a government backstop, individuals would suddenly bear the full financial weight of any disaster. That sharp incentive shift would transform passive homeowners into active risk managers. Many would redirect money once spent on artificially cheap premiums into verifiable mitigation—fire-resistant roofs, ember-proof windows, defensible-space landscaping, or community-level fuel reduction. New technologies (drones, satellite imagery, smart sensors) now make it inexpensive to confirm that these investments are installed and maintained.

Even if insurers discount some upgrades cautiously, any homeowner who believes the expected reduction in loss exceeds the upfront cost will still invest.Some owners would rationally forgo insurance altogether, accepting higher personal risk in exchange for lower ongoing expenses. In a nation of leveraged homeowners, this environment would also spur private innovation: equity partnerships with professional climate-adaptation managers who co-own properties and share both upside (appreciation in safer locations) and downside (joint decisions on resilience upgrades before resale). The tightrope walker without a net moves more carefully; the same logic applies to property owners who can no longer socialize their tail risk.A Practical Reform PathThe solution is straightforward: deregulate rates while protecting

competition and rewarding genuine risk reduction. Insurers should be free to charge forward-looking, risk-based premiums.

Regulators, in turn, should require or strongly incentivize explicit discounts for verifiable mitigation at both the property and community scale. Modern inspection technology makes enforcement cheap and objective. Empirical work would quickly reveal which investments actually pay off in lower claims. Homeowners who still wish to invest beyond what insurers credit would be free to do so—bearing the cost themselves but capturing the benefit.In 2025, millions of Americans own older homes now reclassified as high-risk. Insurers are raising premiums to match reality; incumbent owners are pressuring regulators for price ceilings. They seek a "free lunch": capital gains when markets boom, yet nationalized losses when insurance costs rise. Those who chose safer locations reap the reward of rising asset values.

Demanding subsidies is bad economics and worse capitalism, but it is shrewd politics. The moral hazard frustrates economists; it also supplies vivid classroom examples of how well-intentioned rules can make fat-tail disasters more frequent, more expensive, and more persistent.Disaster losses are not handed down by nature. They are shaped by the institutions we choose. Ending insurance subsidies is politically difficult precisely because it forces a reckoning with property rights and takings. Yet the alternative—perpetual negative-sum redistribution—guarantees larger losses for everyone.

The Resilience Benefits of an Unregulated Insurance Market

When the insurance industry is unregulated, it pushes individuals to seek housing in relatively safer places. The insurance industry has access to actuarial science data highlighting these safer locations. This situation illustrates that even if someone is a climate denier or unaware of which areas are at low risk for wildfires and floods, they will still seek safer housing if they notice significant differences in insurance quotes. However, if zoning laws prevent developers from building housing in these safer areas, individuals may face higher prices when trying to move to higher ground.

Imagine a scenario where a homeowner is aware of the risks in her area and worries that there is a certain percentage chance her home might burn down within the following year. The

insurance company's actuaries agree with her risk assessment, and because she is risk-averse, she decides to purchase a policy.

For instance, a million-dollar policy for a home located in a low-risk area might be priced at $X. The insurer, like State Farm, would evaluate the situation and could say, "Based on your location and the characteristics of your house, we will charge you $Y for a one-year policy that will pay out a million dollars if your home burns down." However, the insurer might propose an alternative: "We will conduct weekly aerial surveillance using a drone. If you improve your roof or clear vegetation around your property, we will lower your insurance rate from $Y to $Z."

This example illustrates a positive incentive for homeowners to enhance their defenses. It shows how slightly reducing premiums can encourage proactive measures against risks. Unfortunately, current government regulations and subsidies often hinder such innovative contracts. We are not experimenting enough, leading to a slower learning process regarding the demand for these agreements and their potential effectiveness.

To illustrate the situation further, imagine a neighborhood in Pacific Palisades with a thousand homes in a fire zone. Some homeowners take proactive steps to protect their properties from fire risks, while others do not. Over a few years, a statistician would likely analyze whether the homes implementing protective measures were less prone to burning down.

This raises the question of whether the insurance industry accurately assesses the risks. In this hypothetical scenario, there remains a certain percentage chance that a home will burn down if no precautions are taken. If homeowners adopt certain precautions, the insurance industry might reduce the premium on a million-dollar policy from a specific amount (say $X) to a lower amount (like $Y).

A researcher could then study the probability that the homes in this selected sample implemented precautionary measures. Suppose that for those homes that took these precautions, the chance of burning down was only Z%. In this case, if the homeowners did not take any precautions, the expected cost to the insurance company for the million-dollar policy might be estimated at $C. However, if precautions were taken, the insurance company would charge $Y

for the policy, while the expected payout for these insured homes would only be $D due to the reduced risk of a fire.

Therefore, if the insurer collects $Y in premiums but only expects to pay out $D, they would likely profit from encouraging precautionary investments. This scenario illustrates how profit-driven, free-market firms can create contracts to incentivize homeowners to take voluntary, costly steps to protect their assets.

By safeguarding their homes, homeowners decrease the likelihood of their houses burning down, reducing the insurer's risk of having to write substantial checks. This situation exemplifies how microeconomic incentives can be structured to help mitigate the risks associated with climate change.

Furthermore, in an interconnected community where homes are situated close to one another, promoting precautions among individual homeowners can reduce the overall fire risk for their neighbors. Encouraging a subset of homeowners to adopt these protective measures can decrease the chances of triggering a domino effect that leads to widespread wildfires.

Contingency Planning

Over time, the insurance industry is discovering new ways to profit by offering innovative insurance policies. When I was young, I was fascinated when I would read that Lloyds of London was injuring a NBA basketball player’s ankles or a famous Movie Actress’ legs from being damaged.

EYE / PEOPLE

Legging It With Lloyd's of London

A host of celebrities and athletes have had their famous legs — and feet — insured by the specialist insurance house for $1 million or more.

By KARYN MONGET FEBRUARY 21, 2012, 12:01AM



Most insurance contracts are simple contingency contracts such that if event X occurs then payoff of dollars $Y will be triggered. For example, if the structure is destroyed then the insurer writes the check to the victim. An actuary, equipped with data and knowledge of the geography of the building at risk, can calculate the probability that a building will be damaged or destroyed within the next year. If there is competition in the insurance market, that policy will be priced in a way that creates mutually beneficial outcomes for both the buyer and the seller.

Now suppose that a disaster such as an earthquake or a fire does not destroy a property but instead has damaged it in hard to measure ways. For example, UCLA is a major university situated in an earthquake zone, with students living in dormitories. The university's leadership is aware that students could be at risk in the event of an earthquake. If an earthquake forces an evacuation of dormitories on campus, the university may incur significant costs. After such an event, it may take some time for building inspectors to evaluate whether a building that is still standing is structurally sound.

From an outside perspective, it may seem that the building has survived the earthquake, leading a naive observer to believe that everything can return to normal. However, a more nuanced view is that the earthquake could have destabilized the building in ways that might result in future collapse. Building inspectors have the challenging task of examining each structure to determine its continued safety.

In the short run, the need for evacuation creates a displacement effect. UCLA has a fiduciary duty to find alternative housing for displaced students. Given that housing in West Los Angeles is expensive, accommodating these students in hotels or Airbnbs around the Westwood campus could quickly lead to costs in the hundreds of thousands of dollars. This scenario is an example of what insurers are now willing to cover.

For instance, if a hospital needs to evacuate patients due to an earthquake, considerations must be made about where to relocate the patients, especially those who require similar care. Additionally, questions of who is responsible for the costs associated with moving these individuals arise. As long as a customer can articulate a scenario they are concerned about, insurers can begin to create coverage for such contingencies.

This highlights the importance of risk-sharing in insurance markets. Without insurance, when an entity like UCLA experiences a catastrophic event, such as an earthquake that destroys a dormitory, the disruption can be significant. In a more moderate scenario, if a building is still standing but deemed potentially unsafe, there may be delays of months while inspectors assess structural soundness.

Ultimately, this reflects the importance of ingenuity and foresight. Our ability to anticipate and prepare for unexpected contingencies fosters the creation of mutually beneficial contracts that account for these surprising scenarios, which economists refer to as "states of the world."

As long as selling insurance is profitable over the long run, then for profit firms will enter this market. A key question here to pertains to what triggers a payment. If insurers never payout to victims, even when horrible events occur, then people would no longer buy insurance. Conversely, if insurers are constantly paying out claims to victims, then the insurers are more

likely to go broke and not offer insurance! This discussion highlights that there has to be an agreed upon "triggering rule" such that both the buyer and the seller of insurance agree to what is a shcok that triggers a payment. For example, with hurricanes one measure of their intensity is their average windspeed. A parametric insurance policy might state that if the average wind speed exceeds 110 miles per hour, then any damage sustained at that time qualifies to receive an insurance payment.

> ## What is parametric insurance?
>
> In a parametric insurance policy, the loss amount is pre-agreed. The policy pays out when an event – in this case, a tropical cyclone related wind speed – meets or exceeds a certain level. For STORM, we use the highest wind speed reported at the insured's location(s) during the duration of a tropical cyclone. Discover more of our parametric insurance.
>
> By using the reported wind speeds at the insured's location(s), STORM is designed to closely mirror what the customer experiences during the storm. Just days after a tropical cyclone makes landfall, we receive a high-resolution wind map. We find the highest one-minute sustained windspeed during the hurricane at the policyholder's location(s), and determine payout based on this wind speed. This allows for policy holders to recover proceeds for tropical cyclones that have a meaningful impact at their locations.
>
> We team up with the leading tropical cyclone windspeed data providers worldwide. In the Atlantic (U.S and the Caribbean) the Eastern Pacific and the Central Pacific, we use Moody's RMS HWind. In other parts of the world, we use Reask.

Weblink from SwissRe

The Insurer as the "Adult in the Room"

This tweet is worth studying

https://x.com/JamesOKeefeIII/status/1897348565082759686

Kirkpatrick bluntly critiqued California residents, stating, "People want to build in areas where they want to have, like, natural areas around them for their ego. But it's also a f*ing desert. And so, it dries out as a tinderbox." He also acknowledged that wildfires in these areas are not surprising to insurance professionals, claiming, "Climate change is pushing these seasons." He explained, "If you're an insurance professional, it's predictable."

Kirkpatrick also admitted that State Farm's decision to pull out of the California insurance market was a calculated move in response to financial concerns and state regulations: "Our people look at this and say, 'Sh*t, we've got, like, maybe $5 billion that we're short if something happens.'" He revealed, "We'll go to the Department of Insurance and say, 'We're overexposed here, you have to let us catch up our rate.' And they'll say, 'Nah.' And we'll say, 'Okay, then we are going to cancel these policies.'"

State Farm, which previously covered over a million homeowners in California, provided insurance against fire, theft, and other damages. However, their decision to withdraw coverage has left thousands of residents without financial protection following devastating wildfires. "Like a good neighbor, State Farm is there," except for the Californians now facing the aftermath of destruction without insurance coverage.

Discrimination Cases and the Courts

Insurance firms may be able to engage in risk pricing but be afraid to if these yield lawsuits as adjacent neighbors are charged different rates and the higher priced person claims "foul". This tax on price discrimination is another reason to allow the equity partner!

There is a broad disdain for "statistical discrimination" across many applications. Risk-based insurance that reflects the risk of the specific property and neighborhood may fall prey to the same complaints—"the evil insurance company charges more for insurance in my

neighborhood because we are [list of reasons that exclude risk].” Could insurance companies escape legal/reputation risk from charging different premiums that, say, varied by race/income based on differential risk assessments?

Another issue raised by the Op-Ed is how much does a specific insurance policy premium reflect mitigation by the household vs mitigation by the broader surrounding area? He may have invested significantly in local mitigation, but this might have only marginally reduced his fire risk if the broader area did little to no mitigation. This reflects the complementarity between mitigation efforts in close proximity.

Housing Equity Partnerships as a Substitute for Insurance

In 2004, a prominent economist wrote a paper titled "Neglecting Disaster: Why Don't People Insure Against Large Losses?" The abstract of the paper indicates that it provides a theoretical explanation for the common observation that individuals often fail to purchase insurance against low-probability, high-loss events, even when it is offered at a favorable premium.

The authors hypothesize that individuals maximize expected utility but face explicit or implicit costs in discovering the true probabilities of rare events. This cost constitutes a threshold that may inhibit insurance purchases but can be offset in several ways by insurance suppliers and state regulators.

This hypothesis raises interesting questions about learning. The paper was written over 20 years ago when the media was not discussing disasters as frequently as it does today. The authors tell a story about how people acquire significant assets, like homes in specific locations, and that some of these homeowners might be blissfully unaware of the risks they face. If climate change raises those risks, this ignorance becomes even more costly, as it relates to expected losses: the probability of a bad event multiplied by the potential damage, should such an event occur.

The authors suggest that individuals with valuable assets are underinsured, thereby taking a gamble without realizing it. This topic ties into behavioral economics. However, I don't believe the authors present any empirical evidence in the paper. The crucial details lie in understanding what percentage of homeowners in various locations fall into the category of naive individuals who are blissfully unaware of the probabilities of adverse events.

Now, imagine a situation where insurance companies begin to retreat from specific areas, as we currently see in California. In this context, even someone without a background in climate science might wonder why insurers are becoming less willing to write policies. Do they have information that I do not?

For instance, if you observe a crowd rushing to a pizza place, the pizza must be excellent. Conversely, if your insurance company, which has consistently provided you with reasonably priced policies in Pacific Palisades, suddenly drops you as a customer, it raises questions. If no other insurance companies approach you to offer their policies, you will undoubtedly notice that you are no longer receiving insurance offers. This silence would signal that something is happening.

The paper's authors imply that homeowners are making substantial investments without seeking information about the world. Their perspective is akin to suggesting that five-year-olds should own homes, which I reject.

If individuals own valuable properties in areas prone to risk and do not purchase insurance, they are aware of their ignorance regarding the risks involved. They have options: they can hire a trusted expert to provide a second opinion and educate them, or, in today’s landscape of private equity, they could invite a private equity investor to buy half of their home, thereby diversifying their risk. For example, if someone owns a $3 million home in Pacific Palisades, selling half of it could yield $1.5 million in cash from a private equity partner. They could then invest that money to diversify their income, implicitly insuring themselves against substantial shocks while allowing the private equity partner to assume part of the risk.

How the financing works between the homeowner and the private equity partner is crucial, particularly when agreeing on which remedies to pursue to protect the property. Conflicts can arise; for instance, the homeowner may want to save cash for a daughter's wedding, while the private equity partner might be more focused on investing around $100,000 in-home upgrades, expecting the homeowner to cover half of that cost. This illustrates potential

disagreements between the two parties. A well-structured contract would detail how these parties make joint decisions regarding their shared asset.

In my discussion of a behavioral economics paper from 2004, the authors present a puzzle suggesting that homeowners tend to underinvest in insurance. They argue that homeowners face significant tail risk due to this behavior. In an evolving economy, this issue must be addressed as a priority. Even if the insurance industry is currently retreating, housing partnerships can serve as a viable alternative.

Insurance Subsidies Discourage the Rise of Housing Partnerships

In regions at risk of wildfires, homeowners will recognize the challenge they face and they will be motivated to take action. In this scenario, a private equity partner would not reside in the house but instead pay the homeowner and collaborate with them to make investments to protect the asset. When the homeowner sells the house in the future, the partner will receive half of the sale proceeds. This is just one example of a potential contractual arrangement.

With such a contract, the amateur homeowner understands that they lack the expertise to fully manage their property, as they have not been formally trained in home management. Owning a home entails a learning curve. However, if they enlisted the help of a professional management company, that company would possess the data, knowledge, and access to capital necessary to help finance and protect the asset. This consideration is critical in states where insurance is not subsidized.

A private equity partner is incentivized to research protective strategies, which can encourage entrepreneurs to develop innovative solutions. For example, many entrepreneurs are actively creating electric vehicles. If more private equity funds were directed toward homes in fire-prone areas, there would be a heightened demand for products designed to protect these homes from wildfires.

Some Economic Analysis of the National Flood Insurance Program

The National Flood Insurance Program (NFIP) was established by Congress in 1968. Approximately 5 million homes are insured under this program, with a significant number located in Texas and Florida. The NFIP allows property owners in participating communities to purchase insurance protection administered by the government against losses from flooding. The NFIP creates flood risk maps trying to educate the public about risks. An unintended consequence of such "bright line" maps is to raise the possibility of lulling some property owners into thinking they face low flood risk if their property is situated outside the NFIP "flood zones". The public sector has weak incentives to continuously update and research these maps because they do not lose profit if they misclassify homes as "safe" when they are truly risky.

