

CONFRONTING THE “CLIMATE LEHMAN MOMENT”: THE CASE FOR MACROPRUDENTIAL CLIMATE REGULATION

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U.S. financial regulators have argued that the risks that climate change poses for large financial institutions are outside of their core regulatory mandate. This Article argues that oversight of the largest financial institutions’ financing of significant amounts of fossil fuels and other carbon-intensive businesses has implications for financial stability, and is therefore a central responsibility for financial regulators.

This Article outlines the various financial risks of climate change. It then analyzes the case for classifying climate change as a systemic risk to the stability of the financial system. In doing so, it explores how we understand systemically risky activities, how this understanding applies to the climate financial risks created by the largest financial institutions, and the public harms created by climate financial risk, namely negative externalities and more hazard.

As a result of the above examination, this Article then lays out a framework for macroprudential regulation to curtail the financial risks caused by climate change, namely the funding of climate change drivers. It further identifies legal authorities available to U.S. financial regulators that provide a basis for issuing specific macroprudential regulations that could address the risks from, and role played by, large financial institutions’ financing of the industries and activities that drive climate change.

This Article further argues that the U.S. response to climate financial risk has been out of step with the international consensus on the magnitude of the risk. It concludes by observing that macroprudential climate regulation would, in addition to preventing a climate-driven financial crisis and mitigating the potential macroeconomic fallout from a systemic climate event, also assist in the effort to ensure an orderly tran-

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sition from a carbon-based economy to an economy that is less reliant upon carbon-intensive energy sources.

INTRODUCTION	111
I. CLIMATE CHANGE IS A SOURCE OF FINANCIAL RISK	114
A. <i>Climate Change Damages Physical Property</i>	115
B. <i>Policy Pathways to Address Climate Change Carry Financial Risks</i>	116
C. <i>Climate Financial Risks Affect the Credit Risks of Financial Transactions</i>	118
D. <i>Climate Financial Risks Can Impair Capital Markets</i>	119
E. <i>Climate-related Losses Have a High Probability of Materializing, and a Long Potential Duration</i>	120
II. CLIMATE CHANGE IS A THREAT TO THE STABILITY OF THE FINANCIAL SYSTEM	122
A. <i>Systemic Risk is Transmitted Through Either Financial Assets or Institutions</i>	123
1. <i>Climate Financial Risk Can be Transmitted Through Systemic Counterparties</i>	123
2. <i>Climate Financial Risk Can be Transmitted Through Vulnerable Asset Classes</i>	124
B. <i>Analyzing Climate Risks Through Systemic Risk Factors</i>	125
1. <i>Climate Risk Involves Leverage, Including From Derivatives</i>	125
2. <i>Climate Risk is Vulnerable to Liquidity or Maturity Mismatch</i>	127
3. <i>Climate Risk Creates Counterparty Risk and Interconnectedness</i>	129
4. <i>Climate Risk Lacks Sufficient Transparency and Contains a High Degree of Uncertainty</i>	130
5. <i>Climate Risk is Highly Concentrated, Significant, and Widespread</i>	133
C. <i>Climate Financial Risks Can Manifest in Myriad Ways</i>	136
D. <i>Climate Change Produces Negative Externalities and Creates Moral Hazard</i>	137
III. EFFECTIVE MACROPRUDENTIAL REGULATION WOULD ADDRESS THE SYSTEMIC RISKS OF CLIMATE CHANGE	141
A. <i>The Dodd-Frank Act Provides a Framework for Using Macroprudential Regulation to Address Systemic Risk</i>	141

<i>B. Macroprudential Regulation Would Address Systemic Climate Financial Risks</i>	144
1. Capital	145
2. Stress Testing	146
3. Margin	148
4. Portfolio Limits	150
5. Divestiture	150
6. Activities-based Regulations	151
<i>C. The United States’ Response to a Prospective Climate Financial Crisis Has Yet to Address the Systemic Nature of the Risks Involved</i>	152
CONCLUSION	154

INTRODUCTION

Experts have been warning for years about the risks of a growing carbon bubble that, should it pop, would result in stranded assets and job losses—to say nothing of the climate impacts that it would have in the interim.¹ As with the subprime mortgage crisis before it, voices warn that the potential carbon bubble will lead to a new global financial crisis.² Meanwhile, business continues to largely proceed as usual, ignoring many of the potential risks and seeking to eke out any remaining profits before the bubble bursts.³ Despite the warnings, and despite the lessons learned from a global financial crisis that is just a little more than a dec-

¹ See Carbon Tracker Initiative, *Wasted Capital & Stranded Assets* (Apr. 19, 2013), <https://www.carbontracker.org/reports/unburnable-carbon-wasted-capital-and-stranded-assets/>; see also Emanuele Campiglio, Yannis Dafermos, Pierre Monnin, Josh Ryan-Collins, Guido Schotten & Misa Tanaka, *Climate Change Challenges for Central Banks and Financial Regulators*, 8 *NATURE CLIMATE CHANGE* 462, 462 (2018) (“[A]sset stranding could not only lead to economic losses and unemployment, but could also affect the market valuation of the companies that own these assets, thus negatively impacting their investors, and potentially triggering cascade effects throughout the interconnected financial system.”).

² See Laurie Laybourn-Langton, Lesley Rankin, & Darren Baxter, *This is a Crisis: Facing Up to the Age of Environmental Breakdown*, INST. FOR PUB. POL’Y RSCH. 20 (Feb. 2019), <https://www.ippr.org/files/2019-02/this-is-a-crisis-feb19.pdf> (“[E]nvironmental breakdown could trigger catastrophic breakdown of human systems, driving a rapid process of ‘runaway collapse’ in which economic, social and political shocks cascade through the globally linked system – in much the same way as occurred in the wake of the global financial crisis of 2007/08.”).

³ Compare Jonathan Watts, Jillian Ambrose & Adam Vaughan, *Oil Firms to Pour Extra Seven Million Barrels Per Day into Markets, Data Shows*, GUARDIAN (Oct. 10, 2019), <https://www.theguardian.com/environment/2019/oct/10/oil-firms-barrels-markets> (quoting one expert that, “[i]f we were serious about addressing climate change we would leave some oil in the ground, so there is a scramble among big oil companies to make sure their assets are not the ones left stranded”); with Michiyo Nakamoto & David Wighton, *Citigroup Chief Stays Bullish on Buy-out*, FIN. TIMES (July 9, 2007), <https://www.ft.com/content/80e2987a-2e50-11dc-821c-0000779fd2ac> (quoting former Citigroup CEO Charles Prince that “[w]hen the music stops . . . things will be complicated. But as long as the music is playing, you’ve got to get up and dance. We’re still dancing.”).

ade behind us,⁴ the United States' financial regulatory agencies have taken few concrete actions to intervene and preempt a potential climate change-driven financial crisis.⁵

If, as former Treasury Secretary Timothy Geithner says, every financial crisis is “largely a failure of imagination,”⁶ then a climate-driven financial crisis should be avoidable, as the movements of financial markets are often conceptualized by invoking our understanding of the natural world. On the tenth anniversary of the “Lehman moment,” the collapse of the investment bank Lehman Brothers that marked a tipping point in the global financial crisis, the regulators who sought to protect the safety and stability of the financial system compared themselves to “firefighters” battling a rapidly spreading conflagration.⁷ Trading markets are evaluated through their “liquidity” that is vulnerable to both “monsoons” and “droughts.”⁸ Credit markets “freeze” and, eventually, thaw.⁹ The financial crisis was a “perfect storm,”¹⁰ with the great recession that followed as a “tsunami that was descending on the U.S. economy.”¹¹ And so on.

