Foreword: On the Imperative of Adapting to Climate Change

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For climate change and the administrative state, imagine two situations:

(1) Congress has enacted a Climate Change Act (CCA), which gives specific directions, and specific authorities, to an assortment of agencies: the Environmental Protection Agency, the Department of Transportation, the Department of Interior, the Department of Homeland Security, the Department of Energy, and others. In the years following enactment of the CCA, the relevant agencies must act in accordance with Congress's directions. To be sure, they must make some important discretionary judgments, calling for both scientific and economic assessments. But those judgments are sharply cabined by congressional instructions about how to handle the problem of climate change.

(2) Over a period of decades, Congress has given an assortment of directions and authorities to an assortment of agencies: the Environmental Protection Agency, the Department of Transportation, the Department of Interior, the Department of Homeland Security, the Department of Energy, and others. In general, those directions and authorities were not given with specific reference to climate change. Some of the relevant authorities involve air pollution. Others involve fuel economy. Still others involve energy efficiency. Others involve preparedness for, and response to, national disasters. Agencies act in accordance with the directions and authorities that they have been given. If the President of the United States is focused on climate change, agencies will respond accordingly, authorized and limited as they are by law. If the President of the United States is not focused on climate change, agencies will also respond accordingly, again authorized and limited as they are by law.

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The current situation is, of course, (2), not (1). For the administrative state in general, and for particular agencies, the existence of various directions and authorities, not specifically focused on climate change, creates a host of opportunities and challenges. Agencies might believe that some statutory term (e.g., "pollutant") is capacious enough to allow, or to require, regulation of greenhouse gases.[1] Agencies might also believe that some broad statutory authority, involving (for example) energy efficiency, permits or requires them to reduce greenhouse gas emissions. We can imagine three sets of possibilities: (1) agencies *must* act to address climate change, given the statutory language;[2] (2) agencies *may not* act to address climate change, given the statutory language;[3] and (3) agencies *may* act to address climate change or not, as they see fit, given the ambiguity of the statutory language.[4]

These are questions about statutory authority. But even if an agency has that authority, it must not act arbitrarily.[5] Suppose that an agency is required or permitted to regulate greenhouse gas emissions by (for example) regulating the energy efficiency of appliances.[6] An agency might choose a level of mandatory efficiency that it has not adequately explained. It might not have dealt adequately, or at all, with an apparently reasonable objection to a high level of stringency. For example, it might not have given adequate consideration to the possibility that energy-efficient refrigerators will not refrigerate as well, or that such refrigerators might be exceedingly expensive upfront, or that they might not last as long as less energy-efficient refrigerators. Or an agency might not have dealt adequately with an apparently reasonable objection to a low level of stringency. For example, it might not have taken sufficient account of the large consumer savings that could result from energy-efficient appliances, or it might have used a social cost of carbon that is unduly low and thus undervalued the benefits of energy efficiency.

The articles in this Symposium tackle various questions raised by agency efforts, within the scope of their existing authority, to deal with climate change. The focus of these articles is largely on mitigation—on efforts to reduce greenhouse gas emissions. Some of the articles present arguments about how particular agencies could, and should, use their existing authorities more effectively to regulate greenhouse gas emissions, given the absence of specific legislation and given the fact that new elections change the direction of the executive branch. Other articles explore the scope of agencies' authorities to

1. *See* Massachusetts v. EPA, 549 U.S. 497, 528 (2007) ("[EPA] maintains that carbon dioxide is not an 'air pollutant' within the meaning of the provision.").

2. *See id.* at 532-34 (holding that EPA cannot avoid its statutory obligation to regulate greenhouse gas emissions if it makes an endangerment finding).

3. *See* Util. Air Regul. Grp. v. EPA., 573 U.S. 302, 321-24 (2014).

4. *See* Chevron U.S.A., Inc. v. Nat. Res. Def. Council, Inc., 467 U.S. 837, 865-66 (1984).

5. *See* 5 U.S.C § 706.