In recent years, the NFIP has been running a deficit. When major hurricanes occur, such as Hurricane Katrina, Hurricane Sandy, or Hurricane Harvey, homeowners in these NFIP areas receive compensation from the government, which ultimately comes from U.S. taxpayers. As a result, the government insurance program has been losing money, effectively being subsidized by the American taxpayer.

Several questions arise from this situation. When the government subsidizes insurance, is it merely transferring money from residents living in safer areas to those residing in flood-prone regions? Furthermore, does the existence of subsidies for homes in these flood areas encourage excessive development in vulnerable locations? If the latter is true, then the perverse incentives built into subsidized flood insurance could be even more costly for society.

Ultimately, this is an empirical question. Researchers examining the NFIP have argued that the program is not as generous as it may seem; substantial compensation checks are not commonly issued to victims after flooding. Behavioral economics researchers in this field suggest that individuals living in communities that enroll in the NFIP tend to overestimate the payoffs they will receive during a disaster.

While this claim is interesting, I want to focus on a different point. What if the National Flood Insurance Program did not exist? Given the deficit it is facing, there are discussions about abolishing the NFIP. Some Congress members representing affected areas strongly advocate for maintaining these subsidies for their constituents.

Imagine if the NFIP were abolished. In this scenario, without interference from state regulators, the private insurance market would have a greater incentive to research and develop expertise in assessing flood risk at the property level. Private insurers, driven by profit, would seek to maximize their earnings; their profit is greater when they collect more premiums than they pay out in disaster claims.

One might speculate that this could lead to "cherry-picking," with private insurers offering lower prices for homes in low flood-risk areas while charging higher prices for properties located in floodplains. While this is certainly possible, these insurers would conduct thorough research in an unfettered market.

They would likely provide sophisticated contracts, offering homeowners in floodplains reduced rates if they take verifiable preventative measures. These could include significant investments, such as elevating a house on stilts, along with various other flood protection strategies that could be verified through inspections and drones. Should homeowners implement these precautions, insurers would charge lower premiums.

Implementing these precautions decreases the likelihood of a house flooding, allowing private insurers to offer policies at lower prices if homeowners in flood-prone areas take appropriate flood protection measures. However, this scenario relies on insured homeowners doing their research. They are likely to do so only if they don't feel they're competing with the federal government, which currently provides flood insurance at lower prices due to taxpayer subsidies in higher-risk areas. If the federal government were to withdraw from offering flood insurance, the competitive pressure would diminish, and private insurance companies would reevaluate insuring these properties.

We can draw a parallel to health insurance. During President Obama's administration, the expansion of healthcare insurance included the mandate that all Americans must purchase some form of health insurance—this mandate aimed to create a market, which can be seen as a debatable approach.

Similarly, the federal government could require all homeowners to have a minimum flood insurance. There will be homes in certain areas where flooding is deemed unlikely, and homeowners may object to the requirement of purchasing $100,000 in flood insurance coverage. However, if insurers, through their research, determine that the flooding risk is very low, the premium for a $100,000 policy in such low-risk areas would be correspondingly low.

Thus, this wouldn't impose an unfair burden on homeowners in less vulnerable areas. Moreover, if there were a government mandate requiring all homeowners to obtain flood insurance, it would help stimulate the market. Private insurers would then recognize the existing demand for this product. They could employ engineers, experts, and data scientists to develop and price flood insurance policies in a way that ensures profitability for their firms. There would be a larger market if all homeowners were required to hold some form of flood insurance.

A libertarian might have mixed feelings about this idea. Under my proposed rules, we are utilizing markets—rather than federally subsidized insurance—to address the flooding challenge. In this scenario, the private insurer acts as the responsible party, guiding the sometimes uninformed homeowner to take preventative measures.

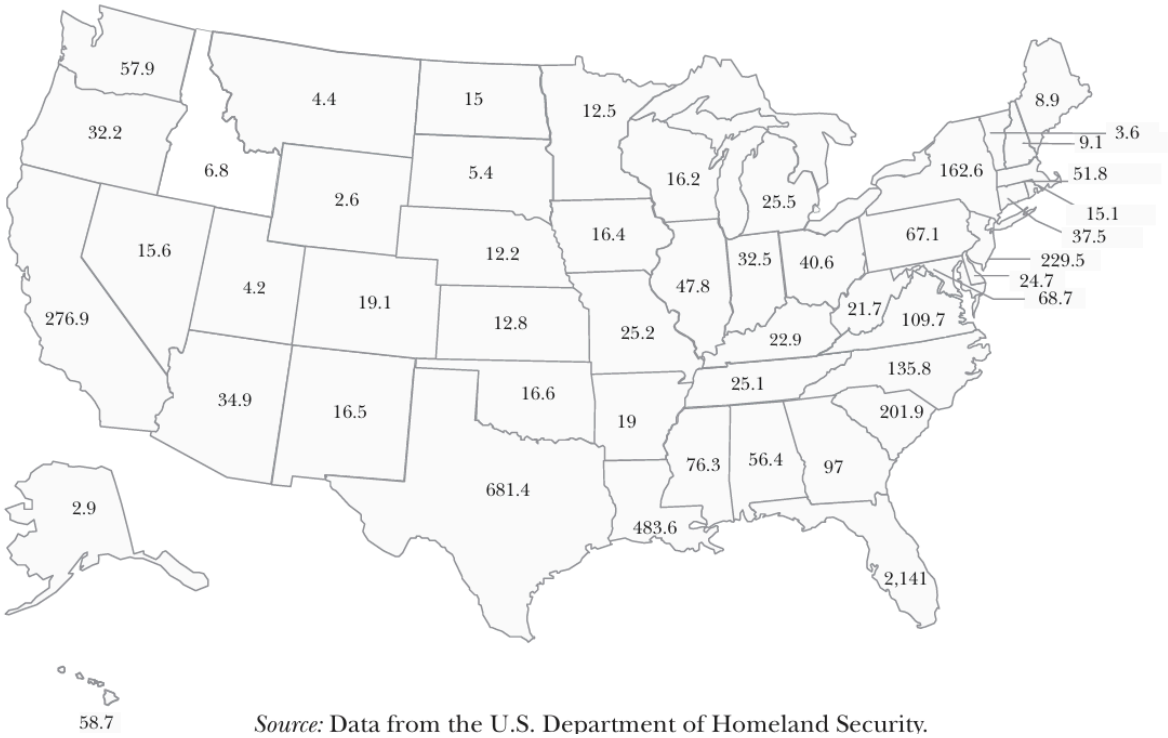
If homeowners took such steps, they would pay less for insurance, especially since they could no longer rely on the federal government if the National Flood Insurance Program were to cease. However, a libertarian might feel uneasy about suggesting that it benefits society to mandate that everyone hold some flood insurance. A staunch libertarian would argue that individuals should have the right to opt out of this requirement, similar to the argument that motorcycle riders shouldn't be required to wear helmets.

Take a look at this Figure below from 2010. States with more NFIP policies feature home owners and communities being subsidized by the rest of the nation for their flood risk. Such spatial subsidies distort incentives (due to the moral hazard effect) and they impose unfair tax burdens on those who live in safer areas who have to pay the higher taxes to subsidize the gambles taken by those who choose to live in flood zones. I think of this as a fundamental property rights issue. Nowhere in the U.S Constitution does it say that people have the right to be subsidized for living in a flood zone!

Figure 2

Number of NFIP Policies in Force by State, as of March 31, 2010

(in 1,000s)



Source: Data from the U.S. Department of Homeland Security.

Source

To summarize this section, a key theme in this book is the development of resilience and skills. People are not powerless; we can develop new skills at any age. The question arises about what incentivizes individuals and companies to invest in specialized skills that enhance resilience, whether mitigating wildfire or flood risk. If the federal government retreats from its role and stops subsidizing insurance, the private insurance market will be more motivated to offer property insurance that focuses on flood and wildfire risks. These entities will invest in the

necessary personnel and resources to develop these skills, which will, in turn, boost their profits.

Insurers will then create nuanced contracts encouraging property owners to take more precautions. This creates a domino effect, as insurers act as the responsible party, motivating property owners to make precautionary investments. This, in turn, creates a secondary market for advancements in resilience investments, such as methods to protect homes from wildfire and flood risks. While building houses on stilts is one example of flood protection, a more innovative engineer may devise the next billion-dollar industry once insurers prompt property owners to invest in these precautions. If property owners take these precautions, they will ultimately pay less for insurance. In this way, price variation and differential pricing incentivize property owners to seek resilient solutions, prompting entrepreneurs in the resilience industry to engage.

Personal Reflections on California's Insurance Dilemma

As I revise this book in November 2025, the challenges of natural disaster insurance have become deeply personal. My family owns a third-floor, two-bedroom condominium in a 1975-era building in Carpinteria, California, located about a mile from the beach and, we believed, outside high-risk wildfire zones. Yet, we've encountered significant difficulties in securing coverage. Our previous carrier dropped us, and finding a new one has proven elusive, despite our primary concern being not wildfires but potential flooding or water leaks that could damage lower units and expose us to liability suits. While we could self-insure and have taken proactive steps—like hiring plumbers to inspect the aging infrastructure—we'd prefer a policy for those rare, unforeseen events. This experience highlights a broader market failure: we demand insurance, but under current rules, we can't even obtain a price quote to explore mutually beneficial trades with providers.

This predicament stems largely from regulatory constraints in California, where insurers face uncertainty about objective risks, particularly for wildfires amid climate change. A prudent insurer might retreat temporarily or invest heavily in research to distinguish low-risk from high-risk properties—a process known as "cream skimming." There are two key strategies here: first, identifying assets where the true risk is lower than competitors perceive, perhaps using big

data to offer competitive deals; second, incentivizing owners (especially those who are responsible and financially stable) to adopt protective measures, reducing net risk and ensuring profitability. For example, consider a $5,000 annual premium for $400,000 in coverage. If owners' actions lower the disaster probability from 2% to 1%, the insurer's expected payout drops to $4,000, yielding a $1,000 profit.

In the economics of insurance, you can either identify places and properties where you think the objective risk is lower than what your rivals think, and come up with a mutually beneficial deal with the person seeking insurance, or you can incentivize the owner of this property, especially if they're compos mentis and deep-pocketed, to take proactive steps to protect the property so that its objective risk is lower relative to the premium paid, ensuring expected profit.

Insurers' retreats in California may reflect game-theoretic negotiations with regulators, particularly Insurance Commissioner Ricardo Lara, or genuine fears of losses due to "time consistency" issues—where continued coverage invites demands for subsidies or extractions. That insurers are stepping back in states like California could mean they're worried about a time consistency issue with the regulator, that if they continue to insure, the regulator will demand more extractions and larger subsidies.

As of November 2025, the crisis persists: major carriers like Farmers are lifting policy caps and proposing modest rate hikes (e.g., 6.99%), hailed by Lara as a "turning point" to reduce FAIR Plan reliance, while Governor Newsom signed reforms to stabilize the market. Yet, fire survivors and critics, including Consumer Watchdog, call for Lara's resignation, accusing him of backroom deals allowing policy drops, rate spikes, and claim delays.

Lara's goals appear multifaceted: stabilizing availability through reforms like catastrophe modeling and mitigation discounts, while protecting consumers from "arbitrary hikes." He supports a "whole-of-government" approach for resilience but faces backlash for proposals seen as retaliatory against intervenors, potentially reducing oversight. Does he reject a fully competitive market without regulations? Not entirely; his strategies update Prop 103 to foster competition by aligning prices with risks, but he insists on safeguards, viewing unregulated markets as prone to abuses. His keenness to regulate stems from political pressures—balancing voter demands for affordability, industry viability, and equity for vulnerable groups—revealing a bureaucracy prioritizing broad access over pure market freedom.

If a property is risky, economists advocate raising premiums until a contract is viable; undercutting by rivals would simply reflect healthy competition. Yet, we're not seeing this play out, as regulations cap charges and restrict data usage in pricing models. California's framework hinders this. Price ceilings under Proposition 103 (passed in 1988) prevent insurers from charging rates that fully reflect risks, leading to retreats rather than competition. Proposition 103 emerged from 1980s public outrage over soaring rates, perceived industry profiteering, and a shift from a "file and use" system to mandatory prior approval. Sponsored by consumer activist Harvey Rosenfield and Voter Revolt (now Consumer Watchdog), it mandated a 20% rate rollback, elected the Insurance Commissioner, and enabled consumer groups to intervene in rate hearings, often receiving fees for successful challenges. Interest groups lobbying for it included consumer advocates, trial lawyers (who preserved liability rules), and broad coalitions representing millions of Californians frustrated with 40% auto rate hikes in prior years. The insurance industry opposed it fiercely, spending over $80 million, arguing it would reduce competition and drive exits. While it initially stabilized rates and saved consumers billions, critics now blame its rigidity for today's crisis, where insurers can't incorporate forward-looking models or reinsurance costs without approval, exacerbating withdrawals amid $50+ billion in wildfire losses since 2017.

Moreover, regulators limit attributes in machine learning models for risk assessment, prohibiting factors like race, ethnicity, or income to prevent discrimination. This raises questions: Can insurers use household data (e.g., number of children, arrest records, or smoking predictors) that might correlate with fire risks? Such "algorithmic profiling" could refine pricing but risks unfairness.

My claim is, in the case of natural disaster insurance, that insurers would be more likely to stay in the game and write policies if they didn't face price ceilings, and if they could use any data they want in their algorithms, to predict in their pricing models of how to charge for insurance. It has to be the case that the state regulator's actions on a whole bunch of the things we've been talking about here reduce the profitability and increase the risk for the insured. So it's in this sense that the insurance regulatory's rules of the game inhibit new policies from being written and renewed. Now, there's a question: Who does the insurance regulatory agency think they're benefiting with their rules? And what is their implied objective function? If they make it harder for me and Dora to get insurance, there must be others in California who are winning. And of course, economists use revealed preference techniques to try to infer this revealed preference of bureaucracy.

How Liability Lawsuits Slow Disaster Adaptation

Natural disasters often involve spatially correlated risks. One household's neglected vegetation or missing defensible space can ignite or flood an entire neighborhood. This creates classic free-rider problems: individuals underinvest in prevention, expecting neighbors to bear the cost. Homeowners associations can partially solve the coordination failure by internalizing externalities, much as a shopping-mall owner aligns tenant incentives.Standard economic models assume that once a shock hits, victims quickly rebuild or relocate. In practice, liability rules can powerfully distort those incentives. When deep-pocketed defendants—especially utilities—are potentially liable, victims gain a financial reason to prolong visible hardship. Delaying rebuilding, maintaining claims of ongoing suffering, and organizing collectively become rational strategies for maximizing settlements or jury awards.

The 2025 Eaton and Palisades Fires in Los Angeles offer a clear illustration. The fires destroyed more than 16,000 structures and generated roughly $40 billion in insured losses. Lawsuits against Southern California Edison, alleging a faulty transmission line sparked the Eaton Fire, quickly escalated toward $10 billion or more in potential liability. Although the utility offered expedited compensation in exchange for waiving litigation rights, many survivors held out for larger payouts through class actions and wrongful-death claims. One year later, rebuilding permits had been filed for only a small fraction of destroyed properties.Empirical evidence from workers' compensation, no-fault auto insurance, and mass torts (Exxon Valdez, Deepwater Horizon, asbestos) confirms the pattern. Litigation involvement consistently slows physical and economic recovery. Claimants report greater pain, longer disability, and extended time away from work—even after controlling for objective injury severity. In community-wide disasters, the lawsuit itself becomes a "secondary disaster," eroding trust and freezing rebuilding.

From a law-and-economics perspective, open-ended strict liability and joint-and-several rules amplify ex-post moral hazard. Victims are incentivized to demonstrate persistent harm; defendants may prolong proceedings. The result is a much slower transition back to a new equilibrium.Liability law serves a legitimate purpose in deterring negligence. Yet when it rewards delay, it raises the total cost of fat-tail disasters and retards adaptation. Clearer damage caps, expedited no-fault compensation tracks, or structured settlements could better balance

accountability with the urgent need for resilience. Disaster losses are not fixed by nature; they are magnified or minimized by the institutions we choose.