Given the intuitive similarities between the natural and financial worlds, it is difficult to deny that there is a “cognitive dissonance” between the potential threat posed by climate change and the intransigence of U.S. financial regulators.¹² One explanation is that policymakers still view the financial industry's climate issues largely through the lens of

⁴ Stephen Kurczy, *Have We Learned the Lessons of the Great Recession?*, COLUMBIA BUS. SCH.: IDEAS AND INSIGHTS (Aug. 27, 2018), <https://www8.gsb.columbia.edu/articles/ideas-work/have-we-learned-lessons-great-recession>.

⁵ Gregg Gelzimis & Graham Steele, *Climate Change Threatens the Financial System*, CTR. FOR AM. PROGRESS (Nov. 21, 2019), <https://www.americanprogress.org/issues/economy/reports/2019/11/21/477190/climate-change-threatens-stability-financial-system/>.

⁶ TIMOTHY F. GEITHNER, STRESS TEST 513 (2014); *see also* FIN. CRISIS INQUIRY COMM'N, THE FINANCIAL CRISIS INQUIRY REPORT 194 (2011) (quoting hedge fund manager Steve Eisman that “Everyone really did believe that things were going to be okay . . . [I] thought they were certifiable lunatics.”).

⁷ *See* Ben S. Bernanke, Timothy F. Geithner & Henry M. Paulson Jr., *What We Need to Fight the Next Financial Crisis*, N.Y. TIMES (Sept. 7, 2018), <https://www.nytimes.com/2018/09/07/opinion/sunday/bernanke-lehman-anniversary-oped.html>.

⁸ Andrew G. Haldane, Executive Director, Bank of England, *The Race to Zero* 14 (July 8, 2011), <https://www.bis.org/review/r110720a.pdf>.

⁹ Nick Timiraos, *Bernanke Says Credit Freeze More to Blame Than Housing Bust for Severity of Latest Recession*, WALL ST. J. (Sept. 13, 2018), <https://www.wsj.com/articles/bernanke-says-credit-freeze-more-to-blame-than-housing-bust-in-latest-recession-1536868914>.

¹⁰ FIN. CRISIS INQUIRY COMM'N, *supra* note 6, at 3.

¹¹ ADAM TOOZE, *CRASHED: HOW A DECADE OF FINANCIAL CRISIS CHANGED THE WORLD* 280 (2018).

¹² Patrick Bolton, Morgan Despres, Luis Pereira Da Silva, Frédéric Samama & Romain Svartzman, *The Green Swan*, BANK FOR INT'L. SETTLEMENTS 42 (Jan. 2020), <https://research-center.amundi.com/page/Publications/Working-Paper/2020/The-green-swan-Central-banking-and-financial-stability-in-the-age-of-climate-change>.

environment, social, and governance practices.¹³ Treating climate change as a niche issue, however—one essentially of corporate social responsibility—approaches climate financial risk as an ancillary risk, like reputational risk, rather than the core financial risk that it is. This results in business and regulatory strategies that reflect this worldview.¹⁴

This Article will demonstrate that the climate crisis is, in fact, sowing the seeds of a potential financial crisis. Namely, it will show that climate financial risk is a significant source of vulnerability for the business models of large financial institutions and the financial system as a whole. Because climate change presents a significant risk to financial stability, oversight of institutions’ financing of climate-change drivers is central to regulators’ responsibility to preserve financial stability. As a result, there is a significant risk that we could experience a “climate Lehman moment,” meaning a systemic financial event, driven by climate change, that is exacerbated by the actions, or lack thereof, taken by financial institutions and regulators.¹⁵

Part I of this Article analyzes the various types of financial risks posed by climate change. Part II explains how these risks have the potential to become systemic and pose a threat to financial stability. Part III then proposes specific macroprudential regulatory measures that could be

¹³ See, e.g., Alexander Kaufman, *Bank of America Touts Going Green but Funnels Billions into Fossil Fuels*, HUFFINGTON POST (Sept. 20, 2016, 1:14 PM), https://www.huffpost.com/entry/bank-of-america-re100_n_57e157bce4b0071a6e09a217.

¹⁴ See Bank of England, *Transition in Thinking: The Impact of Climate Change on the U.K. Banking Sector* 39 (Sept. 2018), <https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/report/transition-in-thinking-the-impact-of-climate-change-on-the-uk-banking-sector.pdf?la=en&hash=A0C99529978C94AC8E1C6B4CE1EECD8C05CBF40D>. Indeed, even U.S. regulators that acknowledge the potential financial stability threats of climate change have cautioned that supervision should be limited to a “risk management perspective, not a social engineering one.” Kevin J. Stiroh, Executive Vice President, Federal Reserve Bank of New York, *Emerging Issues for Risk Managers* (Nov. 7, 2019), <https://www.newyorkfed.org/newsevents/speeches/2019/sti191107>. It is worth noting that embracing the overwhelming weight of climate science, namely that climate change is caused by greenhouse gas emissions driven by fossil fuel consumption and exacerbated by deforestation, is not “social engineering” in any sense of the term. Ignoring the environmental, economic, and financial risks of a climate crisis is a choice based upon certain ideological and political decisions and requires rejecting the overwhelming weight of empirical data. As European Central Bank Governor Christine Lagarde responded when asked about the view that climate change is not the responsibility of central banks: “I’m aware of all that. I’m also aware of the danger of doing nothing.” Jack Ewing, *Climate Change Could Blow Up the Economy. Banks Aren’t Ready*, N.Y. TIMES (Jan. 23, 2020), <https://www.nytimes.com/2020/01/23/business/climate-change-central-banks.html>.

¹⁵ The “Lehman moment,” refers to the bankruptcy filing of Lehman Brothers on September 15, 2008, generally viewed as touching off the worst of the financial crisis of 2008, an event which was precipitated both by the decisions and actions of private market participants as well as government regulators. See, e.g., Carrick Mollenkamp, Susanne Craig, Jeffrey McCracken & Jon Hilsenrath, *The Two Faces of Lehman’s Fall*, WALL ST. J. (Oct. 6, 2008), <https://www.wsj.com/articles/SB122324937648006103>; see also Bernanke, Geithner & Paulson, *supra* note 7.

issued under the authorities contained in the Dodd-Frank financial reform law to mitigate the systemic financial risks of climate change.