6. *See* Chris Mooney, *Obama Just Released the Biggest Energy Efficiency Rule in U.S. History*, WASH. POST (Dec. 17, 2015), https://www.washingtonpost.com/news/energy-environment/wp/2015/12/17/meet-the-biggest-energy-efficiency-rule-the-u-s-has-ever-released/ [https://perma.cc/BRQ7-4NJR]; 10 C.F.R. §§ 429-431 (2021).

assess the harms from greenhouse gas emissions (through, for example, the social cost of carbon) and to act in accordance with that assessment. The focus on mitigation is natural. Many of the key questions raised by climate change involve agency efforts to regulate such emissions.[7] But if the goal is to reduce the harms from climate change, mitigation must be complemented by adaptation and resilience as well.

In recent years, worldwide losses from natural disasters have increased dramatically.[8] The sources of these losses vary, but in some places, wildfires are a significant problem. Over the past five years, California alone has experienced over $40 billion in wildfire-related losses.[9] It might be tempting to think that because of climate change and other contributors to the relevant risks, these kinds of losses are essentially inevitable. To be sure, reduction of greenhouse gas emissions, or mitigation, can slow their growth, and hence much of the focus of climate law and policy has been on such reductions—on their benefits, on their costs, and on whether cost-benefit analysis should be taken as relevant or decisive. In this light, the focus on mitigation should be no surprise.

But consider the following evidence. California has adopted a series of wildfire standards, usually prompted by serious adverse events.[10] Such standards impose a variety of requirements.[11] For example, they require fire-resistant roofing or maintenance of vegetation near the home.[12] They require decks and building appendages to consist of non-combustible materials.[13] They require vents to be covered by a fire-resistant mesh.[14] They require exterior siding to be fire-resistant.[15] Although California's standards are frequently mandatory, they vary over both time and space.[16] For purposes of empirical investigation, at least, that is an advantage; it makes it possible to measure the effects of mandatory codes.

Patrick Baylis and Judson Boomhower have analyzed those effects in detail.[17] They find that even during a catastrophic wildfire, more than half of exposed homes end up surviving.[18] They also find that mandatory codes make a major difference in the probability of survival. If a 1990 home and a 2008 (or later) home experience an identical wildfire, the 1990 home, not governed by a code, is about 40% less likely to survive than the home from 2008 or later, which

7. *See*, *e.g.*, Massachusetts v. EPA, 549 U.S. 497 (2007); *Util. Air Regul. Grp.*, 573 U.S. 302.

8. Patrick W. Baylis & Judson Boomhower, *Mandated vs. Voluntary Adaptation to Natural Disasters: The Case of U.S. Wildfires* 1 (Nat'l Bureau of Econ. Rsch., Working Paper No. 29,621, 2021).

9. *Id.* at 2.

10. *Id.* at 2, 7.

11. *Id.* at 7-9.

12. *Id*. at 7.

13. *Id*. at 8-9.

14. *Id*. at 9.

15. *Id*.

16. *Id*. at 7-8.

17. *Id.* at 2.

18. *Id.*

is governed by a code.[19] Compliance with a code also benefits one's neighbors. If a neighboring home is less than 10 meters away, the likelihood that one's home will be destroyed by a fire is 6% lower if the neighboring home is code-compliant.[20] It is true that code compliance can be costly. But in California's most fire-prone areas, the benefits of wildfire building codes unambiguously exceed the costs.[21] Here, then, is a simple but significant lesson about the potential benefits of policies and reforms that reduce climate-related risks through adaptation. This lesson is only one of many with respect to the benefits from efforts at adaptation.[22]

It is customary to divide climate policy into three categories: mitigation, adaptation, and resilience.[23] As noted, mitigation refers to reductions in greenhouse gas emissions. The difference between adaptation and resilience is less simple.[24] Resilience is sometimes taken to refer to the capacity to absorb and respond to the effects of potentially hazardous events.[25] Adaptation is sometimes taken to refer to adjustments to expected effects or risks, so that harms are moderated.[26] Because the two terms overlap, I shall use "adaptation" to cover all efforts to reduce the adverse effects of climate-related risks, so as to ensure that to the extent possible, a hotter world, or a world with a more volatile climate, is not a more dangerous world. We could easily imagine, for example, a California or Oregon five years hence that has done relatively little to adapt to the risks of wildfire, extreme heat, hurricanes, and flooding. By contrast, we could imagine a California or Oregon that has done a great deal to adapt to those risks, so that they impose much less in the way of harm. If every state in the United States

19. *Id.* at 3.