Chapter Nine: The Tradeoffs in Phasing Out Public Insurance

Who owns the right to a government subsidy? That blunt question sits at the heart of flood-insurance reform. Taxpayers fund the National Flood Insurance Program's chronic deficits. Every dollar of subsidy that keeps premiums artificially low in high-risk zones is taken from someone else—renters in safe neighborhoods, families in low-tax states, future generations who inherit the debt. The program does not create flood risk, but it turns a natural hazard into a far costlier, man-made disaster by rewarding risky location choices and discouraging private resilience. Disaster losses, as this book has shown, are endogenous: they depend on the rules we write.The National Flood Insurance Program: A Case Study in Distorted IncentivesLaunched in 1968 after private insurers fled the flood market, the NFIP was meant to be a temporary bridge. It would make coverage available, nudge communities toward basic floodplain rules, and spare taxpayers endless bailouts. Fifty-five years later it insures 4.7 million properties, carries more than $22.5 billion in Treasury debt, and has become a permanent fixture that does the opposite of what it promised.Chronic underpricing, outdated maps, and heavy cross-subsidies send the wrong price signal: "Build anywhere; the rest of the country will help pay."

Risk Rating 2.0, FEMA's 2021 attempt at actuarial fairness, improved matters by pricing individual properties instead of broad zones. Premiums for the riskiest homes rose, mitigation ticked upward slightly, and some cross-subsidies shrank. Yet political backlash was instant. Homeowners facing sticker shock lobbied Congress for caps and delays; coverage rates actually fell in some communities. The deeper problem remains: a government monopoly cannot replicate the relentless innovation and real-time price discovery of competitive markets.I favor full privatization for three reasons. First, private carriers compete on more than price—they compete on product design, mitigation discounts, and rapid model updates. Second, market prices are far harder for organized interest groups to manipulate than bureaucratic rates

(Mancur Olson's logic again). Third, and most important, only competitive markets price genuine uncertainty—the "known unknowns" of climate change, land-use shifts, and infrastructure decay—fast enough to drive continuous adaptation.

Efficiency Versus Equity: The Neptune Flood Experiment

Enter Neptune Flood, a technology-driven managing general agent that uses AI to price flood risk at the individual-house level. Policies are issued in seconds and backed by thirty-nine private carriers and reinsurers. The market response has been striking: higher coverage limits (up to $4 million), broader protections (basements, living expenses), and—for many properties—premiums below the NFIP's subsidized rates.Neptune's CEO offers a practical exit ramp: stop issuing new NFIP policies while letting existing ones renew. The federal program shrinks to a true insurer of last resort for the 5 percent of properties that genuinely cannot be insured privately. The remaining 95 percent migrate to the market, drawing on global reinsurance capacity and eliminating the disruptions caused by government shutdowns.

Critics immediately raise the equity objection: "Cherry-picking!" If private insurers take the good risks, the NFIP is left with the worst, premiums explode for the remaining homeowners, and Congress will be pressured to restore subsidies. The political-economy trap is real. Concentrated flood-zone owners lobby hard; diffuse taxpayers lose a little each and rarely organize.But the efficiency question is empirical, not ideological. Is Neptune's advantage pure selection, or does its granular pricing and mitigation incentives actually reduce expected losses? The only honest way to find out is a randomized field experiment—exactly the kind of evidence-based test this book has championed.

- Arm 1 (selection + treatment): Neptune underwrites properties using its normal criteria and we track premiums, claims, and mitigation investments.
- Arm 2 (pure treatment): Neptune is required to accept a random sample of NFIP properties, including a representative share of high-risk homes.

If loss ratios fall and mitigation rises even in the randomized high-risk arm, we have proof that private contracting genuinely lowers the endogenous component of flood damage. If performance collapses once the easy risks are removed, cherry-picking dominates and the equity costs of transition become harder to justify. Either outcome makes the hidden taxpayer

subsidy transparent: when high-risk homeowners see real private-market prices, they see exactly how much the rest of the country has been quietly transferring to them.

Disagreement Among Economists: Incentives Versus Compassion

Economists agree on the goal—less suffering, lower total losses. The disagreement is about mechanisms. Some fear that leaving markets alone will abandon the vulnerable. Others fear that interfering with markets will lock in ever-larger losses by dulling incentives and slowing adaptation. This is not a contest between the compassionate and the callous; it is a contest between two views of how the world works.The March 2026 Brookings report captured the latest flashpoint. As wildfire and flood risks rise, private insurers are retreating from high-risk states, premiums are climbing, and mortgages are becoming harder to obtain. Ben Keys and Philip Mulder propose "US Re"—a new federal reinsurer of last resort that would absorb 75–90 percent of losses once an insurer's annual hit exceeds, say, $800 million.

In normal times nothing changes; in the rare mega-event the taxpayer backstop kicks in.Their concern is systemic risk. Without tail-risk reinsurance, insurers pull out, credit markets seize, and housing markets weaken. It sounds compassionate—protect the vulnerable, stabilize the financial system. But it raises the same efficiency-versus-equity tension that haunts the NFIP: once again, taxpayers are asked to absorb the fat tail so that homeowners in risky locations can keep their property values and insurance affordability. The subsidy becomes a de-facto property right, paid for by everyone else.Privatization forces a reckoning with that right. It asks whether society is better off letting competitive markets price risk, reward resilience, and reallocate capital—or whether we prefer to socialize the tail at collective expense. The randomized experiment proposed above lets us answer that question with evidence rather than slogans. In a world of genuine uncertainty about future hazards, the best insurance against policy error is rigorous data. That is how markets—and societies—adapt.

Chapter Ten: Farming Policies Distort the Allocation of Land and Water

Water and land are two of the most important inputs into economic growth. Every household needs water. Every business requires land. As populations grow and cities expand, societies face a fundamental challenge: how should these scarce resources be allocated among competing uses?

In a well-functioning market economy, prices help answer this question. Rising demand for water encourages conservation and directs supplies toward their highest-valued uses. Rising land values create incentives for property owners to convert land from lower-valued activities to higher-valued ones. These price signals help people adapt to changing economic and environmental conditions.

Agricultural policy often interrupts this adjustment process. Across the American West, farmers control vast quantities of land and water through a web of subsidies, regulations, and property-rights restrictions. Many of these policies were originally created decades ago when promoting agricultural production was viewed as a national priority. Yet the unintended consequences of these policies have become increasingly important as urban populations have grown and climate risks have evolved.

Consider California. Millions of households live in metropolitan areas that face high housing costs and periodic water shortages. At the same time, large quantities of water continue to be delivered to agricultural users at prices that often fall below market value. In many locations, farmers face legal and regulatory barriers that make it difficult to sell water rights or convert agricultural land into residential or commercial development. The result is a less flexible economy.

If water markets were more flexible, farmers could voluntarily sell water to growing cities when urban demand rises. If land markets were more flexible, agricultural land near metropolitan areas could be converted into housing and commercial development when the

value of urban uses exceeds the value of farming. Such transactions would increase the supply of housing, expand the geography of urban growth, and improve access to water for households and businesses.

These adjustments would also enhance resilience. Cities would have greater flexibility to respond to drought, population growth, and changing climate conditions. Rather than concentrating development in a limited number of locations, more abundant land and water supplies would allow households and firms to spread across a wider set of communities.

This chapter argues that agricultural policies distort choices along three important margins. First, crop insurance and other subsidies reduce farmers' exposure to downside risk and encourage production in locations that may be increasingly vulnerable to weather extremes. Second, subsidized water prices encourage excessive consumption of a scarce resource. Third, land-use restrictions and institutional barriers often prevent agricultural land from flowing toward higher-valued urban uses.

The result is an economy that adapts more slowly to changing conditions. Policies designed to protect agriculture can inadvertently reduce the resilience of the broader society by preventing land and water from moving to where they create the greatest value.

The Resilience Consequences of Cheap Water for Farmers

The first set of policies concerns farmers who often have the property right to very cheap water in Arizona and California. While farmers do have legal rights to this inexpensive water, they also face an unusual situation. Typically, owning a resource means you have the right to sell it. This right creates incentives to consider opportunity costs. For example, if you own a pair of shoes you value at $20, but someone else is willing to pay $200, you would likely sell them because they value them more highly.

However, this principle does not apply to water in the American West. Farmers have the legal right to cheap water but cannot sell it on an open market, which creates constraints in certain scenarios. For instance, if a real estate developer in Phoenix, Arizona, needs to supply

water to residents in a growing condo complex, they face the challenge of ensuring sufficient water for showers and toilets in a drought-prone region.

Meanwhile, alfalfa farmers in the same area are growing water-intensive crops. One might expect these farmers to sell their water to developers willing to pay a fair price or switch to a less water-intensive crop, allowing for continued farming while trading with an entity prepared to pay more for that scarce resource. However, due to current laws in the American West, farmers are fortunate to have rights to this cheap water, yet they are often unable to sell it to other entities that need it. I want to discuss the resilience of the agricultural sector and the consequences of state and federal regulations that are both slowing down this sector's adaptation to emerging risks and, in turn, affecting cities in ways I will explain.

Localized disasters matter more in populated areas. For example, an earthquake in a less populated region has less significance than one in a densely populated area. Take the Los Angeles fires, for instance. Many people owned valuable homes in the affected areas, putting both lives and capital at risk during the fires. Americans tend to live along the coasts and rivers, while vast sections of the country have relatively few inhabitants. This is especially true in places where we grow food, such as Kansas, Iowa, and North Dakota—regions with large swaths of land and few people.

This issue became even more important after the Los Angeles fires in January 2025, which sparked an ongoing discussion about why there wasn't enough water in the reservoir. Water serves various purposes beyond agriculture, such as for showers or outdoor irrigation; it’s also crucial to have a reserve in place for emergencies like wildfires. This is similar to the inventory challenges we faced during COVID-19, particularly concerning hand sanitizer.

An unintended consequence of our water allocation rules, particularly in the American West, and our refusal to establish water markets is to hinder wildfire resilience. Real estate developers struggle to access water in areas where they want to expand.

The Perverse Effects of Crop Insurance Subsidies

Another way government policy impedes resilience is through crop insurance policies. Imagine a scenario with no public crop insurance or subsidized coverage available. Farmers could instead purchase private insurance, where the insurer would agree to pay a certain amount

if specific weather conditions occur. Risk-averse farmers seek this insurance to ensure they receive compensation in the event of poor weather.

Conversely, a risk-loving farmer might think, “I can either gamble on favorable weather or diversify my planting strategy by cultivating more resilient crops.” However, that’s not what happens under the current generous Federal crop insurance policy. Economists have highlighted a moral hazard effect: farmers flip a one-sided coin. With subsidized crop insurance, farmers have less incentive to take proactive measures, such as planting heat-resistant corn or choosing crops more resilient to water scarcity.

Why is this the case? Farmers think about profit maximization: if the weather is good, they face no issues; if it is bad, the Federal Government will assist. This expectation of post-event financial help creates a moral hazard, encouraging them to take on more risks, with American taxpayers ultimately bearing the cost. For urban residents in California, this means we are partially subsidizing insurance for farmers.

So far, we’ve established two points regarding farmers. First, with subsidized water and a lack of water markets, there is a misallocation of water resources, meaning urban residents have less access to water than they would in a free market system. Second, generous Federal crop insurance policies discourage farmers from seeking innovative solutions to their resilience challenges. If a farmer in Kansas experiences a drought or rising temperatures, they would likely take more proactive steps to adapt if they didn't have access to subsidized Federal crop insurance.

Binding Land Use Regulations

Many farmers control significant amounts of land, some relatively close to cities like San Francisco. In an economy increasingly focused on remote work, land on the exurban fringe—perhaps 70, 80, or 90 miles from a city—has an opportunity cost. Zoning laws inhibit these farmers from selling their land to real estate developers.

As a result, more middle-class individuals and young people face skyrocketing housing costs. If farmers with agriculturally zoned land near productive urban areas could sell their land for development, it could help increase the housing supply and make cities more affordable for

the middle class. However, challenges such as rezoning farmland as suburban land and land conservation regulations hinder this process.

However, there are also costs to consider. In a society where we want more people to have more choices over where they live, if more agricultural land could be converted into residential land, how much would that expand the options for where people could live? Would that increase or decrease their exposure to risks?

For instance, some farmland is in very hot areas, such as California's Central Valley. If this farmland could be transformed into housing, we might see more people living in California but in areas far from the coast and very hot climates. This might be an example of maladaptation, as middle-class individuals could find themselves living in new houses built on previously farmland in high-heat regions. On the other hand, I envision situations where, if farmers faced fewer regulatory constraints in selling their land to real estate developers, more housing could be built in safer locations that face less risk from wildfires and flooding. The specific details would vary on a case-by-case basis.

Currently, our farm policies limit trades in water and land while cross-subsidizing inefficient farmers who do not take measures to protect themselves. This ultimately restricts the personal freedom of urban residents.

Counter-Arguments

A critic might argue, "Matt, urban residents need to eat, and we rely on farmers to grow food." While that statement is true, it doesn't hold the same weight in a globalized economy where the United States has low import tariffs. Other countries, like Mexico, can produce food for us. While successful individuals may prefer organic, locally grown products, most supermarket shoppers purchase imported items. Therefore, there is no justification for protecting American farmers in a world of international trade, especially during times of increased scarcity caused by drought.

Moreover, city land use regulations and our rising deficit complicate the situation. The key takeaway is that the unintended consequences of rules governing farming in our economy have equilibrium effects that lower the quality of life for urban residents, making them less resilient in the face of changing weather conditions across the country.

Chapter Eleven Do Federal Flood Control Investments Bolster Resilience?

In this chapter, I discuss the incentive effects introduced when the U.S. Army Corps of Engineers engages in flood control projects such as levees and seawalls to protect specific geographic areas from flooding risks. These infrastructure investments aim to safeguard individuals who are in harm's way during extreme weather events, presenting significant engineering challenges. An engineer who neglects essential economic principles might only consider the costs associated with constructing a levee and the ongoing operational expenditures required to maintain it over time, ensuring it remains effective and does not deteriorate. This engineer might measure the benefits of this infrastructure by assuming that the people who live in the protected area will not respond to the place based investment. Under "business as usual", they go about their lives as if the ACE didn't make this investment. I explore whether this "passive" assumption is valid.

The benefits of such projects include protecting individuals who would otherwise be at risk if these measures were not taken. However, assessing these benefits is a much more complex task. First, it is necessary to determine how many people are at risk. For instance, if a million people reside in a city that faces flood risks, it is acknowledged that one million people are vulnerable. Next, we must assess the marginal reduction in risk due to the seawall or levee constructed by the Army Corps of Engineers.

This assessment is challenging, as it requires specific parameters, including the baseline levels of flood and disaster risk. Consider flood risk New Orleans, with and without its levee system. If New Orleans lacked seawalls, what would the probability of flooding be in any given year? To understand this, we need to calculate the counterfactual—that is, the probability of flooding in an unprotected city or community near the Mississippi River. If a community near the Mississippi River experiences flooding without protections, we could track how often it floods over a specific period. Then, we would compare that to how often it floods with protective measures, providing a measure of the reduction in flood probability due to the Army Corps of Engineers projects.

Engineers typically assume that their projects do not create feedback effects. They operate under the belief that the population protected by the project does not alter its behavior based on the incentives created by the project. The United States has millions of residents, each deciding where to live and weighing their options. They could choose to reside in Los Angeles, Detroit, or New Orleans, among other locations.

From an economist's perspective, when the federal government invests in making a location like New Orleans safer, this investment effectively acts as an implicit subsidy, encouraging people to move there. Despite the flood risks, some individuals consider relocating to New Orleans due to cultural ties, family connections, or unique opportunities.

The unintended consequence of the Army Corps of Engineers' efforts to protect high-risk areas—whether in Miami, New Orleans, or along the Mississippi River—is that these locations become more appealing. While these efforts protect existing residents, they also incentivize others to relocate closer to these hazards and encourage people from other parts of the country to consider moving to these areas.

Individuals who were previously uncertain about moving to these locations are now more inclined to do so. Unfortunately, those conducting project evaluations for the Army Corps of Engineers often overlook this unintended consequence. To reiterate my point: Engineers who conduct or claim to perform cost-benefit analyses frequently ignore this feedback loop.

When discussing this issue with an economist, it is essential to understand that when an investment makes an area objectively safer, it increases its desirability. Consequently, demand for living in that area rises, leading some individuals to relocate there.