While most scholarship to date concerning climate financial risk has occurred in an international context, without regard to U.S.-specific legal authorities, this Article contributes to the current analysis of climate-driven financial risk by synthesizing our prevailing understanding of how such risks might manifest, and applying that understanding to the U.S. financial regulatory framework, including laws, regulation, and guidance. Further, while much of the prior analyses have focused on the conceptual framework for understanding how a climate-drive financial crisis might materialize, the substantive financial regulatory policy options that have been proposed to date have been relatively limited. This Article proposes a number of financial regulations that stem from existing U.S. legal authorities, using an approach that would force more accurate pricing of the risks created by large financial institutions' financing of climate change-causing activities.

In addition to mitigating the financial risks of a climate-driven financial crisis, addressing some significant drivers of climate change through financial regulations that more accurately price the risks of those investments would have the ancillary benefit of removing a financial subsidy that currently supports the industries most responsible for climate change. This would, in turn, contribute to the policy goal of reducing the reliance on fossil fuels, consistent with the scientific consensus that carbon emissions must be radically reduced, if not eliminated.¹⁶ The inevitable implication is that regulators who ignore their responsibility are allowing financial institutions to exacerbate climate risk by continuing to direct massive amounts of capital into climate-change drivers like fossil fuel, deforestation businesses, and the like.

I. CLIMATE CHANGE IS A SOURCE OF FINANCIAL RISK

There is a growing consensus among international financial regulators that climate change presents real financial risks.¹⁷ Indeed, preliminary studies support the notion that increased climate change will likely

¹⁶ See H. Res. 109, 116th Cong. (2019) (the Fourth National Climate Assessment report found that avoiding the most severe impacts of climate change will require reducing greenhouse gas emissions by 40 to 60 percent from 2010 levels by 2030, and net-zero global emissions by 2050).

¹⁷ Open Letter on Climate-Related Financial Risks, Governor of the Bank of England Mark Carney, Governor of Banque de France François Villeroy de Galhau and Chair of the Network for Greening the Fin. Servs. Frank Elderson (Apr. 17, 2019), <https://www.bankofengland.co.uk/news/2019/april/open-letter-on-climate-related-financial-risks> (arguing that “financial policymakers and prudential supervisors . . . cannot ignore the obvious risks before our eyes.”).

correspond with an increase in the frequency of banking crises.¹⁸ The largest U.S. financial institutions, in particular, are vulnerable to climate change through their roles as major providers of capital to the industries that are driving climate change in the form of lending, underwriting, investing, or some combination thereof.¹⁹

In examining the risks that climate change poses to the financial system, the leading analyses largely focus on physical risk and transition risks.²⁰ These risks seem simple enough to understand. Their simplicity is deceiving, however, because the risks can manifest in a number of different ways, and be transmitted through various channels, with profound implications for financial stability.

A. *Climate Change Damages Physical Property*

Physical risk is the risk to properties and assets financed by financial institutions from the changing climate and extreme weather events.²¹ Examples of physical risk include weather-induced damage to real estate that secures mortgages, damage to crops on properties that have farm loans, or wildfires burning factory buildings owned by companies with small business loans.

Physical risk can be either chronic, meaning it is long-developing and long-lasting, or acute, meaning it is caused by short-term but extreme events.²² For example, an estimated \$1 trillion in real estate property is exposed to flooding and rising oceans in U.S. coastal communities

¹⁸ See Francesco Lamperti, Valentina Bosetti, Andrea Roventini & Massimo Tavoni, *The Public Costs of Climate-Induced Financial Instability*, 9 NATURE CLIMATE CHANGE 829 (2019) (finding results that indicate climate change will increase the frequency of banking crises from 26–248 percent).

¹⁹ See generally Rainforest Action Network, *Banking on Climate Change* (2020), https://www.ienearth.org/wp-content/uploads/2019/03/Banking_on_Climate_Change__2020_vF.pdf.

²⁰ While these are the two main risks to financial institutions from climate change, all firms are also vulnerable to operational risk as their business operations are disrupted by weather events, ranging from financial markets affected by climate-related outages to ATM outages and cash shortages at retail bank branches. See Dominik Rehse et al., *The Effects of Uncertainty on Market Liquidity: Evidence from Hurricane Sandy*, 134 J. FIN. ECON. 318, 321 (2019) (the New York Stock Exchange halted trading for two days, from October 29 until October 31, 2012, due to Hurricane Sandy); see also Kristin Broughton, *Fed's Emergency Cash Plan Swings into Action in Puerto Rico*, AM. BANKER (Oct. 2, 2017), <https://www.americanbanker.com/news/feds-emergency-cash-plan-swings-into-action-in-puerto-rico> (documenting the Federal Reserve System's response to cash shortages on the island of Puerto Rico flowing Hurricane Maria). There are also liability risks that arise when investors, communities, and other stakeholders seek to recoup damage from a foreseeable catastrophe. See Bank of England, *supra* note 14, at 26. Finally, there are reputational risks as the societal consensus regarding the urgency of climate change continues to shift.

²¹ See Bank of England, *supra* note 14, at 17.

²² See Woetzel et al., *Climate Risk and Response: Physical Hazards and Socioeconomic Impacts*, MCKINSEY GLOBAL INST. 2 (Jan. 2020), <https://www.mckinsey.com/business-functions/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts>.

alone,²³ which has implications in the event both of sudden flooding as well as long-term sea level rise.

B. *Policy Pathways to Address Climate Change Carry Financial Risks*

“Transition risks” arise when the basis of the economy transitions from fossil fuels to clean energy.²⁴ Examples of transition risks include the declining value of fossil fuel businesses, as well as the economic impacts to certain geographic regions and communities from such a transition.²⁵ The risks from moving away from a carbon-based economy have the potential to affect financial markets by impacting energy and commodity prices, corporate bonds, equities, and certain derivatives contracts.²⁶

The range and timing of possible transition pathways depend upon the outcome of policymaking processes and the political processes that drive policy priorities. To appreciate the inherent uncertainty in such a situation, consider the substantial risks and unpredictability in the political responses to the global financial crisis, and then consider that political and policy decisions in the U.S. and European countries have only become less predictable in the decade since the global financial crisis.²⁷ Attempts to forecast the likely transition pathways and policy responses to the climate crisis necessarily combine the volatility of the current political moment with the uncertainty of climate science.²⁸

The nature of any transition also depends on the actions taken by financial institutions and other market participants, which have incentives to maximize short-term profits, share price, and bonus payouts over

²³ U.S. GLOBAL CHANGE RESEARCH PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT VOLUME II 47 (2018).

²⁴ See Glenn D. Rudebusch, *Climate Change and the Federal Reserve*, FED. RSRV. BANK SAN FRANCISCO (Mar. 25, 2019), <https://www.frbsf.org/economic-research/files/el2019-09.pdf>.