20. *Id.*

21. *Id.* at 4, 32.

22. *See* ELLEN VAUGHAN & JIM TURNER, ENV'T & ENERGY STUDY INST., THE VALUE AND IMPACT OF BUILDING CODES 1-3 (2013), https://www.eesi.org/files/Value-and-Impact-of-Building-Codes.pdf [https://perma.cc/WYC2-9WMV]; *5 Reasons Building Codes Should Matter to You*, FED. EMERGENCY MGMT. AGENCY (Sept. 29, 2021, 9:04 PM), https://www.fema.gov/blog/5-reasons-building-codes-should-matter-you [https://perma.cc/M6NW-GPYA]; FED. EMERGENCY MGMT. AGENCY, BUILDING CODES SAVE: A NATIONWIDE STUDY, at ES-1 to -3 (2020), https://www.fema.gov/sites/default/files/2020-11/fema_building-codes-save_study.pdf [https://perma.cc/R7N9-J2XP]; INS. INST. FOR BUS. & HOME SAFETY, BUILDING CODE RESOURCES: THE BENEFITS OF STATEWIDE BUILDING COSTS (2019), https://ibhs.org/wp-content/uploads/2019/01/The-Benefits-of-Statewide-Building-Codes_IBHS.pdf [https://perma.cc/9GDF-76NH]; ENV'T PROT. AGENCY, SMART GROWTH FIXES FOR CLIMATE ADAPTATION AND RESILIENCE 1-4 (2017), https://www.epa.gov/sites/default/files/2017-01/documents/smart_growth_fixes_climate_adaptation_resilience.pdf [https://perma.cc/EJ9Q-2PPM].

23. *See Mitigation, Adaptation and Resilience: The Three Pillars of the Response to Global Warming*, COP23, https://cop23.com.fj/mitigation-adaptation-resilience/ [https://perma.cc/R29U-WRJF] (last visited Jan. 10, 2022).

24. *See Climate Change: Defining* Adaptation *and* Resilience*, with Implications for Policy*, CONG. RSCH. SERV. (May 11, 2011), https://sgp.fas.org/crs/misc/IF11827.pdf [https://perma.cc/2GTX-BTX8].

25. *See* UN SYS. TASK TEAM ON POST-2015 UN DEV. AGENDA, DISASTER RISK AND RESILIENCE 3 n.1 (2012), https://www.un.org/en/development/desa/policy/untaskteam_undf/thinkpieces/3_disaster_risk_resilience.pdf [https://perma.cc/9UVF-6EL7].

26. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, ANNEX II: GLOSSARY 1758 (2018), https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-AnnexII_FINAL.pdf [https://perma.cc/5FTE-USH2].

adopted wildfire codes akin to those in California, it is clear that the harms of wildfire would be significantly reduced. At the same time, it is not at all clear that every state in the United States should adopt such codes—a point to which I will return.

It is important to see that policymakers have a toolbox for promoting adaptation (just as they have a toolbox for promoting mitigation). They might impose *incentives*—for example, by giving out money, goods, or technical assistance to encourage private and public institutions to adapt.[27] They might impose *regulation*—for example, by following California's example and requiring various steps to reduce wildfire-related risks. (Those steps might or might not be subsidized.) They might engage in *nudging*—for example, by providing information about climate-related risks (educative nudges) and how to reduce them,[28] by making climate-related risks more salient,[29] by making it easier to take steps to reduce such risks,[30] or by making enrollment in risk-reducing actions essentially automatic.[31] Each of these steps will have both costs and benefits. We could imagine costly adaptation efforts that would do a great deal of good—or very little. A large economic subsidy might not produce much in terms of benefits. A regulatory mandate could cost a great deal but deliver nothing. Nudges are typically inexpensive, and in part for that reason have been found to be highly cost-effective,[32] especially when they involve architectural interventions, which alter the underlying design of social environments (as, for example, through default rules).[33] *Nudging climate adaptation* would be an eminently worthwhile effort. But by itself, information disclosure may or may

27. *See Building Resilient Infrastructure and Communities*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities [https://perma.cc/Y9TM-ZYN2] (last visited Jan. 10, 2022).