If this gravitational effect is large enough, the Army Corps of Engineers might be surprised to discover some fascinating—and frightening—data. An unintended consequence of investing in levees, which are designed to enhance safety, could be that more people ultimately die in a subsequent flood. Although this may sound paradoxical, let me explain why.

In a hypothetical world without federal taxation to fund flood protection in risky areas and without implicit federal infrastructure subsidies, many people would likely choose to avoid living there. As a result, areas like New Orleans would be perceived as objectively risky, leading to relatively few residents.

A Moral Hazard Example

Suppose just 100 people live in New Orleans, and there is a 1% chance of disaster that could wipe out the city. The expected number of deaths from flooding each year would then be calculated as 1% multiplied by 100, resulting in an expected one death per year. If the Army Corps of Engineers undertakes a project that reduces this risk by 50%, lowering it from 1% to 0.5%, one might assume that this would save lives. However, if the reduced risk increases the New Orleans population from 100 to 1,000 as people move to the newly upgraded city, then a new scenario unfolds. If the government's project to protect the area effectively discourages private self-protection, a population increase in New Orleans—from 100 to 1,000—could inadvertently result in more expected deaths.

Revisiting the calculations reveals an ironic causal relationship: as the area becomes safer, more people, on average, could die from flooding. While this may sound paradoxical, let me emphasize my point again. If the tendency for people to migrate to risky places is highly responsive to perceived safety, then if New Orleans' probability of a disaster decreases from 1% to 0.5%, that perception could motivate more people to move there.

Out of our initial population of 1,000, 100 people have decided to relocate to New Orleans, bringing the population to 1,100. According to my calculations, if each of these individuals faces a 0.5% chance of death from flooding, that would lead to approximately 5.5 expected deaths.

In that case, the Army Corps of Engineers has increased the population's exposure to risk. But how did this happen? This situation relates to the "crowding out hypothesis," which posits that when the federal government does not conduct projects to make places safer, individuals who want to live a long life seek to protect themselves. As a result, they tend to move to relatively safer locations. The opportunity cost of living in New Orleans is significant; people may choose to live elsewhere. If individuals adopt a mindset of rugged individualism, they might realize that no federal government is actively implementing large-scale projects to manage natural risks.

To reiterate, if the American public trusts the Army Corps of Engineers, when the Corps undertakes a significant multi-billion dollar project to upgrade flood protection infrastructure in a city like New Orleans or Miami, people may believe that the city has been made

climate-proof. This perception would increase the likelihood of people moving to that area, especially if it is desirable for other reasons, thus amplifying migration responses.

The unintended consequence of federal investment in infrastructure is that it can make certain areas more attractive, attracting more people to live there. If this infrastructure ages or fails, it could actually increase the expected number of people who might die in future flooding events due to the influx of new residents.

When evaluating whether the Army Corps of Engineers projects pass a cost-benefit test, it is crucial to ask essential questions; Do these projects primarily protect existing residents committed to the location, or do they attract many additional people? This latter effect needs to be quantified. Common sense suggests that this in-migration effect will be larger if the upgraded area is either beautiful or highly productive. If the protected location is ugly and unproductive then upgrading its safety is unlikely to lead many people to move there.

Local Public Goods Improvements Should be Financed Locally!

When it comes to local infrastructure projects, the federal government should provide expertise and guidance on what specific investments a particular location should pursue. However, flood prevention investments should be financed at the local level. For instance, if New Orleans is considering investing in seawalls, it should use its own funds, either by raising taxes on residents or by issuing municipal bonds. The proceeds from these bonds would then finance the project.

If local communities are responsible for financing their defenses, local companies, property owners, voters, and the media would engage in vigorous debates about the proposed projects. Residents would hold their local mayor accountable by asking questions such as, "Why is this project beneficial? Who will carry out the work? Will it be completed on budget, or will there be cost overruns?"

When localities use their own funds, it fosters accountability and aligns incentives. A mayor seeking re-election who proposes a protective project must consider that there is no free lunch. The project will be funded through tax increases or by issuing bonds that will need to be repaid. As homeowners realize they will face higher property taxes in the future, these costs will be reflected in their home prices.

If a city does not provide good public services while also having rising property taxes, home prices in that city are likely to be lower. Consequently, homeowners will earn a lower rate of return on their investments. When public finance decisions are decentralized and the locality benefiting from a project is responsible for funding it, voters tend to make better decisions.

Consider this analogy: when you go to a restaurant and have to pay your bill, you are more likely to carefully consider the menu than if someone else is covering part of your meal. If someone else pays a percentage of your dinner bill, try everything on the menu, ordering the most expensive drinks and entrees. In contrast, spending your money makes you more cautious about your choices.

When a city must spend its own money—whether through raising taxes or issuing bonds—it has much stronger incentives to evaluate the costs and benefits of a project thoroughly. Decision-makers must consider the opportunity costs of their choices; for example, they could have raised taxes to improve schools or invest in policing instead of allocating funds to flood protection. Spending your money forces decision-makers to prioritize—this is true for household budgets and a city's finances.

To summarize, an unintended consequence of the federal government financing and implementing large-scale infrastructure projects is that it may encourage people to move to higher-risk areas. This approach can also discourage localities from thoroughly examining whether a project is worthwhile and achieving accountability in monitoring contractors.

Decentralizing the Army Corps of Engineers' responsibilities to be financed locally would be advantageous during a time of large federal deficits. I would not advocate disbanding the federal Army Corps of Engineers, as ideas are public goods. The federal government should focus on data collection and analysis. For instance, if a city like New Orleans faces specific infrastructure challenges, lessons can be learned that could benefit other towns in the United States facing similar threats. The federal government can accumulate and analyze data, utilizing its satellite capabilities to assist localities in understanding their unique challenges. This enables the sharing of best practices and the dissemination of knowledge effectively. However, localities should retain the autonomy to choose which infrastructure projects they pursue and how to finance them. Put simply, local public goods should be financed locally!

Chapter Twelve Is the United States Over-Investing in Decarbonization and Under-Investing in Resilience?

Suppose climate change is increasing the frequency and severity of natural disasters. If that is true, then society faces two broad strategies for reducing future losses.

The first strategy is mitigation. We can invest in decarbonization to reduce greenhouse gas emissions and thereby slow the pace of climate change. The second strategy is adaptation. We can invest in making households, firms, and communities more resilient to whatever climate conditions emerge in the future. Stronger infrastructure, improved forecasting systems, better insurance markets, more resilient housing, and flexible land and water markets all fall into this category.

Both strategies require resources. Every dollar devoted to one approach is a dollar that cannot be spent on the other.

In recent years, the United States has dramatically increased its commitment to decarbonization. The Inflation Reduction Act and related federal initiatives directed hundreds of billions of dollars toward clean energy, electric vehicles, battery production, and other technologies designed to reduce greenhouse gas emissions. Supporters view these investments as essential for slowing climate change and encouraging technological innovation.

Yet this raises an important economic question. Given finite resources, has the United States devoted too little attention to adaptation and resilience?

If a portion of these funds had instead been invested in strengthening local resilience—hardening the electric grid, improving wildfire management, expanding water infrastructure, modernizing flood-control systems, or encouraging more resilient housing construction—how much disaster risk could have been reduced? Might such investments have generated larger benefits for American households over the next several decades?

The question becomes even more important once we recognize that climate change is a global problem. The benefits of decarbonization are dispersed across the entire world, while the costs are borne by the jurisdictions undertaking the investments. Economists have long described climate change as the ultimate global public-good problem. Every nation benefits when emissions fall, but each individual nation has an incentive to free ride on the efforts of others.

The United States remains one of the world's largest emitters, but it represents only a fraction of global greenhouse-gas emissions. Even aggressive domestic decarbonization policies will have only a limited effect on future global temperatures unless other major emitters pursue similar policies. This reality does not imply that decarbonization is unimportant. It does, however, raise questions about the optimal balance between mitigation and adaptation.

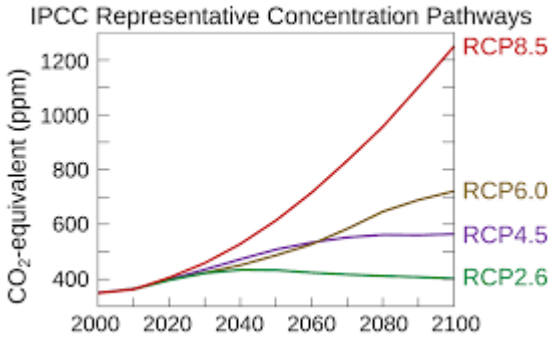
An encouraging trend is that the global emissions picture may be gradually improving. While total greenhouse-gas emissions continue to rise, the rate of increase has slowed. Population growth is decelerating in many parts of the world, economic growth is becoming less energy intensive, and emissions per dollar of global output continue to decline. Technological progress is steadily reducing the carbon intensity of economic activity.

These trends suggest that humanity may eventually decarbonize through a combination of innovation, market incentives, and policy changes. But they also highlight a practical reality: regardless of what happens to future emissions, societies must still adapt to the climate risks they face today. Wildfires, hurricanes, floods, droughts, and extreme heat are occurring now. The question explored in this chapter is whether the United States has struck the right balance between reducing future climate change and increasing present-day resilience.

Investing more in resilience is the most effective way to reduce our economy's exposure to disaster risk. However, given our finite budgets, this focus comes with significant opportunity costs, mainly as observed in California under Gavin Newsom and the United States under Joe Biden. It raises crucial questions about the most effective allocation of limited resources to protect the American people against high-impact risks.

Some Optimism

It is also important to note that the U.S share of global Greenhouse gas emissions is declining over time. The main reason for this is growth in the rest of the world. While global carbon dioxide emissions are growing, they are not growing at the severe rate that was predicted under the RCP 8.5 scenario. It is now credibly argued that we are on a more gradual RCP 4.5 pathway or even a slower trajectory. This suggests that the accumulation of global greenhouse gas emissions may be less concentrated, potentially leading to less severe climate change than previously anticipated. If climate change is linked to the frequency and intensity of natural disasters, then this is very good news.



Investments in the green economy in California and the U.S. are unlikely to be central to decarbonizing the rest of the world. Instead, emissions in many countries such as Turkey are rising at a slower rate because they are transitioning from coal to natural gas primarily because natural gas is readily available and has become cheaper over time. The cleaner burning of natural gas results in fewer PM 2.5 particles and less local air pollution than coal.

Significant improvements in air quality have been observed in developing nations such as China. As these countries become wealthier, the value of reducing ambient particulate matter rises. Consequently, they prioritize cleaner energy sources, moving up the energy ladder from coal to natural gas. This shift occurs not out of a desire to combat climate change for the sake of global responsibility but rather to address local air pollution for the benefit of their populations.

This is a prediction of basic economic principles: out of self-interest, as nations grow richer and their populations expand, they are more inclined to prioritize clean air, leading to more productive urban environments. The Chinese Communist Party recognized long ago the

benefits of transitioning from coal to cleaner fuels to enhance local air quality. Siqi Zheng and I explore this theme in our 2016 book.



A Paradox!

Until now, the U.S government has not prioritized resilience investments because it has been primarily focused on decarbonization. It is ironic that the free rider hypothesis predicts the opposite empirical claim namely that nations are too small to unilaterally be able to reduce the global negative externality and thus they should focus their efforts on protecting themselves. This is the collective action challenge!

California as the Green Guinea Pig and the Resilience Guinea Pig?

For decades, California has been the leader in the U.S. in taking decisive steps to decarbonize its economy. This includes incentives to reduce fossil fuel use in our electricity grid, which means relying less on natural gas power plants. While California has never relied heavily on coal-fired power plants, we have depended on natural gas-fired power plants. This reliance has contributed to greenhouse gas emissions from electricity consumption, as many homes, including mine, use natural gas for heating and cooking. Additionally, we consume a substantial amount of fossil fuels through transportation. California has sought to decarbonize

all these sectors—transportation, residential, and power. In transportation, there has been a concerted push for increased adoption of electric vehicles, supported by generous subsidies for their purchase, which initially helped boost Tesla.

Over the years, I have supported decarbonization efforts. We need "guinea pigs" to experiment and learn what approaches work in a world of uncertainties. There is often a debate about whether there is a first-mover advantage or disadvantage. In decarbonization, we face the classic free-rider issue: everyone is incentivized to wait for others to take action since decarbonization can be costly.

Given that California is a liberal, educated state with many wealthy residents, it makes sense for us to invest in decarbonization. We acknowledge that it is not a free lunch—we will pay more for energy and food, and we have lost manufacturing jobs as electricity and fuel prices have increased. California has the highest gasoline prices in the nation, which impacts the middle class. California's energy regulations impact middle-class Hispanic small business owners, particularly those in the trucking sector using diesel trucks. These business owners face increased fuel costs due to California's regulatory policies.

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← **Post**

Assemblywoman Alexandra Macedo
@AsmwomanMacedo

After 17 years and $13.7 BILLION spent, no tracks have been laid on the High-Speed Rail project. Time to reprioritize funding to prevent wildfires & improve water infrastructure to better serve Californians.

Thank you @NBCLA @conanNBCLA for your coverage.



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[Back in 2012, I wrote this blog post]

JUL
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Investing in Public Mega-Projects During a Time of Deep Fiscal Deficits

You have to respect the courage of California's state leaders to make a major long term investment in high speed rail during a time of deep and ongoing fiscal deficits at the local, state and national level. The NY Times reports here. I must admit that I side with the Republicans on this issue. Peter Gordon's recent blog post eloquently traces out the issues. I would like to add a few points.

1. How much will this high speed rail really cost? This is a random variable that the current governor will not be around to know the final answer. I may never learn the answer either!

2. A high speed rail train will offer some externality benefits. Has any economist quantified these? How much less traffic congestion will there be? How much less GHG emissions will there be? What is the social benefits of these increments? Could these benefits add up to match the billions of dollars of costs?

3. Who will really enjoy the benefits of HSR? The answer is geographical locations that are currently far from San Fran and LA that will now become suburbs of these cities. You should buy land now in the areas where the train will stop. You will be the winner from HSR.

4. How much Federal $ will California collect to pay for this train?

Note that each of these simple points are unknowns. But, when add up the uncertainty here you'd have to be a real risk lover to justify this project. Everyone in California should have to watch the Simpsons' Monorail episode one more time.

Posted 7th July 2012 by Matthew E. Kahn

For the past 15 years, I have consistently argued that decarbonization comes at a cost to California. We risk losing manufacturing jobs and facing higher food and energy prices, disproportionately affecting the poor and middle class by reducing their purchasing power. However, I contend that the world needs a "green guinea pig," California, an educated, progressive, and affluent state, fits that role.

California has long been a leader in environmental regulations. However, in discussing disaster resilience, it is essential to acknowledge that California's leadership in decarbonization has imposed financial burdens on the state's budget. This has driven up the prices of goods in

California, ultimately reducing households' disposable income for resilience investments and other personal expenditures that might have occurred without these regulations.

California's decarbonization efforts have inadvertently crowded out some adaptation and resilience initiatives in this context. We must recognize the binding budget constraint at play. It is not true that California's decarbonization efforts have made the adaptation challenge easier. With a global population of 8 billion and only 40 million in California, the state's decarbonization represents merely a drop in the bucket. Even if California successfully decarbonized, the overall impact on global greenhouse gas emissions would be minimal. Thus, claiming that California's mitigation efforts have accelerated adaptation is misleading.

A more nuanced view is that while California serves as a "green guinea pig," it has fostered the growth of companies like Tesla and SolarCity, which could eventually aid in the global decarbonization effort. It’s important to clarify whether California’s initiatives significantly accelerated global decarbonization. We can’t know if the worldwide effort would have progressed more slowly without California's policies. While California has indeed been a pioneer, I believe the ongoing global decarbonization is more a result of factors such as declining population growth and a shift from coal to natural gas and cleaner fuels—trends driven by fracking and economic forces independent of California's actions.

The state leadership's focus on decarbonization raises questions about whether this focus has partially distracted them from other critical policy priorities. With all the funding directed toward subsidies and initiatives to stimulate the green economy, one must consider whether more of that money could have been used to enhance individual financial autonomy or to invest in public goods aimed at resilience. .

Chapter Thirteen: An Optimistic Take on Senator Sheldon Whitehouse's Nightmare Scenario

Rhode Island Senator Sheldon Whitehouse served as the Chair of the Senate Budget Committee during 2023 and 2024. He used his Chair powers to focus the budget committee on climate change issues. On January 10th 2024, I testified at a Senate Hearing. Here is my document I supplied that day. I have not edited this statement.