²⁵ For an example of a transition risk, see Corey Paul, ‘*We Are Collateral Damage*’: *Gas Industry Grapples with Political Winds*, S&P GLOB. MKT. INTEL. (Oct. 15, 2019), <https://www.spglobal.com/marketintelligence/en/news-insights/trending/0yXZbZ0C0IYiSuP0XE-ofDA2>. The Principles for Responsible Investment has projected the Inevitable Policy Response, a set of policies that would need to be implemented in order to meet various target scenarios, along with the accompanying macroeconomic implications. See *The Inevitable Policy Response: Policy Forecasts*, PRINCIPLES FOR RESPONSIBLE INV. (last visited Apr. 20, 2020), <https://www.unpri.org/download?ac=7102>.

²⁶ See Bank of England, *supra* note 14, at 8.

²⁷ See generally TOOZE, *supra* note 11.

²⁸ See Part II.C, *infra*. This is to say nothing of the fact that climate change itself has the potential to increase political unrest. See See Woetzel et al., *supra* note 22, at 47 (“Severe climate change effects could trigger migration, social and political unrest, and potentially even conflict in affected regions[.]”).

long-term interests.²⁹ While there are isolated examples of institutions taking incremental steps to address climate risk,³⁰ many financial institutions—from banks³¹ to insurers³²—still fail to either fully account for the various financial risks of climate change or take affirmative steps to fully mitigate such risks. Indeed, in one example, financial institutions lag the rest of corporate America in implementing policies and practices around financing the commodities that drive deforestation.³³ Perhaps there is no better illustration of the current tepid pace of the financial industry’s current transition efforts than the fact that the largest banks and asset managers have increased their holdings of fossil fuel assets in the wake of the landmark Paris Agreement.³⁴

²⁹ See Anat R. Admati, *A Skeptical View of Financialized Corporate Governance*, 31 J. OF ECON. PERSP. 131, 132 (2017); see also Woetzel et al., *supra* note 22, at 31 (Investment “opportunities from a changing climate will emerge and require consideration.”).

³⁰ See Thomas Biesheuvel, *Big Coal Escapes BlackRock’s New Climate Plan*, BLOOMBERG (Jan. 14, 2020), <https://www.bloomberg.com/news/articles/2020-01-14/blackrock-s-tough-on-coal-plan-skirts-around-the-biggest-miners>; see also Russell Ward, *Goldman Sachs Curbs New Lending on Coal and Arctic Oil*, BLOOMBERG (Dec. 15, 2019), <https://www.bloomberg.com/news/articles/2019-12-16/goldman-sachs-strengthens-climate-policy-as-global-talks-falter>. Research suggests that such modest voluntary industry actions on the environment, sometimes referred to as “greenwashing,” may actually have the effect of forestalling substantive government regulations. See Neil Malhotra, Benoit Monin & Michael Tomz, *Does Private Regulation Preempt Public Regulation?*, 113 AM. POL. SCI. REV. 19, 30–32 (2018).

³¹ See, e.g., Bank of England, *supra* note 14, at 23 (“While many banks identified the potential impacts from physical risk factors on property and real estate, few identified the potential impacts from the transition.”); see also Rainforest Action Network, *Banking on Climate Change* 6 (2019), https://www.ran.org/wp-content/uploads/2019/03/Banking_on_Climate_Change_2019_vFINAL1.pdf (“[B]anks’ clean financing is in any case swamped by the volumes they funnel into fossil fuels”). While some banks have made isolated promises to phase out certain kinds of fossil fuel financing, most do not have policies on the books to end their financing of climate change-causing industries. See *id.* at 15. The biggest banks, in particular, are falling short of the rest of the banking industry’s modest efforts to combat climate change. See Emily Chasan, *Biggest Banks Sit Out Industry Climate-Goals Pledge*, BLOOMBERG (Sept. 22, 2019), <https://www.americanbanker.com/articles/biggest-banks-sit-out-industry-climate-goals-pledge>.

³² See Int’l Ass’n of Ins. Supervisors & Sustainable Insurance Forum, *Issues Paper on Climate Change Risks to the Insurance Sector* 22 (July 2018), https://www.unepfi.org/psi/wp-content/uploads/2018/08/IAIS_SIF_Issues-Paper-on-Climate-Change-Risks-to-the-Insurance-Sector.pdf (“A 2016 analysis found that nearly 60% of the 116 insurers surveyed recognise climate risk as an issue; however two fifths of these insurers are taking no action to adjust their portfolios.”). Eighty of the world’s largest insurers have combined assets under management of \$15 trillion, and yet an average of only one percent of that is allocated to low-carbon investments. *Id.*

³³ See Sarah Rogerson, *Forest 500 Annual Report 2018: The Countdown to 2020*, GLOB. CANOPY 24 (2019), <https://forest500.org/forest-500-annual-report-2018-countdown-2020>.

³⁴ See Rainforest Action Network, *supra* note 31, at 4 (the six largest U.S. banks are responsible for 37 percent of global fossil fuel financing since the signing of the Paris Agreement, with the amount financed rising each year); see also Patrick Greenfield, *World’s Top Three Asset Managers Oversee \$300bn Fossil Fuel Investments*, GUARDIAN (Oct. 12, 2019), <https://www.theguardian.com/environment/2019/oct/12/top-three-asset-managers-fossil-fuel-investments> (the potential CO₂ emissions from the investments made by the “Big Three” asset managers have increased from 10.593 gigatons to 14.283 gigatons since the Paris agreement,

* * *

Physical and transition risks have the potential to compound because climate change-causing activities, in a mutually reinforcing dynamic, create and exacerbate both types of risk. The more that financial institutions invest in fossil fuels, the more climate change that they cause, leading to more potential and actual damage to their investments. At the same time, financial institutions' continued investment in fossil fuel and deforestation-related assets makes the transition to a clean energy economy more difficult.³⁵ Both the physical and transition risks of climate change can manifest in financial institutions through credit risk, market risk, or both.

C. *Climate Financial Risks Affect the Credit Risks of Financial Transactions*

Credit risk affects lending businesses, causing loan defaults, lost income, and severely discounted assets on the balance sheet.³⁶ In one vivid example of the credit risks of climate change, the bankruptcy of the California utility Pacific Gas and Electric has been described as the "first climate change bankruptcy."³⁷ In other examples, the fossil fuel industry has become a greater and greater credit risk in recent years, with three of the top five U.S. coal firms having filed for bankruptcy since 2011, and some of the largest banks increasingly exposed to companies with sub-investment-grade credit ratings.³⁸ Even firms that might not directly fi-

equivalent to 38 percent of global fossil fuel CO₂ emissions in 2018); *see also* Patrick Jahnke, *Holdings of Last Resort: The Role of Index Funds and Index Providers in Divestment and Climate Change*, SOC. SCI. RES. NETWORK 5 (2019), <https://ssrn.com/abstract=3314906> (the largest asset managers increased their investments in carbon-intensive industries by 20 percent from 2016 to 2018).

³⁵ Katie Nelson, *Davos Financial Players Pump \$1.4 Trillion Into Fossil Fuels: New Greenpeace Report*, GREENPEACE (Jan. 21, 2020), <https://www.greenpeace.org/usa/news/davos-financial-players-pump-1-4-trillion-into-fossil-fuels-new-greenpeace-report/>.