28. *See National Risk Index for Natural Hazards*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/flood-maps/products-tools/national-risk-index [https://perma.cc/FDP2-EQUR] (last visited Jan. 10, 2022); *Nature-Based Solutions*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/emergency-managers/risk-management/nature-based-solutions [https://perma.cc/CUH9-MQH2] (last visited Jan. 10, 2022); FLOOD FACTOR, https://floodfactor.com/ [https://perma.cc/D4WW-S4ZR] (last visited Jan. 10, 2022); Henry Fountain, *This Vast Wildlife Lab Is Helping Foresters Prepare for a Hotter Planet*, N.Y. TIMES (Jan. 5, 2022), https://www.nytimes.com/2022/01/05/climate/fire-forest-management-bootleg-oregon.html [https://perma.cc/NA52-7TKR].

29. *See* Zhongchen Hu, Salience and Households' Flood Insurance Decisions 1-3 (Feb. 22, 2021) (unpublished manuscript) (on file with author).

30. *See generally* CASS R. SUNSTEIN, SLUDGE: WHAT STOPS US FROM GETTING THINGS DONE AND WHAT TO DO ABOUT IT (2021) (exploring administrative burdens and their adverse effects).

31. *See* Lynn Conell-Price, *Encouraging Resiliency with Auto-Enrollment in Supplemental Flood Insurance Coverage*, WHARTON RISK MGMT. & DECISION PROCESSES CTR. (Jun. 17, 2021), https://riskcenter.wharton.upenn.edu/lab-notes/autoenrollment/ [https://perma.cc/9V8F-NANV].

32. Shlomo Benartzi, John Beshears, Katherine L. Milkman, Cass R. Sunstein, Richard H. Thaler, Maya Shankar, Will Tucker-Ray, William J. Congdon & Steven Galing, *Should Governments Invest More in Nudging?*, 28 PSYCH. SCI. 1041, 1044-52 (2017).

33. Stephanie Mertens, Mario Herberz, Ulf J. J. Hahnel & Tobias Brosch, *The Effectiveness of Nudging: A Meta-Analysis of Choice Architecture Interventions Across Behavioral Domains*, 119 PROC. NAT'L. ACAD. SCI., no. 1, 2022, at 1-8.

not deliver much in the way of adaptation; everything depends on the context. Inertia or optimistic bias might ensure that disclosure is ineffective.[34]

I have noted that, with respect to climate change, much of public policy and academic work has focused on the question of mitigation. On one view, which can be found in many of the pieces included in this Symposium, it is important to set some kind of ceiling on increases in global temperatures—perhaps 2 °C, perhaps 1.5 °C[35]—and to achieve emissions reductions that will ensure that the ceiling is not exceeded.[36] Approaches of this kind raise an assortment of questions. Where, exactly, does the stated ceiling come from? Is it based on an assessment of costs and benefits, such that 1.5 °C, and no more and no less, is clearly known to be optimal? (The fact that the stated ceilings are typically simple and memorable—2.0 °C or 1.5 °C as opposed to, say, 1.954 °C, or 1.4823 °C—might raise doubts about that possibility.) Is it based on a judgment that once a ceiling is exceeded, the harms from climate change will be truly catastrophic, and that within the ceiling, the harms would be tolerable? If so, the argument for a stated ceiling would be easy to understand. Suppose that you are told that if you eat five sausages, you will be fine, but that if you eat a sixth, you will die; if so, you had better not eat the sixth, even if you really love sausages. But in light of the multiple uncertainties associated with climate change[37] and the relationship between emissions and harms, it would be surprising if anyone could say, with real confidence, that any particular ceiling on emissions, or on anticipated warming, is precisely the right one.