STATEMENT OF

DR. MATTHEW E. KAHN

to the COMMITTEE ON the BUDGET

of the UNITED STATES SENATE

HEARING on

Investing in the Future: Safeguarding Municipal Bonds from Climate Risks

10 January 2024

Does climate change pose a major risk for America's municipal bond sector? My short answer is "no". My optimism is based on two points. First, global greenhouse gas emissions are likely to rise but the pessimistic RCP8.5 model scenario over-states likely future global emissions growth.[1] Second, our economy's capacity to adapt to emerging climate risks will vastly expand in the coming decades.[2]

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[1] Kahn, Matthew E., and Somik Lall. *Will the Developing World's Growing Middle Class Support Low Carbon Policies?*. No. w30238. National Bureau of Economic Research, 2022.

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https://www.aei.org/wp-content/uploads/2022/06/Zycher-comment-SEC-climate-risk-disclosures-file-S7-10-22-RIN-3235-AM87-6-17-2022.pdf

[2] Anderson, Sarah E., Terry L. Anderson, Alice C. Hill, Matthew E. Kahn, Howard Kunreuther, Gary D. Libecap, Hari Mantripragada, Pierre Mérel, Andrew J. Plantinga, and V. Kerry Smith. "The critical role of markets in climate change adaptation." *Climate Change Economics* 10, no. 01 (2019): 1950003.

Bond buyers have an incentive to do their "due diligence". If a municipality faces rising climate impacts that imperil its ability to repay debt, bond buyers will recognize this and they will offer lower prices for bonds. Places that fail to adapt to new risks will thus pay higher interest rates and insurance rates. While bond defaults are rare, there have been high profile cases such as Detroit's default in 2013.[3]

To see why climate risk does not imperil the financial system via municipal bond defaults, let's play out a hypothetical Doomsday Scenario. What does it take for a "climate event" to cause a financial crisis?

A Doomsday Scenario

The year is 2034. Over the last decade, the climate has gotten worse, storms are more frequent. The city of Chicago issues new bonds each year. A new batch of bonds are rated at Baa3/BAA- (i.e., the lowest notch in the investment grade category) and the majority of the bonds are purchased by a hedge fund. While well below the median bond rating for a municipal bond of around Aa3/AA-, the hedge fund is familiar with the financial woes of Chicago. It thinks these bonds are a good opportunity to earn high returns.[4] This hedge fund uses the City of Chicago bonds as collateral to borrow at a short term low interest rate from banks.

Suppose that an unprecedented storm strikes the City of Chicago in mid-2034. This storm floods the city and tax revenue plummets as this becomes the straw that breaks the camel's back, following years of financial mismanagement and crime waves and warnings from credit rating agencies. Tourists do not visit the city and work dinners and office hotels are vacant. Sports teams relocate to safer jurisdictions. Major firms depart for other locations. Suppose that the storm also severely impacts other areas in the Midwest and the local service economy stalls out. Local infrastructure is overwhelmed such that the power supply and water treatment systems and roads are left heavily damaged.

As the short run damage from the shocks materialize, the governor of Illinois and the federal government chooses not to offer disaster relief to the city. Further, Chicago's feature powerful public sector unions refuse to take a short term earnings reduction to help balance the city's short run budget. Rating agencies see the federal government's refusal to step in and bail out the

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[3] Holian, Matthew J., and Marc D. Joffe. "Assessing municipal bond default probabilities." *Available at SSRN 2258801* (2013).

[4] Longstaff, Francis A. "Municipal debt and marginal tax rates: Is there a tax premium in asset prices?." *The Journal of Finance* 66, no. 3 (2011): 721-751.

people of Chicago as a sign the city will be unable to repay its debts and the raters embark on a series of bond grade downgrades. This once mighty city comes to a decision point.

Chicago chooses to default on repaying all of its municipal debt. This causes downstream consequences. The hedge funds who own the bonds go under. Banks who lent them money now own worthless collateral and they fail. Still, only a few banks have failed. Suppose depositors at other banks, worried about hidden risks, run. For some reason, the federal government does not bail out the banks or depositors. Finally, we have a crisis.

An Economic Critique of the Doomsday Scenario

Based on my ongoing research in urban and environmental economics, I reject this Doomsday Scenario. Starting with my 2010 book Climatopolis: How Our Cities will Thrive in Our Hotter World and my 2021 book; Adapting to Climate Change: Markets and the Management of an Uncertain Future, I have argued that free market competition protects our economy from place-based extreme weather risks.

My critique has six sections.

First, local property owners seek to enhance the value of their assets. They have an incentive to lobby local leaders to invest in resilience to reduce default risk. Property owners recognize that a municipal default leads to lower local quality of life and higher property taxes.

Second, if local property owners, insurers and municipal bond investors prioritize addressing local resilience challenges, then this provides mayors with an incentive to invest in resilience.

Third, in recent years the Federal Government has provided generous disaster relief. This aid reduced municipal default risk.

Fourth, portfolio theory warns against "putting all your eggs in one basket". Municipal bond investors do not hold concentrated risks in one city, such that a default will cause them to fail. They invest in spatially diversified asset portfolios. Banks do not make concentrated loans to hedge funds.

Fifth, a recent empirical research literature documents that the fiscal impacts of storms have been relatively small.

Sixth, as we grow richer, we are willing to pay more for products that enhance our safety such as anti-flood equipment, and stronger windows. Firms have a profit motive to design these climate resilient products. Competition in adaptation product markets leads to lower prices.

I predict that over time that the investments made by people, firms and local governments in building up their local resilience will translate into less damage and less municipal bond default risk being caused by future natural disasters. This is the core climate change adaptation hypothesis.

Critique #1: Local property owners form a powerful adaptation coalition

A central lesson in real estate valuation is the importance of "location, location, location". Those properties in areas with a booming local economy and objectively better quality of life sell for a price premium. Past economic studies have examined the relationship between local risk factors such as crime on home prices.[5] Real estate prices are higher in places with more pleasant weather.[6]

The owner of a property is entitled to its rental stream for the duration of the asset's life. Real estate scholars are now exploring how place based forecasts of future weather conditions are capitalized into current real estate prices. Such research finds evidence that areas expected to face more severe weather conditions feature lower current real estate prices.[7] This

[5] Bishop, Kelly C., and Alvin D. Murphy. "Estimating the willingness to pay to avoid violent crime: A dynamic approach." *American Economic Review* 101, no. 3 (2011): 625-629.

[6] Cragg, Michael I., and Matthew E. Kahn. "Climate consumption and climate pricing from 1940 to 1990." *Regional Science and Urban Economics* 29, no. 4 (1999): 519-539.

[7] Bernstein, Asaf, Matthew T. Gustafson, and Ryan Lewis. "Disaster on the horizon: The price effect of sea level rise." *Journal of financial economics* 134, no. 2 (2019): 253-272.

Gibson, Matthew, and Jamie T. Mullins. "Climate risk and beliefs in new york floodplains." *Journal of the Association of Environmental and Resource Economists* 7, no. 6 (2020): 1069-1111.

Kousky, Carolyn, Howard Kunreuther, Michael LaCour-Little, and Susan Wachter. "Flood risk and the US housing market." *Journal of Housing Research* 29, no. sup1 (2020): S3-S24.

Ortega, Francesc, and Süleyman Taşpınar. "Rising sea levels and sinking property values: Hurricane Sandy and New York's housing market." *Journal of Urban Economics* 106 (2018): 81-100.

capitalization effect is not a "law of physics". Suppose that a given area is expected to face more severe weather over the next decade but that offsetting technological advances such as stronger windows protects local homes from such risks. In this case, basic real estate economics predicts that we will not observe large real estate price discounts in such areas. Investment in effective market products that offset local weather risk helps to boost real estate prices in areas facing more volatile weather.

Millions of Americans live near the coasts.[8] There are trillions of dollars of real estate invested in high quality of life areas that do face natural disaster risk.[9] Owners of these assets have an incentive to invest in private market precautions and to push for local public policies to protect their assets against anticipated risks. Their asset's value will decline if local insurance rates increase.

The American West features many growing cities that face extreme heat and drought risk. Some posit that Phoenix will soon face a "day of reckoning" as Phoenix will become too hot in summer and run out of water.[10] If quality of life declines in Phoenix, then firms and people will be less likely to locate there and the city's municipal default risk would rise. If property owners anticipate that water is becoming more scarce in Phoenix, then they may vote for a municipal bond to be issued to pay for an aqueduct to transport water they buy from nearby farmers. If Phoenix heat is rising, then new local initiatives will be explored such as tree planting to offset the summer heat. Such investments in creative solutions to local climate risks helps to reduce default risk.

Critique #2 Mayors Have a Growing Incentive to Invest in Climate Resilience

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Severen, Christopher, Christopher Costello, and Olivier Deschenes. "A Forward-Looking Ricardian Approach: Do land markets capitalize climate change forecasts?." *Journal of Environmental Economics and Management* 89 (2018): 235-254.

[8] Rappaport, Jordan, and Jeffrey D. Sachs. "The United States as a coastal nation." *Journal of Economic growth* 8 (2003): 5-46.

[9] Pielke Jr, Roger A., Joel Gratz, Christopher W. Landsea, Douglas Collins, Mark A. Saunders, and Rade Musulin. "Normalized hurricane damage in the United States: 1900–2005." *Natural hazards review* 9, no. 1 (2008): 29-42.

[10] https://www.theguardian.com/us-news/2023/jul/14/phoenix-heatwave-summer-extreme-weather-arizona

In the doomsday scenario, Chicago was not prepared for the intensity of the major storm. Those mayors that fail to invest in local resilience will lead cities that borrow at a higher interest rate, and pay more for city insurance. Such cities risk losing people and firms who will migrate away to higher quality of life areas featuring lower taxes and higher quality of services.[11] No mayor seeks to lead a declining city.

Mayors from Red states and Blue states have incentives to invest in local resilience. If their city's quality of life suffers, they face rising interest rate costs and rising insurance costs.

The current mayor of Miami is a Republican. The city has implemented a bond selling program to invest in flood protection.[12] The open question here is how effective will this investment be in reducing flood risk? The answer depends on how the city oversees the construction work that seeks to reduce the flood risk. The cost of construction projects is lower in Red States because local public sector unions are less powerful.[13] Public sector wages are higher in places with more powerful local public sector unions and this reduces the real purchasing power of a given amount of capital invested in enhancing resilience.

Many cities seek to buy insurance for their municipal debt.[14] If insurers charge more such insurance in cities that face more objective climate risk, then this provides cities with an incentive to offset such risk through investments in natural capital and infrastructure projects because if these risk mitigation projects are successful then they will face lower insurance prices. Insurance markets and bond markets are the "adults in the room" whose pricing of insurance and bonds sends price signals that facilitate climate risk adaptation.

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[11] Gyourko, Joseph, and Joseph Tracy. "The structure of local public finance and the quality of life." *Journal of political economy* 99, no. 4 (1991): 774-806.

[12] https://www.miami.gov/My-Government/ClimateChange/Coastal-and-Stormwater-Infrastructure

[13] Jerch, Rhiannon, Matthew E. Kahn, and Shanjun Li. "The efficiency of local government: The role of privatization and public sector unions." *Journal of Public Economics* 154 (2017): 95-121.

[14] https://www.brookings.edu/articles/the-price-of-safety-the-evolution-of-municipal-bond-insurance-value/

Critique #3 The Federal Government's Disaster Relief Reduces Default Risk

In the midst of a Doomsday-like Shock, consider two different scenarios that can arise concerning the responses by the Governors and the Federal Government. In case #1, the governors and the Federal Government respond to the shock by sending in billions of dollars to rebuild the afflicted areas. In this case, bond default risk will be unlikely. This case does have fiscal implications for the state and the Federal Government as their respective deficits will increase.

The influx of disaster relief causes two unintended consequences. In the short run, the shocked place is awash in disaster relief funds. This raises the risk of corruption as accountability and oversight are less likely to be in place as new construction takes place.[15] A second unintended consequence of expected Federal Government bailouts of shocked places is to induce a moral hazard or "too big to fail" effect. Cities that anticipate that they will be rebuilt using "other people's money" will invest less of their own funds in protecting themselves.

In providing such disaster relief, the Federal Government must balance being compassionate with unintentionally encouraging excessive municipal risk taking. A Federal Government seeking to decentralize responsibility for paying for local defenses to municipalities might commit to offering no disaster relief to shocked places. If such a promise is credible, then this "tough" approach would cause localities to invest more of their own money in protecting the place.[16] This strategy poses major political risks for national leaders and they are unlikely to choose this path unless the Federal government faces extreme budget challenges.

Critique #4 Municipal Bond Investors Seek to Diversify Their Risk

The Doomsday Scenario becomes less likely if municipal bond investors hold a more spatially diversified portfolio. The first idea in portfolio theory is to avoid "putting all of your eggs in one basket". Investors have strong incentives to consider how a specific investment affects their

[15] https://www.npr.org/2014/02/12/275989820/face-of-katrina-recovery-found-guilty-of-corruption-charges

[16] Kydland, Finn E., and Edward C. Prescott. "Rules rather than discretion: The inconsistency of optimal plans." *Journal of political economy* 85, no. 3 (1977): 473-491.

overall portfolio's risk and return. If more investors fear emerging climate risks, then they will demand bond index funds that are spatially diversified. Wall Street's financial engineers will design these products. The profit motive helps to mitigate the risk of the Doomsday Scenario.

The Doomsday Scenario is more likely to occur if bond investors naively trust the credit rating agency's ratings.[17] If the agencies give a city a "AAA" bond rating, is it really risk free? Humble investors are more likely to recognize that they know "that they do not know" all of the risks that may be materializing. They will seek out experts. For profit and non-profit climate risk firms are popping up offering risk maps that alert people and firms about local climate risks. Of course, these predictive maps feature unknowns but they do inform decision making under uncertainty. Climate science is making objective progress and this science forms the foundation for this new generation of climate risk models.

Cities differ with respect to their credit ratings because some cities such as Baltimore face large public pension obligations while simultaneously experiencing a shrinking population. Those cities facing a rising expenditure stream and declining revenues are at greater risk of default. Information about these pension obligations is known and market prices for bonds and insurance reflect these risks.[18] Those cities with the worst credit ratings are the most likely to default in the aftermath of a major local disaster. Bond buyers have strong incentives to consider how much to invest in these high risk/high returns assets in forming their optimal portfolios.

Municipal bonds have different maturity structures. If investors anticipate that a given city faces rising risks over the next 20 years, then this city will pay a lower interest rate for its short term bonds and will pay a higher interest rate for its 30 year bonds. This long term interest rate risk premium provides the city's Mayor with an incentive to work with the Army Corps of Engineers to upgrade local infrastructure. The financial sector's forward looking price signals provide an incentive for mayors today to invest more effort to adapt to medium term risks. These efforts defuse the "doomsday bomb".[19]

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[17] Kahn, Matthew E. "Climate change adaptation will offer a sharp test of the claims of behavioral economics." *The Economists' Voice* 12, no. 1 (2015): 25-30.

[18] Giesecke, Oliver, and Joshua Rauh. "Trends in state and local pension funds." *Annual Review of Financial Economics* 15 (2023): 221-238.

[19] Painter, Marcus. "An inconvenient cost: The effects of climate change on municipal bonds." *Journal of Financial Economics* 135, no. 2 (2020): 468-482.

Goldsmith-Pinkham, Paul, Matthew T. Gustafson, Ryan C. Lewis, and Michael Schwert. "Sea-level rise exposure and municipal bond yields." *The Review of Financial Studies* 36, no. 11 (2023): 4588-4635.

Critique #5 Past Disaster Shocks Have Not Caused Large Municipal Default Risk Increases

Environmental economists study how people and places are affected by natural disasters. In recent years, major weather related disasters have struck California, Florida, Louisiana and others states, and none have resulted in defaults of investment grade municipal bonds.