³⁶ *See generally*, John Colas et al., *Climate Change: Managing a New Financial Risk*, MARSH & McLENNAN COS. (2019), https://www.oliverwyman.com/content/dam/oliver-wyman/v2/publications/2019/feb/Oliver_Wyman_Climate_Change_Managing_a_New_Financial_Risk1.pdf.

³⁷ *See* Steven Mufson, *Inside a California Utility: Mandatory Blackouts Amid Wildfire Threats and Bankruptcy*, WASH. POST (Dec. 21, 2019), https://www.washingtonpost.com/climate-environment/inside-pgandes-choices-blackouts-and-the-threat-of-wildfires/2019/12/21/868d58e8-107c-11ea-9cd7-a1becbc82f5e_story.html (The PG&E bankruptcy "has been widely dubbed the 'first climate change bankruptcy.'").

³⁸ *See* Bank of England, *supra* note 14, at 32; *see also* Dan Freed, *Wells Fargo Energy Investment Unit Sought Risky Deals, Faces Losses*, REUTERS (Apr. 12, 2016), <https://www.reuters.com/article/us-wells-fargo-energy-idUSKCN0XA09K> (as of 2016, Wells Fargo had a \$42 billion energy loan portfolio, 80 percent of which had been made to the two riskiest subsectors within energy, exploration and production companies and services companies, and most of which were to non-investment grade companies).

nance certain industries that drive climate change may have exposures to regions or industries that would be impacted by it.³⁹

Climate change is a unique source of credit risk because climate events can impact both the creditworthiness of a borrower and the value of loan collateral.⁴⁰ This means that, unlike other types of risk, it can lead to both a higher probability of default as well as higher losses in the event of default.

D. *Climate Financial Risks Can Impair Capital Markets*

Market risk affects the capital markets activities of large, diversified financial institutions, especially the equities and bonds held in funds owned, sponsored, and managed by large financial companies. Market disruptions can lead to asset devaluations and the market dynamic known as a “fire sale,” where market participants simultaneously seek to monetize assets that are declining in value, leading to further devaluation.⁴¹ Climate events can also cause uncertainty that impairs market liquidity, meaning the ability of participants to readily buy and sell assets at a desirable price.⁴²

The potential culmination of market risk would be a “climate Minsky moment,” wherein “wholesale reassessment of prospects could destabilise [sic] markets, spark a pro-cyclical crystallisation [sic] of losses and lead to a persistent tightening of financial conditions” which would be “difficult for banks to manage their exposures to carbon-intensive investments simultaneously, increasing losses and potentially also causing liquidity issues.”⁴³ Today, such an event has the potential to impact the vast majority of financial markets, as clean energy assets remain a relatively scarce asset class.⁴⁴

³⁹ See Rudebusch, *supra* note 24, at 3 (stating that “financial firms with limited carbon emissions may still face substantial climate-based credit risk exposure, for example, through loans to affected businesses or mortgages on coastal real estate.”).

⁴⁰ See Bank of England, *supra* note 14, at 22.

⁴¹ See OFF. OF FIN. RES., ASSET MANAGEMENT AND FINANCIAL STABILITY 21–22 (Sept. 2013), https://www.financialresearch.gov/reports/files/ofr_asset_management_and_financial_stability.pdf.

⁴² See, e.g., Rehse, et al, *supra* note 20, at 28 (concluding that, “[d]ue to the unprecedented strength, scale, and nature of . . . Hurricane [Sandy], the potential consequences of the storm were nearly impossible to quantify[.]” ultimately impacting liquidity on the New York Stock Exchange).

⁴³ Bank of England, *supra* note 14, at 24.

⁴⁴ See Victor Galaz, Beatrice Crona, Alice Dauriach, Bert Scholtens & Will Steffen, *Finance and the Earth System: Exploring the Links Between Financial Actors and Non-Linear Changes in the Climate System*, 53 GLOB. ENV’T CHANGE 296, 296–97 (2018) (as of 2017 “green bonds” made up less than 0.2 percent of debt securities issued globally).

E. Climate-related Losses Have a High Probability of Materializing, and a Long Potential Duration

While the appropriateness of considering the probability that risks will materialize is a matter of ongoing debate, as discussed more below, it is worth considering that the probability of financial risks from climate change materializing is high, if not a certainty.⁴⁵

Research suggests that capital markets assets, like equities, are already losing value as a result of climate change. Between 1970 to 2012, a 1°C increase in temperature resulted in a decline in equity valuation of approximately five percent, and the losses caused by temperature increase have become greater over time.⁴⁶ Since 2011, the Dow Jones U.S. Coal Index has fallen by over 85 percent.⁴⁷ BlackRock, the world's largest asset manager, has already lost its investors over \$90 billion, in both value destruction and opportunity cost, by ignoring climate risk in its investment strategies over the course of the last decade.⁴⁸

In the insurance sector alone, inflation-adjusted climate-related losses have increased from an annual average of around \$10 billion in the 1980s, to around \$55 billion over the past decade.⁴⁹ In 2018, the U.S. experienced 14 separate billion-dollar weather and climate disaster events with a total cost of at least \$91 billion.⁵⁰ Insurance companies

⁴⁵ Compare note 53, *infra*, with 12 C.F.R. § 1310 App. A.III.e. (when considering designating a nonbank financial company for enhanced regulation, the Financial Stability Oversight Council “will assess the likelihood of a firm’s material financial distress, in order to assess the extent to which a determination may promote U.S. financial stability[.]”); see also Task Force on Climate-Related Fin. Disclosures, *2019 Status Report* 55 (June 2019), <https://www.fsb-tcfd.org/wp-content/uploads/2019/06/2019-TCFD-Status-Report-FINAL-053119.pdf> (almost half of corporate respondents said climate-related risks are material today, and almost a quarter said climate-related risks will be material in the next 1-2 years or 3-5 years); see also Rhodium Group, *Clear, Present and Underpriced: The Physical Risks of Climate Change 2* (Apr. 2019), https://rhg.com/wp-content/uploads/2019/03/RHG_PhysicalClimateRisk_Report_April_Final.pdf (a 2018 report by the World Economic Forum listed extreme weather events as the most likely risk to the global economy over the next ten years and the second most impactful).

⁴⁶ See Marcelo Ochoa, Dana Kiku & Ravi Bansal, *What Do Capital Markets Tell Us About Climate Change? 2* Society for Economic Dynamics, 2016 Meeting Papers, Paper 542 (2016), <https://ideas.repec.org/p/red/sed016/542.html>.

⁴⁷ See Bank of England, *supra* note 14, at 32.

⁴⁸ See Tim Buckley et al., *Inaction is BlackRock’s Biggest Risk During the Energy Transition*, INST. FOR ENERGY ECON. & FIN. ANALYSIS 2 (Aug. 2019), http://ieefa.org/wp-content/uploads/2019/07/Inaction-BlackRocks-Biggest-Risk-During-the-Energy-Transition_August-2019.pdf (examining holdings in fossil fuel companies, utilities, and coal companies from 2009–19).