Nothing here is meant to raise questions about aggressive efforts to reduce greenhouse gas emissions, including those discussed in this Symposium. For various reasons, including the risk of catastrophe,[38] those efforts are essential.[39] At the same time, reasonable people have raised serious questions about the feasibility of meeting some prominent current goals, including a 1.5 °C ceiling and even a 2 °C ceiling.[40] This is a domain in which predictions are especially hazardous, but according to some accounts, it is extremely unlikely that nations will be able to do what must be done to meet those goals. As Robert Pindyck puts it:

34. *See* George Loewenstein, Cass R. Sunstein & Russell Golman, *Disclosure: Psychology Changes Everything*, 6 ANN. REV. ECON. 391, 398-404 (2014).

35. *See generally* Nicholas Stern & Joseph E. Stiglitz, *The Social Cost of Carbon, Risk, Distribution, Market Failures: An Alternative Approach* 1 (Nat'l Bureau of Econ. Rsch., Working Paper No. 28,472, 2021) (arguing for a ceiling on emissions and a social cost of carbon that is a product of that ceiling).

36. *Id.* at 59.

37. *See* Robert S. Pindyck, *Climate Change Policy: What Do the Models Tell Us?*, 51 J. ECON. LITERATURE 860, 870 (2013); Robert S. Pindyck, *What We Know and Don't Know About Climate Change, and Implications for Policy*, 2 ENV'T & ENERGY POL'Y & ECON. 4, 17-26 (2021).

38. *See* Martin L. Weitzman, *Fat-Tailed Uncertainty in the Economics of Catastrophic Climate Change*, 5 REV. ENV'T ECON. & POL'Y 275, 279-83 (2011).

39. *See* ROBERT S. PINDYCK, CLIMATE FUTURE: AVERTING AND ADAPTING TO CLIMATE CHANGE (forthcoming 2022) (manuscript at 7), http://web.mit.edu/rpindyck/www/Papers/ClimateFuture_0521.pdf [https://perma.cc/A29M-NWME].

40. *See id.* (manuscript at 8).

> The sad but fundamental problem is that over the coming decades worldwide GHG emissions are likely to grow, and atmospheric GHG concentrations will surely grow. This will be the case under any conceivable (but realistic) climate policy. Current targets for GHG emission reductions vary, but . . . even the more aggressive targets are insufficient to prevent increases in atmospheric GHG concentrations. (As part of the Paris Agreement, for example, China pledged to reduce the *growth rate* of its emissions between now and 2030, but it did not pledge to reduce its *level* of emissions.) Furthermore, it is very unlikely that the world will even come close to meeting current targets for emission reductions. Thus we must come to grips with the likelihood of a global mean temperature increase over the next 50 to 70 years that could turn out to be 3°C or even higher—well above the 1.5°C to 2°C that many climate scientists and policy analysts have argued is a critical limit. This could lead to rising sea levels, greater variability of weather, more intense storms, and other forms of climate change.[41]

Perhaps this view is too pessimistic; perhaps political will, technological innovation, or both will lead to less warming than many people anticipate. But in light of the multiple harms likely to arise at 1.5 °C or 2 °C, let alone 3 °C or higher, it makes sense to focus intensely on adaptation.

But what kinds of adaptation? What kind of framework might be useful?[42] The study of wildfire standards in California offers important clues. The study focuses on the state's most fire-prone areas, where the benefits of those standards are clearly worth the costs. In areas that are least fire-prone, their costs are not necessarily justified.[43] The point should be intuitive: precautions against low-probability risks might not be worthwhile, depending on their cost, on how low the probability is, and on the magnitude of the bad outcome if it should come to fruition. Consider the planned seawall designed to encircle southern Manhattan, with the goal of preventing flooding from storm. The federal government allocated $176 million for the project in 2016, which seems like a large sum. But subsequent analysis produced a plan with an expected cost of $1 billion. And by 2020, the estimated cost rose to $119 billion, at which point the whole project was put on hold.[44]

A competent cost-benefit analysis should take all of the relevant considerations on board, and that analysis is a valuable clue to the welfare effects of adaptation measures.[45] Indeed, the cost-benefit analysis of adaptation may well be far more tractable than that of mitigation.[46] We do not have to rely on

41. *Id*.