Several recent papers have examined the association between hurricane strikes and local public finance dynamics.[20] On average, these shocks have small quantitative effects on a city's fiscal health. Municipal bonds that are insured are more insulated from disaster risk. Measured municipal bond price declines are attenuated as Federal disaster aid inflows occur.[21]

In addition to studying the effects of hurricanes on municipal finance, new research is exploring the impacts of wildfires on places in the American West. Such wildfires tend to occur in ex-urban areas where relatively few people live. Recent research has documented that such wildfires increase the affected municipality's deficit but the magnitude per person is small.[22]

Critique #6 The Adaptation Menu of Market Products Keeps Growing

As we grow richer, we are willing to pay more to be safe. Those who live in hurricane prone areas will demand better anti-flood equipment, and stronger windows and roofs that can

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[20] Deryugina, Tatyana. "The fiscal cost of hurricanes: Disaster aid versus social insurance." *American Economic Journal: Economic Policy* 9, no. 3 (2017): 168-198.

Jerch, Rhiannon, Matthew E. Kahn, and Gary C. Lin. "Local public finance dynamics and hurricane shocks." *Journal of Urban Economics* 134 (2023): 103516.

[21] Auh, Jun Kyung, Jaewon Choi, Tatyana Deryugina, and Tim Park. *Natural disasters and municipal bonds*. No. w30280. National Bureau of Economic Research, 2022.

[22] Liao, Yanjun, and Carolyn Kousky. "The fiscal impacts of wildfires on California municipalities." *Journal of the Association of Environmental and Resource Economists* 9, no. 3 (2022): 455-493.

withstand extreme wind. This demand creates incentives for firms to innovate. This dynamic process increases our adaptation menu and reduces prices.[23]

Future innovation will help us to adapt to extreme heat, wind and flood risk. Think of the cell-phone and the personal computer. Over time, these products have featured quality improvements and price declines.[24] As municipal residents adopt improved safety products, more of them are protected from extreme weather shocks and the overall economy becomes more resilient.

A Final Thought

Going forward, big city municipal bond risk will mainly be determined by public pension obligations and day to day quality of life concerns leading to suburban flight, not by a change in the frequency of bad weather events beyond that which cities and bond investors are already planning for.

[23] Barreca, Alan, Karen Clay, Olivier Deschenes, Michael Greenstone, and Joseph S. Shapiro. "Adapting to climate change: The remarkable decline in the US temperature-mortality relationship over the twentieth century." *Journal of Political Economy* 124, no. 1 (2016): 105-159.

[24] Acemoglu, Daron, and Joshua Linn. "Market size in innovation: theory and evidence from the pharmaceutical industry." *The Quarterly journal of economics* 119, no. 3 (2004): 1049-1090.

Boskin, Michael J. "Causes and Consequences of Bias in the Consumer Price Index as a Measure of the Cost of Living." *Atlantic Economic Journal* 33 (2005): 1-13.

Chapter Fourteen: Economics Lessons from Natural Disasters Around the World

Most of this book has focused on the United States, but of course, the world is vast. The vast majority of the world's population lives outside the United States. Many developing countries are scattered throughout the globe, and some are situated in natural disaster zones. For example, the Philippines experiences more disasters than many other nations. In this chapter, I want to discuss what I know and don't know about disasters, economics, and resilience worldwide, mainly focusing on developing countries.

Other research has been done on disasters in the developing world. One study documented that a silver lining of extreme weather is that children are more likely to attend school during those times. The argument here is that for young people in the developing world, working in the rural countryside is an alternative to going to school. If extreme weather has lowered productivity in agricultural areas, there is an incentive for children to go to school.

However, it's essential to add that if a family is at risk of starvation, they may work extra hours when agricultural productivity is very low. Researchers observed a "sweet spot" where farming productivity was low enough to incentivize sending kids to school but not so low that the family risked starvation. Children could attend school if families weren't working 20 hours a day to harvest food.

Additionally, there are many studies on how agricultural yields are affected by extreme weather. Research that matches yields at the parcel level to temperature data from nearby weather stations allows statisticians to estimate complex relationships. For example, it's possible to go beyond assessing a linear or quadratic relationship between corn yields per acre and outdoor temperature during the growing months. Researchers have documented very nonlinear effects in these relationships.

The interesting economic aspect here, related to our discussion of disasters, is that farm output should be most sensitive to unexpected weather events. If farmers anticipate that summers will be hot, they might wonder why they weren't prepared for that impact. Why haven't they diversified their income or planted some of their land with crops that thrive in hot weather?

If they know that summers in Kansas are increasingly becoming hotter, it raises the question of why they haven't diversified their previous land holdings. This leads us back to the earlier chapter about preparing for disasters. When examining agriculture and extreme weather, it is necessary to determine if the shock was anticipated.

There's a concept in modern economics that the key element is "new news": if a shock is anticipated, it tends to have less impact because rational entities—such as farms, firms, and families—have already taken preventative steps. They may have moved away from the affected area if the impending shock was deemed significant enough, or they may have taken other proactive measures. For instance, if you know I'm going to punch you in the jaw every July 5th at 2 PM, you would take steps to avoid being hurt.

Poverty and Resilience

Due to their economic challenges, developing countries face significant risk. While the residents have fewer assets that can be lost, each individual is at a greater risk. We know that with economic development, the death toll from disasters tends to decline. Poor people often live in lower-quality housing, have less access to protection infrastructure, and possess fewer resources to recover in the aftermath of disasters.

This lack of resources affects the immediate response to disasters, such as search and rescue operations and healthcare availability. Furthermore, the long-term consequences can be severe for households, as their capital may be destroyed, their health impacted, and their local economies may recover more slowly.

In every country, poor people often live in lower-quality housing in less desirable areas due to limited incomes, forcing them to make tough trade-offs. Higher-quality housing in safer neighborhoods is more expensive, which means spending more on rent leaves less money for essentials like food.

As a result, many choose to live in riskier areas, where they can save on rent, despite the increased danger. Society faces the challenge of determining how much to invest in protecting

these communities. While some economists argue that economic growth benefits everyone, evidenced by poverty reductions in places like China and India, the most vulnerable still suffer significantly during disasters.

For example, during tornadoes in the American South, people living in mobile home parks face higher risks of death due to their less resilient structures and risk-prone locations. Similarly, in Las Vegas, some homeless individuals shelter in storm drains, posing dangerous risks during unexpected heavy rains.

This raises important questions about whether limiting where poor people can live is right. Should they be allowed to make those risky choices? A libertarian perspective emphasizes individual freedom and informed decision-making. If people understand the risks and accept them, that should be respected.

Ultimately, discussions about trade-offs are crucial. Economists consider revealed preferences seriously, so when someone is willing to gamble with their living situation, should we intervene, or respect their choices?

The Key Role of High Quality Risk Information

The rise of information technology and the widespread access to cell phones have significantly reduced the number of deaths from disasters in countries ranging from Indonesia to China and India in recent years. Take, for example, the Asian Tsunami of 2004; many lives were lost due to the lack of early warning systems for evacuation. Now, even in the developing world, more people can access cell phones and receive text message alerts about potential disasters. Just having an hour's notice can significantly lower the risk of death, as people can prepare and evacuate when a credible warning is issued.

Economists have implemented event studies in the developing world to document how real time information impacts economic well-being. Here is a famous paper written by a friend of mine.

The Digital Provide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector

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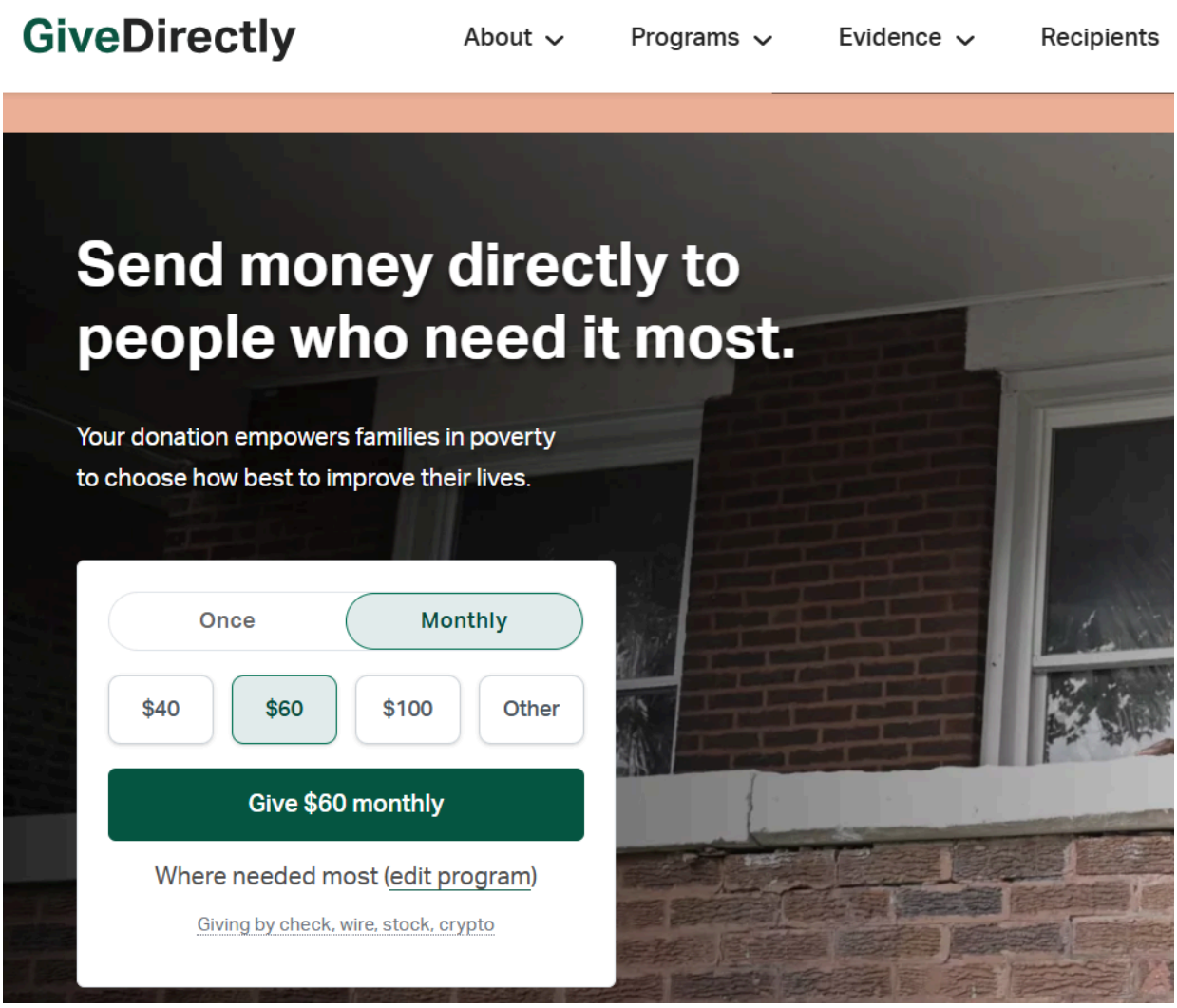
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Abstract

When information is limited or costly, agents are unable to engage in optimal arbitrage. Excess price dispersion across markets can arise, and goods may not be allocated efficiently. In this setting, information technologies may improve market performance and increase welfare. Between 1997 and 2001, mobile phone service was introduced throughout Kerala, a state in India with a large fishing industry. Using microlevel survey data, we show that the adoption of mobile phones by fishermen and wholesalers was associated with a dramatic reduction in price dispersion, the complete elimination of waste, and near-perfect adherence to the Law of One Price. Both consumer and producer welfare increased.

We also live in an era of mobile money, which allows individuals to wire money directly to someone's phone. This technology creates liquidity, enabling charities and families to send funds quickly to those in need following a disaster. Take a look at Give Directly as an example of an entity that allows for low cost money transfers to vulnerable poor people.



However, for cell phones to function effectively, internet connectivity is essential. Technologies like Starlink play a fundamental role in this regard. In the United States, we have seen how Starlink can serve as a form of disaster resilience. With a cell phone, individuals can access real-time information about the risks they face and seek help. Furthermore, search and rescue teams can locate individuals more effectively using the geo-coordinates provided by cell phones. This technology is not just for the wealthy; astonishingly, the information technology revolution and the rise of ubiquitous cell phones mean that poorer individuals also have access to this technology.

In my research in the United States, I have explored how entities like the First Street Foundation and Jupiter are developing climate risk report cards. There is a growing number of spatial climate risk modelers in the United States who combine art and science.

Every area, whether it's my neighborhood near UCLA in Los Angeles, my parents' home on the Upper East Side of New York City, the University of Chicago's location on the South Side of Chicago, or a farm in Kansas, faces different daily risks related to rainfall, temperature, and the possibility of natural disasters such as wildfires or tornadoes. It would greatly aid us if climate science could progress in predicting these random variables. For instance, we could predict the likelihood of experiencing over 95-degree days in Kansas during July, providing helpful information.

Of course, no model can perfectly predict these outcomes, but having predictions with some level of accuracy is beneficial. Statistical methods can help cross-validate these predictions. If climate science progresses in analyzing smaller geographic units, such as dividing Kansas into 64 squares, we could gain educated guesses about the summer heat, pollution levels, tornado risk, and flood risk in each square. This information is crucial for building disaster resilience, as it gives individuals in those areas a heads-up about the dangers they face.

In a recent paper, we studied how home buyers react to flood risk information using the Redfin platform. We looked at a random subset of home buyers who began receiving flood risk scores for the properties they were interested in compared to a control group that did not receive this information. Our findings showed a change in behavior among the home buyers who received flood risk information, highlighting the importance of transparency in the real estate market.

I bring this up in the context of the developing world because establishing risk maps is a primary step toward fostering resilience. Collecting data and implementing climate model predictions globally is essential, providing insights into heat, natural disasters, drought, extreme heat, and pollution risks for different locations.

If such data and modeling could be accomplished, along with a validation process to ensure the quality of these models, this information could be disseminated through mobile

technology. This would empower individuals to make more informed choices about where to live. In this way, climate science can serve as a modern-day Paul Revere, alerting communities about relative safety based on model predictions. Areas deemed safer could attract more economic activity. At the same time, those identified as risky could benefit from investments in flood control and cooling measures to mitigate physical risks due to their geography.

Importantly, I am not suggesting that any area is doomed because of its climate risks. Consider Abu Dhabi: There are places in the Middle East that are currently thriving, even with extremely hot summer temperatures. Significant investments are being made in cooling technologies to address these climate challenges. While these investments come at a cost, they are essential for protecting the area.

However, it is essential to note that wealthier regions have a greater ability to borrow and invest capital in adaptation projects. In contrast, if we look at poorer African areas facing climate risks, such as flood threats, those nations are often unlikely to have the resources to build adequate flood control systems. As a result, they may have to retreat from those flood-prone areas.

For example, if a region is at significant risk of flooding and the government lacks the resources to invest in flood control, risk-averse individuals are unlikely to live there—or they may choose to avoid such areas during rainy seasons.

This scenario illustrates how informed individuals can make better personal decisions to avoid risk. It is somewhat similar to living in the Palisades near Los Angeles where, in areas designated as fire zones, fewer people will choose to live there if there's no investment in fire protection. Those who do may take on greater risk, knowing that if a disastrous event occurs, they will face significant losses due to a lack of government support.

Facilitating Migration

Within a nation such as Bangladesh, areas differ with respect to a range of risks. A rural household can diversify its income risk from local shocks if family members can cheaply migrate to the city and work there during lean times in the farming area. In this sense,

increased mobility due to railroad expansions and road construction and road improvements and investments in buses all help to increase the economic opportunities for poor people. With access to such earnings, they are more likely to be able to withstand weather shocks.

Economic Growth Fuels Resilience

Richer people are willing to pay more to be safe. Such safety can produced by living in better neighborhoods or fortifying one's home against the specific risks the general area faces. Consider the case of air pollution in the developing world. People's willingness to pay for air purifiers depends on how much they value avoiding particulate exposure. However, when it comes to risks like wildfires or hurricane tail risks, we do not possess enough data to determine the varying amounts different people, at different times, are willing to pay to avoid such risks.

During my graduate studies, my professor, Sherwin Rosen, introduced us to a thought-provoking concept. He asked us to consider the game of Russian roulette. Imagine a gun with 10 chambers, one containing a bullet. If someone were to play this game, knowing there is a 10% chance of death, how much would they need to be paid to pull the trigger? Although it is a morbid thought experiment, it is valuable for understanding our willingness to take risks.

For instance, coal mining is particularly challenging and has a higher mortality rate. Despite the risks, coal miners earn more than individuals in safer occupations. This additional pay is a form of "combat pay" for the extra risks they assume. Economists use comparisons like this to infer how much people are willing to pay to avoid various risks.