⁴⁹ See Bank of England, *supra* note 14, at 3–4.

⁵⁰ See U.S. GOV’T ACCOUNTABILITY OFFICE, GAO-20-127, CLIMATE RESILIENCE: A STRATEGIC INVESTMENT APPROACH FOR HIGH-PRIORITY PROJECTS COULD HELP TARGET FEDERAL RESOURCES 1 (Oct. 2019), <https://www.gao.gov/assets/710/702236.pdf>.

paid out an estimated \$219 billion in natural disaster-related claims over 2017 and 2018, the highest for any two-year period in history.⁵¹

Some future climate losses are already “baked in,” as the climate will warm by 1.1°F over the next century solely based upon emissions that are already in the atmosphere.⁵² Furthermore, meeting the goals in the Paris Climate Accord, or better yet even more aggressive emission reduction targets, would require significant reductions in carbon emissions, possibly to zero or negative, by 2040.⁵³ Thus, the likelihood of further financial impacts from either climate change itself, or the accompanying policy response, far exceeds the estimates of tail events predicted by financial models before the 2008 crisis.⁵⁴

Unlike other financial crises and recessions that last for months or years, many of the risks arising from climate change are irreversible and will last for a much longer period. Indeed, the National Climate Assessment warns that, “[w]ithout substantial and sustained global mitigation and regional adaptation efforts, climate change is expected to cause growing losses to American infrastructure and property and impede the rate of economic growth over this century.”⁵⁵ It continues: “climate change resulting from human-caused emissions of carbon dioxide will persist for decades to millennia.”⁵⁶ This suggests that the types of short-term interventions that have sufficed to stabilize financial markets during previous panics will not stem the potential damage caused by climate change.

* * *

As the above discussion demonstrates, the financial risks from climate change have many potential manifestations. The analysis would be incomplete, however, if it ended there. Next, we must move beyond an

⁵¹ See Courtenay Brown, *Climate Change Rains Insurance Misery on Homeowners*, AXIOS (Nov. 26, 2019), <https://www.axios.com/climate-change-home-insurance-f07655b5-969f-4523-8042-c546ca997801.html> (citing estimates by reinsurance company SwissRe).

⁵² U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 23, at 76, 80.

⁵³ See *id.* at 83.

⁵⁴ Compare Timothy M. Lenton, Johan Rockström, Owen Gaffney, Stefan Rahmstorf, Katherine Richardson, Will Steffen & Hans Joachim Schellnhuber, *Climate Tipping Points — Too Risky to Bet Against*, 575 NATURE 592, 594 (2019) (“The world’s remaining emissions budget for a 50:50 chance of staying within 1.5°C of warming is only about 500 gigatonnes (Gt) of CO₂ . . . With global total CO₂ emissions still at more than 40 Gt per year, the remaining budget could be all but erased already.”); *with* Interview of Gary Gorton, Professor, Yale School of Management, Professor, Yale School of Management, Financial Crisis Inquiry Commission, in N.Y., N.Y. (May 11, 2010), https://fcic-static.law.stanford.edu/NARA.FCIC.2016-03-11/SCREENED%20Interviews/2010-05-11%20Transcript%20of%20Gary%20Gorton%20Interview%20by%20D%20Noonan_1.pdf (AIG’s risk models showed that there was a 0.05% chance that their credit default swap portfolio would experience any losses).

⁵⁵ U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 23, at 45.

⁵⁶ *Id.* at 100.

examination of how these risks might play out in isolation and consider climate change through our framework for understanding systemic risk, including how threats to financial stability arise and are transmitted. In particular, we will see that in addition to the systemic risk factors that have already been codified in regulation, additional variables like uncertainty, negative externalities, and moral hazard have unique implications in the climate context.

II. CLIMATE CHANGE IS A THREAT TO THE STABILITY OF THE FINANCIAL SYSTEM

While the concept of systemic risk does not have a single legal definition, it can be summarized as the “impairment of financial intermediation or of financial market functioning that would be sufficiently severe to inflict significant damage on the broader economy.”⁵⁷ The financial risks of climate change do not just have the potential to rise to the level of a systemic risk based upon the various factors outlined above. Those attributes, as well as others discussed below, mean that, like other sources of systemic risk, climate risk is likely to manifest in ways that are unpredictable, difficult to contain, and create negative externalities and moral hazard.

Importantly, the proper conceptual framework for evaluating potential threats to financial stability is not to wait for the risks to come to fruition. Instead, we must preemptively launch an inquiry into a range of prospective climate crisis scenarios and seek to anticipate how such scenarios might be prevented.⁵⁸

⁵⁷ 12 C.F.R. § 1310 App. A.II.a; *see also* *MetLife Inc. v. Fin. Stability Oversight Council*, 177 F. Supp.3d 219, 227 (D.D.C. 2016) (“The phrase ‘could pose a threat to the financial stability of the United States’ is open to numerous interpretations.”).

⁵⁸ *See* Simon Johnson & Antonio Weiss, *The Financial Stability Oversight Council: An Essential Role for the Evolving U.S. Financial System*, PETERSON INST. FOR INT’L ECON. 7 (May 2017), <https://www.piie.com/system/files/documents/pb17-20.pdf> (the Financial Stability Oversight Council’s mandate to address systemic risk “requires that it tackle far more tentative risk hypotheses than those . . . that have already manifested themselves in a financial crisis; indeed, its job is to address those risks before they contribute to a crisis.”); *see also* 79 Fed Reg., 3,329, 3,335 (Jan. 21, 2014) (“[R]ecent events (including the financial crisis) demonstrate that low probability events can pose a danger to large organizations as well as to the financial stability of the United States.”). This approach to systemic risk is consistent with the “forward-looking, scenario-based methodologies” that supervisory agencies in other countries are taking towards climate risk. *See* Bolton et al., *supra* note 12, at 22. *But see* *MetLife Inc.*, 177 F. Supp.3d at 237 (“Predictive judgment must be based on reasoned predictions; a summary of exposures and assets is not a prediction.”).

A. *Systemic Risk is Transmitted Through Either Financial Assets or Institutions*

Systemic risk is transmitted through direct financial exposures between institutions or indirect common exposures that institutions have to particular asset classes.⁵⁹ The financial industry is deeply interconnected, and, as a result, risk—particularly climate risk—can be transmitted within and across subsectors via either of these channels.