42. I discuss some of the issues here in CASS R. SUNSTEIN, AVERTING CATASTROPHE: DECISION THEORY FOR COVID-19, CLIMATE CHANGE, AND POTENTIAL DISASTERS OF ALL KINDS (2021).

43. *See* Baylis & Boomhower, *supra* note 8, at 32.

44. PINDYCK, *supra* note 39 (manuscript at 187).

45. On why it is a valuable clue and no more, see MATTHEW D. ADLER & ERIC A. POSNER, NEW FOUNDATIONS OF COST-BENEFIT ANALYSIS (2006).

46. For various views on this, see John Horowitz & Andreas Lange, *Cost-Benefit Analysis Under Uncertainty—A Note on Weitzman's Dismal Theorem*, 42 ENERGY ECON. 201, 201-03 (2014); Martin L. Weitzman, *Tail-Hedge Discounting and the Social Cost of Carbon*, 51 J. ECON. LITERATURE 873, 881-82 (2013); William D. Nordhaus, *Revisiting the Social Cost of Carbon*, 114 PROC. NAT'L. ACAD. SCI. 1518, 1518-23 (2017).

integrated assessment models,[47] or to pick among them, to know whether it makes sense to take specific precautions with respect to flooding, extreme heat, and wildfires.

Still, there are problems. The first involves valuation. Assume that there are two communities in California: Rich and Poor. In Rich, the median value of a home, vulnerable to wildfire, is $5 million. In Poor, the median value of a home, vulnerable to wildfire, is $300,000. Rich and Poor are equally vulnerable to wildfire. A subsidy to Rich, designed to fund measures to reduce the risks associated with wildfire, will produce far higher benefits (and net benefits) than an equivalent subsidy to Poor for that purpose. Does it follow that on welfare grounds, Rich should receive the subsidy, and that perhaps Poor should not? Not at all.[48] Notwithstanding the monetary figures, the citizens of Poor might receive the same *welfare* from their homes as the citizens of Rich (or perhaps more). A policy that subsidizes Rich but not Poor might well be mistaken to rely on monetized benefits, because they do not adequately capture the welfare effects of subsidies. (Does a wealthy person get more welfare from a $5 million home than a poor person gets from a $300,000 home? That is not at all clear. The opposite might be the case.)

The second problem involves distributional equity. Suppose that, in fact, the citizens of Rich would receive more welfare from a given subsidy[49] than would the citizens of Poor. Does it follow that officials should subsidize the citizens of Rich? Not at all. "Prioritarianism" instead suggests that we should devote special attention to the welfare of those who are least well-off.[50] Imagine that the world consists of two people, Mary and Edna. Mary has 100 units of welfare; Edna has 1 unit of welfare. If we choose Intervention A, both will gain 20 units of welfare, so that Mary will have 120, and Edna will have 21. If we choose Intervention B, Mary will gain 10 units of welfare and Edna will gain 28, so that Mary will have 110, and Edna will have 29. Though Intervention A results in more aggregate welfare (141 is larger than 139), prioritarians would prefer Intervention B, not because it results in a more *equal* distribution, but because it *gives more help to the person at the bottom*. As for individuals, so for groups: we might give priority to those whose welfare is lowest and sacrifice aggregate

47. *See* Michael Greenstone, Elizabeth Kopits & Ann Wolverton, *Estimating the Social Cost of Carbon for Use in U.S. Federal Rulemakings: A Summary and Interpretation* (Nat'l Bureau of Econ. Rsch., Working Paper No. 16,913, 2011).

48. *See* Cass Sunstein, *Cost-Benefit Analysis, Who's Your Daddy?*, 7 J. BENEFIT-COST ANALYSIS 107, 107-10 (2016).

49. I am speaking here of subsidies, not regulation. If adaptation takes the form of mandatory measures, with the beneficiaries paying the costs, the analysis must be different. If the citizens of Poor are paying for adaptation, it might do them no favors to require them to pay as much as the citizens of Rich.