Understanding the wage premium associated with taking on mortality risk is essential for evaluating the benefits of increased disaster resilience. Disasters are rare occurrences in our daily lives, so it's necessary to consider both the probability of experiencing catastrophic events and the potential damages they could cause when they do happen.

A fundamental issue arises in the developing world as nations grow wealthier— they begin investing more in protective infrastructure. There is an intriguing debate in economics regarding whether private investments in resilience are complements or substitutes for

government investments. For instance, if a city in a developing country constructs flood control systems, will more people move to that area, feeling that the government can protect them, thus allowing them to enjoy a productive and attractive environment that they previously avoided due to flood risks? If there is confidence in the capabilities of new engineers to manage these risks, individuals may be more inclined to live in those areas.

In the developing world, an advantage of developing later is the opportunity to leapfrog to the technological frontier without being constrained by outdated technologies. An essential question for the future is what resilience investments will be made as cities in developing regions emerge and expand.

There will be competition among these cities. Research indicates that there is a disparity between the capital city and other cities in many nations. For example, in Bangladesh, Dhaka is the capital city. The challenge with a capital city being the dominant urban center is that the government is generally expected to invest in protecting that city. As urban economists have argued, when a country's primary city is also its capital, too many people may be drawn to that location.

In contrast, in the United States, the capital was intentionally located in Washington, D.C., rather than in major cities like New York, Boston, or Los Angeles. In countries like Argentina, where Buenos Aires is the capital, the risk is akin to holding an undiversified portfolio of cities. If significant resources are directed toward one city—particularly through government funding—this creates an implicit incentive for people to relocate there.

This can lead to unbalanced growth, as seen in cities like Jakarta, Indonesia, where it is widely accepted that the government will allocate national resources to invest in public goods for the capital city. Consequently, there may be an implicit subsidy for people to move there, causing the capital to grow disproportionately.

Urban economists often discuss that the optimal city size should balance its benefits against its costs. When a city becomes too large, the negative impacts can begin to outweigh its advantages.

Understanding the local risks that these areas face and assessing whether those risks are improving or worsening is a necessary step in building disaster resilience in the developing

world. The second step is to monitor the incentives in place. As we have discussed using examples from the United States, we need to consider what the existing rules encourage: do they promote private investment in resilience, foster experimentation, and enable A/B testing to determine what works? Or do the current rules create a moral hazard effect, indirectly subsidizing risk-taking in developing countries? Historically, these incentives have often been detrimental, leading to significant death counts from disasters. However, I expect that in this age of information technology, the death toll from disasters will decrease significantly, even in the developing world.

Recent economic research has focused on supply chains, highlighting issues such as those observed in Pakistan. For example, firms that source inputs from areas prone to flooding can experience significant short-term economic impacts when massive rain events occur. This illustrates how disasters ripple through local economies.

In a large and diversified economy like the United States, the capacity to absorb such shocks is greater, but the implications of localized disasters are still significant. This phenomenon is not as significant. We will find that the LA fires had a minimal impact on the California economy despite their high costs. Similarly, the terrorist attacks of September 11 did not have a long-term effect on the New York economy. These attacks contributed to a subsequent economic boom in the city, driven by a collective urgency to grow.

How different countries respond to disaster shocks can reveal interesting dynamics. The timing and extent of these impacts can vary—sometimes, they ripple through the economy, leading to macroeconomic negative consequences, while other times, the effects are localized without broader implications.

One key insight from microeconomic analysis is that a diversified economy can absorb the shock when the affected area is not a crucial part of the economy. A local region may suffer significantly, but other parts of the country can provide substitutes, allowing the overall economy to function effectively.

A positive aspect of having various geographical locations experience different disasters is that it creates a valuable laboratory for learning what strategies are effective and which are

not. If only one nation were to face disasters while others remained unaffected, our learning would be much slower.

In our interconnected world, with diverse economies and geographies, we can leverage sophisticated statistical models—particularly in this age of artificial intelligence—to assess outcomes. The silver lining in experiencing a range of disasters is that we can glean insights from these events. This knowledge ultimately helps us mitigate future losses by learning from past experiences

I expect that in the next few years that there will be many new empirical studies examining the resilience challenge in the developing world. What will interest me here is whether nations and cities are learning from each other's experiences. Must a location suffer from a disaster in order for its leaders and residents to learn about risks? Or do in our Internet connected world, do we increasingly observe that people learn from other's experiences?

Flattening the Climate Damage Curve

Traditional climate-economic models treat the damage function as fixed: higher temperatures or more intense hazards automatically produce proportionally larger losses. This view is incomplete. Economic damages are endogenous. They depend on institutions, information, technology, and incentives.When markets price risk accurately, households invest in mitigation, developers build more resilient structures, capital reallocates toward safer locations, and innovation accelerates. The damage curve flattens. Societies that allow price signals to operate, reward self-protection, and encourage financial and technological experimentation will experience lower total losses—even as physical hazards change.Real-estate markets sit at the heart of this process. By getting the microeconomic incentives right—accurate risk information, risk-based insurance, flexible land use, and innovative financing—we can turn the challenge of climate risk into an engine of adaptation and resilience. The "one place-based egg" need not remain as fragile as it has been in the past.

Chapter Fifteen: Conclusion

My home in Los Angeles, near UCLA, has many attractive features, and we paid a high price per square foot for it. However, we face risks associated with this investment. These risks include a decline in the national economy, rising interest rates, an increasing state deficit in California, and a downturn in the Southern California economy. Additionally, if City of Los Angeles runs a deficit and local quality of life decreases, all of these threats could reduce the value of my home, which is one of the key assets in my portfolio as I save for retirement.

We all strive for financial security; we want to own assets that ideally provide a reasonable rate of return while maintaining low risk. Housing is a unique asset that allows us to enjoy our investment. For instance, if we owned a thousand shares of Tesla instead of a house, it would be hard to enjoy that investment. It's merely a piece of paper or a digital file indicating ownership. In contrast, owning a home allows us to benefit from living in it while potentially increasing its value.

We seek safe assets, but the supply of such assets is limited. This fact explains why so many international investors seek to buy U.S dollars despite the fact that our nation is running a large deficit. For example, U.S. Treasury bonds can be considered safe assets, especially if the nation experiences low inflation and remains the world's strongest economy. Treasury bills promise that by purchasing them, you will earn interest over the bond term (for example, 30 years) and then receive your principal back, with the expectation that the United States will not default. Hence, Treasury bills are regarded as safe investments.

The question arises: how do we create safer real estate assets? Why haven't developers construct safer homes in vulnerable areas? How could disaster risks spread across homes during events like wildfires and flooding? Why weren't homes affected by flooding built to withstand such events?

Part of the answer relates to the time period when these homes were constructed. What were the existing technologies at that time? What would it have cost to make these properties more resilient to wildfire and flood risks? As time passes and homes age, the technological

frontier expands. One might wonder why homeowners don't take proactive steps to upgrade and retrofit their homes.

Retrofitting a home is costly and inconvenient; families may need to move out temporarily, especially for major projects like redoing a roof. It's also expensive. This raises an intriguing question about the risks we take and those we avoid.

We understand how to build safer real estate assets, yet we implicitly gamble by not making these investments for much of our housing stock. For instance, when it comes to reducing wildfire risk, some homeowners argue that such measures make their properties less aesthetically pleasing, as clearing vegetation—some of which may be beautiful or ecologically significant—can alter the landscape. In other cases, enhancing a home's resilience with a more substantial roof or flood control technology may negatively impact its design. Consequently, homeowners face trade-offs; there may not be an immediate disaster on a typical day.

In regions like Los Angeles, many days are clear and pleasant. Families might celebrate the beauty of their surroundings, enjoying the temperate weather, blue skies, gentle breezes, and low humidity. This leads to the question of which homes thrive typically but face extreme risks on dangerous days. It ties into the economic concept of risk assessment, where homeowners must estimate the risks they face on any given day.

Suppose homeowners believe the probability of disaster is zero. In that case, they are unlikely to take proactive steps—such as flood and fire risk mitigation—because they assume a catastrophic event will never occur. Adaptation requires financial investments

From a "tough love" libertarian perspective, one could argue that homeownership comes with responsibilities. If individuals enjoy the benefits of owning a home, they should also bear the costs associated with protecting their property during times of crisis. This viewpoint may be considered tough love.

However, the advantages of holding homeowners accountable for safeguarding their assets could have several positive effects on the economy. Economists discuss who has an advantage in adapting within the asset market; homeowners aware of their limitations in managing assets during risky times are less likely to purchase these properties.

As understanding of climate risks increases and knowledge about which properties are vulnerable to floods and wildfires becomes more widespread, individuals skilled in handling these risks—whether through a diversified portfolio, expertise, or access to essential data—will

be more inclined to invest in such properties. As more informed property managers acquire these assets, they continuously seek cost-effective solutions to mitigate risks, particularly as climate change exacerbates these challenges. However, these property managers may also seek subsidies from others.

Ultimately, this raises a political economy question regarding the phase-out of government subsidies for protective measures. As property owners search for cost-effective solutions to mitigate risks, they help stimulate capitalism by prompting entrepreneurs to devise innovative solutions.

Homes perceived to be safer will command a price premium. Consequently, resilient homes offer a rate of return on their investment, and this resilience can be easily verified through technologies like drones, inspections, and AI. Lenders will offer lower interest rates for purchasing these properties, and insurance companies will provide relatively cheaper policies for such homes.

Homeowners who take proactive steps to make their real estate assets safer, even in fire-prone areas like the Palisades, will be rewarded in a competitive market. Suppose the government refrains from distorting price signals. In that case, developers of new homes will recognize this dynamic and construct properties that are not only beautiful and equipped with modern appliances but also increasingly fire-resistant and flood-resistant.

In real estate, we often discuss the importance of location, location, and location as a primary determinant of property prices. Real estate prices are generally higher in attractive cities with lower crime rates, better schools, easy access to commercial activities, and major employers, such as Century City in Los Angeles. However, there is a growing concern about flood and fire risks. In that case, real estate developers will have more substantial incentives to focus on higher ground in safer areas, constructing taller buildings there, significantly if single-family zoning laws do not constrain them.

In areas that face fire and flood risks, developers will recognize that potential buyers are aware of these dangers. As a result, they will invest more in verifiable actions to build safer, more resilient homes. In flood zones, they will construct homes specifically designed to withstand flooding, and in fire-prone areas, they will make more fire-resistant homes. This involves considering factors such as private hydrants, vegetation around the property, and appropriate roofing materials.

For-profit firms will design products that meet people's needs. Developers will have strong incentives to create suitable products if individuals have accurate risk perceptions regarding the hazards they face. It is important to note that there is a marginal cost curve: the cost of protecting an area increases with the intensity of protection. One cannot simply "triple bubble-wrap" a home to eliminate fire risks. Nevertheless, ongoing efforts to improve safety and resilience will result in each home built in these areas facing reduced risks. Additionally, this dynamic stimulates a growing industry focused on adaptation.

Young individuals entering the workforce are more likely to pursue careers in this field, as it offers a dual benefit: a steady income while providing a valuable service that enhances safety for where Americans live and where children grow up during increasingly risky times. This exemplifies how free-market capitalism enables us to adapt.

This process may be messy, reminiscent of Milton Friedman’s discussion about the pencil in a well-known video available on YouTube. Friedman uses the pencil as a prime example of the dynamism of capitalism, emphasizing that no single person knows how to make a pencil. Yet, through experimentation and trial and error, we have an affordable and functional product for everyone. There's an analogy between a pencil and a fire-resilient home. There was no government-mandated way to make the pencil. Instead, there was open competition, which led to the emergence of an affordable pencil through market competition.

I have outlined how deregulation and the phase-out of specific rules and regulations can help protect us from weather-related risks. While the death toll from weather events is declining, some individuals still perish during these occurrences. Due to our prosperity, we have built properties in high-risk areas, which can lead to billion-dollar damages when shocks occur. For instance, if a thousand homes worth a million dollars each are destroyed in a disaster, that results in a billion dollars in losses.

A silver lining to such disasters is the opportunity to rebuild. The question is: Given what we now know and our expectations, how should we plan for the future? A property can last 50 or 60 years, so anyone building a house in 2025 must consider how the world might look in 2075. None of us know how the future will evolve.

Humble individuals understand that they cannot predict the future. An important concept to remember is building in more option value, recognizing that we will continue to learn. The humble person knows what he doesn't know. For example, suppose we know that a

property is in a fire zone, but we're uncertain about the severity of the risk. In that case, we should consider relatively low-cost property protection strategies. What affordable options exist for keeping our choices open so property owners can adapt as engineers make advancements and climate science refines our understanding of local risks? One example might be a roof that can be easily removed and replaced with newer, better technology as it becomes available.

By focusing on the property owner, I'm placing the responsibility on them to make these decisions. These individuals are more likely to take charge if they realize a benevolent government isn't looking out for them as if they were children. An unintended consequence of extensive government regulations in real estate, insurance, and lending markets has been decreased choice and freedom available to individual property owners.

Whether a notion of benevolent paternalism justifies this is unclear, but this has slowed overall resilience to extreme weather events. Individual decision-makers are not bearing enough of the risk associated with their choices and are not held accountable for their decisions.

I've outlined a new set of contract regimes that would encourage the identification of the right person to own a property when it is up for sale and the establishment of appropriate incentives for that individual.

The Political Economy of Phasing Out Anti-Resilience Policies

I have argued that government policies—at the federal, state, and local levels—often benefit small groups while imposing costs on larger groups. I have pointed out the unintended consequences of policies such as not allowing insurance prices or water prices to reflect scarcity. The costs of such policies may increase over time due to extreme weather events. As we face more significant risks from disasters and extreme heat, the consequences of maintaining the status quo are expected to escalate.

This situation raises the question: When will political reform occur? If current rules and regulations are causing problems, can we trust that these rules will be removed or that reforms will happen? Or do we accept that once regulations are enacted, they remain in place indefinitely due to inertia and the benefits some individuals derive from them?

An optimist might argue that reforms will naturally take place as the social costs of outdated regulations rise. Economists recognize this as a version of the Coase Theorem. If

society-wide gains are possible through political reforms and the inefficiencies of current rules and regulations increase, we expect that the beneficiaries of reforms will compensate those who lose out and mitigate any opposition to change. Surprisingly, economists have found it challenging to achieve this outcome. Given these realities, I propose a potential pathway to reform, which resembles a domino effect.

One way forward to reform land use rules would be to promote policies that encourage more individuals to become renters. The median voter is less likely to support policies restricting housing supply if more people are renters. In many communities dominated by single-family homeowners, the prevalence of Nimbyism (Not In My Backyard sentiment) is often driven by homeowners' fear that allowing more housing construction will lower their property values and change the character of their neighborhoods. If a more significant proportion of the community were renters, they would likely have a greater incentive to support policies that increase housing availability.

Coase versus Olson and Decentralized Competition

Economists who research the political economy of policy reform have been divided into two camps. The first camp consists of those who argue that, eventually, a prosperous society adopts policies where the winners gain more than the losers lose. This optimistic outcome can emerge through competition in a decentralized system where different states have their policies. A state with inefficient policies that benefit only a small minority would lose individuals and businesses that can relocate. As a result, the overall economy would begin to decline unless that area possesses unique amenities and attractions that no other state offers. For instance, economists have documented that California, known for its beautiful beaches, holds implicit market power. Despite having a progressive tax code that charges wealthy individuals a higher marginal tax rate—sometimes as high as 15 or 16%—billionaires disproportionately reside in California. They do not uproot and move to states like Texas, which has much lower taxes. The explanation for this trend is that, despite its taxes and risks, California provides a quality of life that no other American state can match.

Elon Musk is a rare billionaire who has left California for Texas. In a decentralized system where states compete with one another and individuals can "vote with their feet" if a locality implements inefficient policies, increased regulations, and high taxes—actions that the majority dislike—individuals and businesses have the choice to relocate to more favorable environments.

A governor aiming to maintain a large tax base would recognize when the "golden goose" is leaving the state. This realization would incentivize them to reconsider their policies and regulations to be more business-friendly rather than catering to favored groups who benefit from the existing laws and subsidies.

This perspective presents an optimistic view: when localities compete against each other, they are incentivized to pursue efficient public policies, which grow the economy and create more prosperity and opportunities. Such resources can then be allocated to minimize risks and maximize resilience.