1. Climate Financial Risk Can be Transmitted Through Systemic Counterparties

In the counterparty transmission channel, when vulnerable financial markets and financial institutions are exposed to one another, losses or the threat of losses at a single large counterparty lead to runs and fragility at other counterparties.⁶⁰ For example, the \$182 billion bailout of insurer AIG was necessary in part to protect the counterparties to AIG’s over-the-counter credit default swap contracts from experiencing distress themselves.⁶¹

Ultimately, a catastrophic climate event that impacts credit or market risk can start a panic that leads to funding pressure, depletion of capital, and insolvency at a large financial institution or group of institutions.⁶² These events would then trigger defaults on payments to counterparties, many of which may themselves be both systemic and experiencing financial distress. This transmission channel is particularly relevant when considering the systemic footprints of large bank holding companies, asset managers, and insurers, an evaluation that includes interconnectedness as a factor.⁶³ At the same time, and as discussed further

⁵⁹ *Senate Comm. on Banking Housing, and Urban Affairs*, 111th Cong. 9 (2009) (statement of Daniel K. Tarullo), <https://www.banking.senate.gov/imo/media/doc/TarulloTestimony72309.pdf> (observing that direct exposures “arise from lending, loan commitments, guarantees, or derivative counterparty relationships among institutions[,]” while indirect exposures “arise through exposures to a common risk factor, such as the real estate market, that could stress the system by causing losses to many firms at the same time.”). There is a third transmission channel, substitutability, that is less relevant for the purposes of specifically assessing climate financial risk.

⁶⁰ See Jeremy Kress, Patricia McCoy & Daniel Schwarcz, *Regulating Entities and Activities: Complementary Approaches to Nonbank Systemic Risk*, 92 S. CAL. L. REV. 1455, 1490 (2019).

⁶¹ See FIN. CRISIS INQUIRY COMM’N, *supra* note 10, at 376–78.

⁶² See, e.g., 81 Fed. Reg. 67,224 (Sept. 30, 2016) (“[T]he public confidence in a holding company that was engaged in a physical commodity activity could suddenly and severely be undermined by an environmental disaster, as could the confidence in the company’s subsidiary [insured depository institution] or their access to funding markets.”).

⁶³ See 79 Fed. Reg. 3,332 (Jan. 21, 2014) (there is potential for a tail risk event affecting a GSIB as a result of physical commodity activities to lead to market contagion). The Financial Stability Board (FSB) defines systemically important financial institutions (SIFIs) as financial companies whose “disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic

below, the most systemic financial institutions also contribute the most to and have the most exposure to climate change.⁶⁴

2. Climate Financial Risk Can be Transmitted Through Vulnerable Asset Classes

Through the asset liquidation channel, a number of financial firms that hold the same assets, and by extension the entire financial system, experience fragility, leading to runs or fire sales that decrease the value of those assets and thereby endanger the value of firms' capital.⁶⁵ Examples of financial markets that experienced this dynamic in the 2008 financial crisis include money market mutual funds and commercial paper.⁶⁶

Climate risk can be transmitted through a sudden re-valuation of asset classes that destabilizes the financial sector; such a re-valuation could be triggered by a significant climate event.⁶⁷ Counterintuitively, it could also be triggered by financial institutions' efforts to mitigate their exposure to a significant climate event, for example, by suddenly exiting

activity." *Reducing the Moral Hazard Posed by Systemically Important Financial Institutions*, FIN. STABILITY BD. 1 (Oct. 20, 2010), https://www.fsb.org/wp-content/uploads/r_101111a.pdf. The FSB has identified a number of large U.S. financial institutions as being systemically important. The six largest U.S. bank holding companies, and the two largest U.S. "custody banks," are all considered Global Systemically Important Banks (GSIBs) by the Financial Stability Board (FSB). See *2018 List of Global Systemically Important Banks (G-SIBs)*, FIN. STABILITY BD. (Nov. 16, 2018), <https://www.fsb.org/wp-content/uploads/P161118-1.pdf>. Three large U.S. insurance companies – AIG, MetLife, and Prudential Financial – have been identified as Global Systemically Important Insurers (G-SIIs) that present "systemic and moral hazard risks." *2016 List of Global Systemically Important Insurers (G-SIIs)*, FIN. STABILITY BD. (Nov. 21, 2016), <https://www.fsb.org/wp-content/uploads/2016-list-of-global-systemically-important-insurers-G-SIIs.pdf>.

Similarly, though not named by the FSB, the asset management industry is highly concentrated, with the "Big Three" U.S. asset managers responsible for 73 percent of the global exchange-traded fund market. See Buckley, *supra* note 48, at 24; see also Michael Wursthorn, *The \$4 Trillion ETF Industry Is Creating More 'Roadkill'*, WALL ST. J. (Oct. 28, 2019), <https://www.wsj.com/articles/the-4-trillion-etf-industry-is-creating-more-roadkill-11572255004> ("ETFs' assets grew by 90% over a five-year stretch through August, but just 100 funds captured 83% of those assets, according to a report by CFRA. BlackRock Inc. and Vanguard Group managed more than two-thirds of those funds, according to the report."). The two largest asset managers, BlackRock and Vanguard, have around \$12 trillion in combined assets under management. See Suzy Waite, Annie Massa & Christopher Cannon, *Asset Managers With \$74 Trillion on Brink of Historic Shakeout*, BLOOMBERG (Aug. 8, 2019), <https://www.bloomberg.com/graphics/2019-asset-management-in-decline/>. The third, State Street, is a bank holding company that has been designated as a U.S. GSIB.

⁶⁴ Gelzinis & Steele, *supra* note 5.

⁶⁵ See Kress et al., *supra* note 60, at 1495.

⁶⁶ See FIN. CRISIS INQUIRY COMM'N, *supra* note 10, at 356–58.

⁶⁷ Gelzinis & Steele, *supra* note 5.

short-term assets that are exposed to climate risks.⁶⁸ It can also result in stranded assets that are no longer productive in the real economy.⁶⁹

* * *

The potential scenarios that could result from climate-driven financial risks being transmitted through either of the above channels are similar to those that we saw play out following the original “Lehman moment.”⁷⁰ A climate-driven Lehman moment would be different insofar as it could result in a systemic event that has a potential impact that is orders of magnitude more catastrophic than 2008.

B. Analyzing Climate Risks Through Systemic Risk Factors

The next appropriate step in this inquiry is to consider some of the risk factors that render climate change a systemic phenomenon according to the criteria that regulators serving on the Financial Stability Oversight Council (FSOC) apply when determining whether a financial activity “could amplify potential risks to U.S. financial stability.”⁷¹

The characteristics that the FSOC considers include credit risk; leverage, including from derivatives; liquidity or maturity mismatch; counterparty risk or interconnectedness; transparency; and the risk of destabilizing particular financial markets.⁷² While the credit and market risks associated with climate change have already been unpacked above, the other factors will be discussed below. In addition, we will consider whether an activity is “highly concentrated or significant and widespread[.]”⁷³ Using this framework, the systemic nature of climate change-driving financial activities comes into greater focus.

1. Climate Risk Involves Leverage, Including From Derivatives

Exposures to climate change can come through a variety of financial products that are complex, opaque, and insufficiently regulated. Large financial institutions trade a variety of securities and derivatives that are

⁶⁸ See, e.g., Bank of England, *supra* note 14, at 33 (“Many [banks] also suggested the short tenure of loans to vulnerable industries indicated that these could be exited relatively quickly if the counterparty’s credit risk increases. However, if multiple banks look to exit loans simultaneously this could create feedback effects exacerbating the risks of stranded capital and leading to a disorderly adjustment to carbon-intensive energy supply.”).