50. *See generally* Matthew D. Adler, *Theory of Prioritarianism*, *in* PRIORITARIANISM IN PRACTICE (Matthew D. Adler & Ole F. Norheim eds., forthcoming 2022) (outlining the theory of prioritarianism as a branch of welfare consequentialism); Matthew D. Adler & Nils Holtug, *Prioritarianism: A Response to Critics*, 18 POL. PHIL. & ECON. 101 (2019) (defending prioritarianism against objections).

welfare in order to achieve that goal.[51] Prioritarianism has strong defenders, though it also raises many questions. It is easy to imagine a prioritarian approach to adaptation, which would place a premium on helping those who are least well-off.

A third problem actually consists of two separate ones: (1) very low-probability risks and (2) uncertainty. Suppose that in a community, the annual risk of an extreme climate-related event is 1 in 100. Suppose that if the event occurred, the amount of damages would be $100 million. Would it make sense to spend $1 million, annually, to eliminate that risk? Might it make sense to spend more? People buy insurance; perhaps a degree of risk aversion is justified in these circumstances. But how much risk aversion? Or suppose that in a community, the annual risk of an extreme climate-related event is 1 in X, where X is unknown. Suppose that if the event occurred, the lower bound of the relevant amount of damage would be $100, and the upper bound is unknown. What then?

Consider in this regard a passage from John Maynard Keynes, who lived through the Great Depression and World War II, who spent much of young adulthood in same-sex relationships before he fell head over heels in love with a woman, and who knew a great deal about the unforeseeable:

> By "uncertain" knowledge, let me explain, I do not mean merely to distinguish what is known for certain from what is only probable. The game of roulette is not subject, in this sense, to uncertainty; nor is the prospect of a Victory bond being drawn. Or, again, the expectation of life is only slightly uncertain. Even the weather is only moderately uncertain. The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention, or the position of private wealth-owners in the social system in 1970. About these matters there is no scientific basis on which to form any calculable probability whatever. We simply do not know.[52]

With respect to some climate-related risks, communities might be in the vicinity of this problem, sometimes called Knightian uncertainty.[53] As Pindyck states,

> No one could have predicted the arrival and strength of Hurricane Katrina in August 2005, never mind its impact on New Orleans. Furthermore, climate change means that the statistics for storm surges that might have been valid in 2005 or 2020 are unlikely to be valid two or three decades from now.[54]

If so, communities might want to take steps to prevent the worst-case scenarios. But if those steps are very expensive, they might want to hesitate.

We need far more conceptual, normative, and empirical work on adaptation. In the relatively short-run, it should be possible to match particular climate-

51. This paragraph borrows heavily from a discussion in Cass R. Sunstein, *Arbitrariness Review and Climate Change*, 170 U. PA. L. REV 991 (2022).

52. JOHN MAYNARD KEYNES, THE GENERAL THEORY OF EMPLOYMENT, INTEREST AND MONEY 113-14 (1936).

53. *See* FRANK H. KNIGHT, RISK, UNCERTAINTY AND PROFIT (1921).

54. PINDYCK, *supra* note 39 (manuscript at 187).

related risks to particular strategies for adaptation,[55] with some clarity on the welfare effects of those strategies and their distributional impacts. The initial step is to give communities far more clarity about the risks they face and how to combat them.[56] Even as we explore the best approaches to the problem of mitigation, we need to explore, with real urgency, how best to protect vulnerable people and places from what is now here, and very likely to get worse.

55. Some valuable information can be found in FED. EMERGENCY MGMT. AGENCY, FEMA RESOURCES FOR CLIMATE RESILIENCE (2021), https://www.fema.gov/sites/default/files/documents/fema_resources-climate-resilience.pdf [https://perma.cc/NMY5-DGBF].

56. In the context of flooding, see FLOOD FACTOR, https://floodfactor.com/ [https://perma.cc/D4WW-S4ZR] (last visited Jan. 10, 2022). In the context of a large number of risks, see *National Risk Index for Natural Hazards*, FED. EMERGENCY MGMT. AGENCY, https://www.fema.gov/flood-maps/products-tools/national-risk-index [https://perma.cc/FDP2-EQUR] (last visited Jan. 10, 2022).