Olson

The second school of thought in political economy focuses on the theory of asymmetric interest groups. In many cases, especially within industries and among consumers, it is not always a classic "David versus Goliath" scenario. Let's consider a concrete example. Imagine an industry that produces aluminum cans that are used in many products, including soda. However, pollution is associated with the production of these aluminum cans. In this scenario, many people living near aluminum factories may be exposed to pollution, resulting in minor losses for each of them. Conversely, a relatively small number of aluminum firms and their workers could incentivize them to form trade associations and lobby the government for minimal regulation of the aluminum sector. Note the asymmetry. If there are a limited number of aluminum firms and their profits increase without environmental regulations, these firms will have strong incentives to influence lawmakers against the rules. It could lead to a situation where society would benefit if the aluminum manufacturers were regulated. However, the asymmetry arises because many people are affected by the pollution, but each experiences a tiny loss and faces transaction costs in organizing to combat the situation collectively.

The lesson here for those who seek to enact disaster resilience policies reforms is to keep a close eye on what concentrated interest groups gain from the status quo. If they have the property right to veto reforms, what payment could they be made to buy their veto?

Benchmarking Disaster Resilience Progress

What performance criteria would lead an objective observer to conclude that a society is making resilience progress such that our ability to reduce our risk exposure is increasing and the marginal cost of achieving this goal is decreasing over time? A society can take no preventative steps and yet not suffer catastrophes. In such a case, they might simply have gotten lucky. If that happens, it wouldn't indicate that the prudent society established rules encouraging resilience. When horrible events occur, people and their communities may have adapted. However, there could be decades where no significant shocks occur, meaning those who weren't prepared wouldn't face any consequences because nothing happened.

As an empiricist, it's crucial to monitor empirical benchmarks. Are we seeing a decline in the death toll from natural disasters? Are insurance premiums in high-risk areas decreasing because these areas are becoming objectively less risky? Are certain types of cities that are hit with an extreme hurricane slow to recover from the shock? While are there other cities that quickly recover? These are examples of benchmarks indicating our progress in adapting to tail risk.

I have been wrong before. After the terrorist attacks of 9/11/2001, I predicted that fear of future terrorist attacks in dense Manhattan would accelerate out-migration from that Superstar City. I predicted that people would adapt to disaster risk by moving away from Manhattan. If enough productive people left the city then home prices would decline and the City would lose its vitality. Despite my prediction, New York City rallied in the 2000s as Mayor Bloomberg worked hard to improve the city's quality of life and to overcome fears of a new terrorist attack.

Here is direct quote from one of my articles;

Fear of center city terrorism could certainly encourage both population dispersion and job sprawl. Paul Krugman and I anticipated this point immediately after the September 11th attacks. In the days following the September 11th attacks, I wrote a draft of an editorial that was never published titled 'Will Wall Street Leave Wall Street?' This

editorial built on my current work at the time on the causes and consequences of employment suburbanization (Glaeser and Kahn, 2001, 2004). But Dr. Krugman authored a far better piece in his *New York Times* column. An excerpt from the 3 October 2001 opinion piece 'Reckonings: An Injured City' is worth reprinting here:

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Will the terror attack permanently damage New York's position as America's economic capital?

After all, America's pre-eminent city owes its position to historical accident. The natural advantages of New York – its fine harbor, its location at the terminus of the only possible canal route to the Great Lakes – were real enough during the city's rise. But those natural advantages have long since ceased to be important to the city's economy. What keeps New York a great city is circular causation; people and businesses locate there because of the opportunities created by the presence of other people and businesses.

And because the city's economy is sustained by circular causation, a sufficiently large blow to that economy could in theory do permanent damage. If enough businesses and people leave, for whatever reason, the local economy could fall below critical mass and enter a downward spiral in which businesses leave because other businesses are leaving.

The beneficiaries of such an exodus would probably not be other great cities; instead, businesses would move out into the endless sprawl. I was not the only

> person in suburban New Jersey who, somewhat to my shame, felt perfectly safe on Sept. 11: there are millions of people living and working nearby, but no obvious targets, because there's no there here.
>
> The question is how large a blow would be needed to start such a spiral? How robust are cities, anyway? (Krugman, 2001)

These quotes highlight that even a shock as large at the 9/11 attacks had a minimal impact on the vast area of the New York City metro area. Of course, the devastation at Ground Zero was extreme. Perhaps my prediction back in late 2001 that Manhattan would decline as "Wall Street would leave Wall Street" was also a concern of Mayor Bloomberg and he devoted extra effort to increase the competitiveness of his city to overcome the terrorism tax.

Going forward, tens of millions of us are likely to face tests in the face of ongoing hurricanes, tornadoes, wildfires, and storms, just as Los Angeles did with the wildfires in January 2025. If we encounter these stress tests, what objective evidence would indicate that we are progressing in adaptation?

The first sign of progress would be a decline in the number of deaths when these events occur. Another metric would focus on economic dislocation caused by such shocks. In my own research, I have used lights at night as a measure of high frequency economic activity. In the past, lights dimmed more in the aftermath of a disaster. If this diming effect shrinks and if lights at night recover faster in the aftermath of the shock, then this is evidence of adaptation. Additional evidence of progress would include a continued decline in the insurance loss ratio. For example, if there is a trillion dollars worth of real estate in a part of Florida, we must assess how much of that value is lost to disasters each year. The loss ratio is calculated by comparing the total value of real estate in an affected area (the denominator) to the value of the destruction from lost or damaged homes and commercial buildings (the numerator). If this loss ratio decreases over time, the real estate stock is becoming more robust and resilient.

In that case, insurers can expect to earn expected profits because they collect annual premium policies and only pay out if something terrible occurs. But if the probability of something terrible happening declines, their expected costs of issuing these policies decline, and profit equals revenue minus expenses. Suppose costs are expected to decrease. Then profits are expected to rise, and that's a desirable and juicy target for insurers to write new policies.

If progress is being made in mitigating disaster risk, a key question is the pace of that progress. This pace depends on the incentives present in the economy and the level of innovation. Suppose entrepreneurs believe there is a market demand for solutions that help to mitigate risks. In that case, top engineering and architecture school engineers are more likely to dedicate their time and effort to developing such products. Entrepreneurs tend to choose fields where they perceive a high-profit potential, so they are more likely to enter markets focused on creating resilient real estate or enhancing the resilience of existing properties.

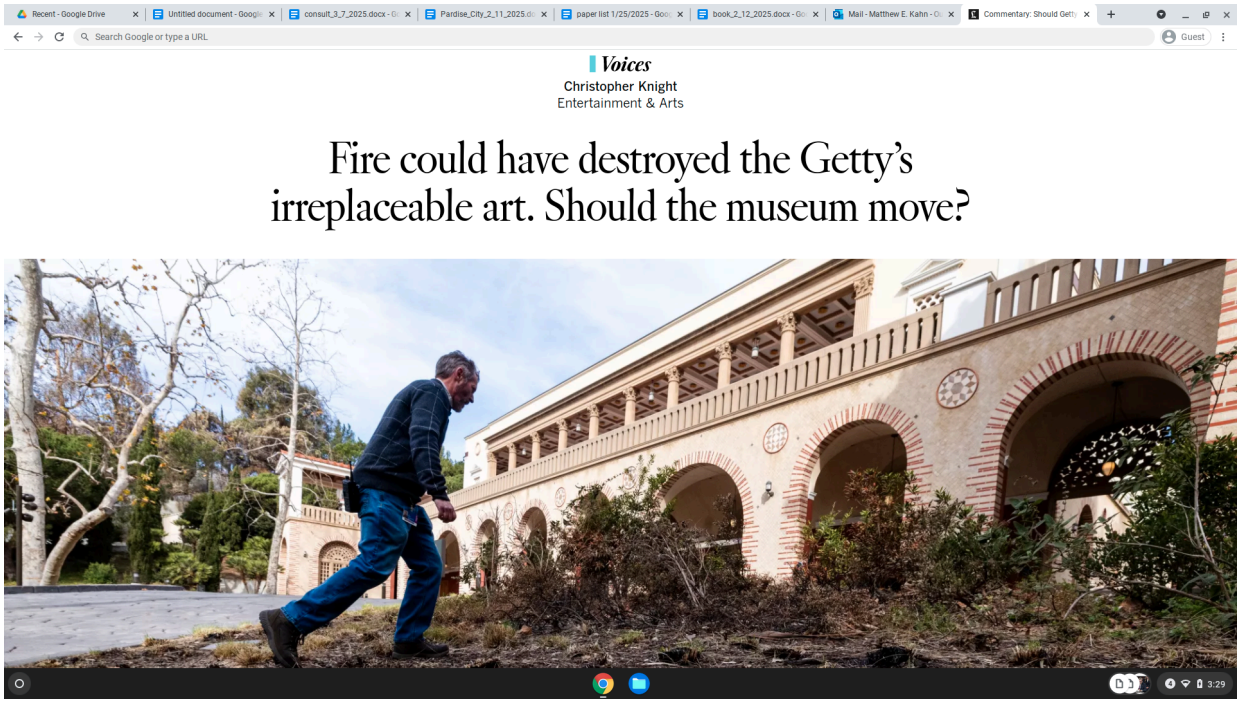
The overarching theme of this book is that, subject to the laws of physics, the market economy is constantly in flux as sellers strive to offer products that buyers want. Buyers, especially those concerned about their family's safety and well-being, will seek market solutions to mitigate the risks they anticipate — mainly if they live in desirable areas like Pacific Palisades.

Sophisticated households will demand effective solutions to protect themselves in a world with increasing information about our risks. This point is particularly relevant when discussing benchmarking disaster resilience progress. There is an optimistic theme here: demand creates supply. Households aim to be comfortable and healthy while raising children who can thrive.

The Pacific Palisades was a beautiful place to reside before the fires, and I predict that in a few years, it will be beautiful once again as the homes and community are rebuilt. When the community is rebuilt, will the newcomers have a memory of the events of January 2025? I predict they will take precautions, especially if market price signals are allowed to function, and the government steps back from various markets we've discussed. If market forces are permitted to operate in the Palisades, I believe a much safer community will emerge, continuing to attract wealthy residents. The area will remain beautiful, and many new homes will likely be more admirable than those that burned down.

The Power of Imagination

A silver lining of disasters is that they stretch out our imagination as we experience events we never thought could occur. Consider this salient example about whether the unique art at the Getty Museum in West Los Angeles should move to a safer place.



Voices

Christopher Knight
Entertainment & Arts

Fire could have destroyed the Getty's irreplaceable art. Should the museum move?

While everyone with a laptop has experienced a hard drive crash that has infuriated us, the rise of Google Drive allows us to backup our files and have peace of mind. That same "uploading" cannot be done with unique physical assets such as paintings and sculptures. How do we protect ourselves, our art and our families in a risky world? You know my answer! Unleash market forces!!

A Final Optimistic Point

I wrote this book because the Los Angeles Fire of January 2025 shocked me. I want to end with some good news based on a public health study that documented that the short run health costs of the disaster was tiny.

The KEY point discussed in the paper below is that based on emergency room visits, the health damage was very small. Why? My theory is that people adapted. They spent more time inside. They put on masks and they operated their air filters that more and more people own. Dora and I were running our air filter 24 hours a day. These devices are declining in price and improving in quality. Adaptation technological progress is accelerating.

Ebinger, Joseph E., Tzu Yu Huang, Sandy Y. Joung, Juliane Louise F. Kwong, Wasay Warsi, Nancy Sun, Jesse Navarrette, Patrick Botting, Zaldy S. Tan, Brian L. Claggett, Alan C. Kwan, and Susan Cheng. "Emergency Encounters for Illness During and After the Los Angeles Wildfires." Journal of the American College of Cardiology (2025). https://doi.org/10.1016/j.jacc.2025.10.079.

Emergency Encounters for Illness During and After the Los Angeles Wildfires

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Wildland-urban interface (WUI) fires are increasing in frequency and scope, as exemplified by the Los Angeles fires that began on January 7, 2025. When compared with urban-only and wildland-only fires, WUI fires spread more rapidly and consume a greater mixture of both biomass and industrial fuels.[1] Data regarding specific health outcomes experienced by locally affected Los Angeles residents are limited.[2,3]

METHODS

We examined data on emergency encounters at Cedars-Sinai, comprising the largest adult acute care medical center in Los Angeles County and located 18.1 and 10.2 miles from the Eaton and Palisades fire origins, respectively. We focused on encounters involving residents from zip codes within our catchment area that were either directly a fire-affected zip code (39 zip codes). For this region, mean outdoor concentration of particulate matter with a diameter of ≤2.5 μm was 20.1 ± 14.5 μg/m^3 during the week preceding fire onset and 33.6 ± 86.2 μg/m^3 during the week after fire onset.[4] We identified the most frequently occurring International Classification of Disease, 10th Revision coded emergency discharge diagnoses (≥50 per month). For clinical interpretability, we categorized respiratory diagnoses as upper (J00-J06, J30-J39) or lower (ie, acute pulmonary: J09-J18, J20-J22, J40-J4A, J60-J70, J80-J84, J85-J86, J90-J94, J96-J99). We manually chart reviewed randomly selected encounters across all years to ensure validity of all code-based diagnoses.

To analyze encounters occurring within 90 days after fire onset (January 7, 2025 to April 7, 2025) compared with those during prior years (2018-2024), we conducted interrupted time series analyses using

I spoke to Grok about this paper and here is what Grok has to say;

I gave Grok this prompt;

Take a look at the attached paper that uses the LA Wildfires of January 2025 to study health impacts in Los Angeles county. Can an optimist conclude that in a County with 9.5 million people that the overall health impacts were small?

GROK replied;

The study focuses on a subset of Los Angeles County—specifically, 39 zip codes directly affected by or adjacent to the January 2025 wildfires, encompassing a stable population of around 1.2 million people (based on U.S. Census estimates from 2018–2025). This represents only about 13% of the county's total population of approximately 9.5 million. The analysis was limited to emergency encounters at Cedars-Sinai Medical Center, the largest adult acute care facility in the county, but not the only one, and it examined data from the 90 days following the fire onset (January 7 to April 7, 2025) compared to the same period in prior years (2018–2024).Key observations from the paper that could support an optimistic view:

- There was no overall increase in total emergency encounters during the post-fire period (rate ratio: 0.98, 95% CI: 0.85–1.11). Monthly encounter volumes remained stable (2,062–2,602 in prior years vs. 2,586 in 2025 for January–March).
- While specific excesses were noted, the absolute numbers were modest relative to the study population:
    - Acute pulmonary illness: 24% increase, equating to 83 extra encounters (1,490 vs. 1,407 in prior years).
    - Acute myocardial infarction (AMI): 46% increase, equating to 37 extra encounters (259 vs. 222).
    - Blood chemistry laboratory abnormalities (indicating systemic illness): 218% increase, equating to 283 extra encounters (398 vs. 115).
- These figures represent a tiny fraction of the 1.2 million people in the studied zip codes—less than 0.04% experienced these excess emergency visits over 90 days combined across all three categories.
- The paper notes that these effects were not uniform; for instance, the excesses in more severe illnesses (like AMI) appeared early, while others may have been delayed or less severe. It also references a related study (Paglino et al., 2025) showing excess all-cause deaths limited to the first 4 weeks post-onset, returning to baseline thereafter.

- Broader context from the paper suggests that while wildland-urban interface (WUI) fires like these produce complex smoke exposures, the health impacts observed were localized to areas near the fires (e.g., PM2.5 levels rose from 20.1 μg/m^3 pre-fire to 33.6 μg/m^3 post-fire in the study region), and not necessarily reflective of county-wide effects.

END of GROK QUOTE

A statistical point that I have made many times is that over time; such as in the year 2030 or 2035 that a future Los Angeles populace will suffer less from the next equally intense Fire because we will have access to better adaptation technology.

Yes, the population is aging. Yes, our value of avoiding risk is rising but because our demand to be safe is rising; people have strong incentives to invest in self protection against anticipated shocks such as PM2.5 spikes. We are not passive victims here. Anticipating that we do face risks and anticipating that governments are unlikely to protect us, people are grown ups and use their wits, and markets to protect themselves. As demonstrated by this new study, we are adapting!

Extra Reading

How Los Angeles Can Rebuild After the Wildfires

Kindling for an Inferno

The Death Toll from Disasters

Adapting to Floods

Expecting Climate Change: A Nationwide Field Experiment in the Housing Market | NBER

Climate Change Adaptation Will Offer a Sharp Test of the Claims of Behavioral Economics

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