⁶⁹ Gelzinis & Steele, *supra* note 5.

⁷⁰ Indeed, Federal Reserve officials have acknowledged this risk dynamic, at least insofar as it relates to catastrophic environmental risks that bank holding companies are exposed to through their physical commodities activities. *Senate Subcomm. of Investigations*, 114th Cong. 8–9 (2014) (statement of Daniel K. Tarullo), <https://www.hsgac.senate.gov/imo/media/doc/STMT%20-%20Federal%20Reserve.pdf>.

⁷¹ 12 C.F.R. § 1310 Appx A.II.a.

⁷² See *id.*

⁷³ *Id.*

both exposed to climate risks, and that derive their value from industries that produce climate risk.⁷⁴

For example, the four largest U.S. bank derivatives dealers are currently exposed to \$929 billion in notional value of commodity swaps contracts.⁷⁵ The vast majority of these contracts are traded over-the-counter⁷⁶ and therefore do not benefit from the risk mitigating effects of central clearing.⁷⁷ These transactions, though a small percentage of the overall derivatives market, are “where the greater risks and capital subsidy is most useful to these banking firms.”⁷⁸

In addition, the energy industry derives significant funding from products like leveraged loans and collateralized loan obligations, which are often have low credit ratings, trade in less liquid markets, and have begun declining in value in recent months.⁷⁹

Even financial institutions’ efforts to hedge their perceived risks from climate change can increase financial risk, as the act of hedging itself creates exposures through financial instruments that can introduce additional sources of exposure.⁸⁰ For example, individual institutions attempting to hedge individual risks using products like “weather derivatives” can create and spread additional risks across other institutions or sectors.⁸¹ Recall the role that the ineffective hedging of subprime mort-

⁷⁴ Following the enactment of the Gramm-Leach Bliley Act of 1999, the largest, most complex bank holding companies have been authorized to invest in and trade in a variety of securities, commodities, and derivatives. See Saule T. Omarova, *The Quiet Metamorphosis: How Derivatives Changed The “Business of Banking”*, 63 U. MIAMI L. REV. 1041, 1090 (2009).

⁷⁵ See Office of the Comptroller of the Currency, *Quarterly Report on Bank Trading and Derivatives Activities*, Appx., Table 10 (Dec. 2019), <https://www.occ.gov/publications-and-resources/publications/quarterly-report-on-bank-trading-and-derivatives-activities/files/q3-2019-derivatives-quarterly.html>.

⁷⁶ See *id.* at Appx., Graph 15 (approximately 15 percent of “other” swaps contracts, including commodities, held by the seven largest U.S. commercial bank dealers are centrally cleared).

⁷⁷ See *id.* at Appx., Table 10 (Dec. 2019), <https://www.occ.gov/publications-and-resources/publications/quarterly-report-on-bank-trading-and-derivatives-activities/files/q3-2019-derivatives-quarterly.html>.

⁷⁸ Thomas Hoenig, Vice Chariman, Fed. Deposit Ins. Corp., Hoenig on Congressional Moves to Repeal Swaps Push-out Requirements (Dec. 10, 2014), <https://www.fdic.gov/news/news/speeches/spdec1014.html>.

⁷⁹ See, e.g., Katherine Doherty, *A \$40 Billion Pile of Leveraged Loans is Battered by Big Losses*, BLOOMBERG (Oct. 9, 2019), <https://www.americanbanker.com/articles/a-40-billion-pile-of-leveraged-loans-is-battered-by-big-losses> (\$12 billion in leveraged loans to energy companies fell by more than 10 cents on the dollar over the course of three months).

⁸⁰ See Bolton et al., *supra* note 12, at 42 (property and casualty insurers withdrawing from certain markets can lead to the restriction of mortgage credit).

⁸¹ Weather derivatives were pioneered by the now-bankrupt Enron Corporation, which wrote over 5,000 weather derivatives deals, with a notional value of more than \$4.5 billion. See *The Fall of Enron: How Could it Have Happened?: Hearing Before the U.S. Senate Committee on Homeland Security and Governmental Affairs*, 107th Cong. (2002) (statement of Frank Partnoy, Professor of Law, University of San Diego School of Law), <https://>

gage risk played in 2008, when institutions protected themselves from losses on mortgage-backed securities and structured mortgage products by buying credit default swap protection from AIG.⁸² Margin calls from AIG’s credit default swap counterparties created funding problems, and, as noted above, the AIG bailout was necessary in part to protect its counterparties from experiencing distress themselves.⁸³

Indeed, it is likely impossible in the absence of broad system-wide reforms to fully hedge climate risk for reasons including the fact that a sufficient amount of truly “green” alternatives may not be available.⁸⁴

2. Climate Risk is Vulnerable to Liquidity or Maturity Mismatch

There are a variety of ways in which climate change could create pressures that exacerbate the mismatch between institutions’ assets and liabilities or the liquidity of relevant markets. For example, as discussed earlier, the decline in the value of certain climate-exposed assets held by investment funds can lead to fire sales, or redemptions of the interests in such funds due to climate-related concerns can also create runs.⁸⁵ Securities markets, however, are not the only source of potential mismatches.

On the lending side, as noted above, if a critical mass of banks simultaneously sought to exit their short-duration loans on the basis of potential or actual climate exposure, it would likely impair those markets.⁸⁶ It is also important to remember that 30-year mortgages are long-term assets that must be paired with property and casualty insurance policies that are renewed every year, creating duration mismatch.⁸⁷ A repricing of, or failure to renew, homeowner insurance policies could have implications for borrowers’ ability to repay their loans, leading to delinquencies or defaults.⁸⁸ It could also affect the value of current or future mortgage assets in particularly climate-exposed areas.

Large financial institutions also make private equity investments in industries that are exposed to catastrophic and transition risks, and trade commodities that drive climate change, all which may not be subject to

www.hsgac.senate.gov/imo/media/doc/partnoy.pdf. Such derivative products “could not be valued without a healthy dose of professional judgment.” *Id.* As discussed in Part II.C, *infra*, predictive climate modeling has only become more uncertain, with historical trends increasingly less useful for future projections, in the ensuing decades.

⁸² See FIN. CRISIS INQUIRY COMM’N, *supra* note 10, at 8.

⁸³ *Id.* at 352.

⁸⁴ See Bolton et al., *supra* note 12, at 24.

⁸⁵ *Id.* at 28.

⁸⁶ See *id.* at 20.

⁸⁷ See Woetzel et al., *supra* note 22, at 78.

⁸⁸ Even “homeowners who are not financially distressed may choose to strategically default if their homes fall steeply in value with little prospect of recovery.” *Id.*

sufficient oversight and regulation.⁸⁹ The largest bank holding companies have used this authority to develop stockpiles of climate change-driving fossil fuels including coal, crude oil, heating oil, ethanol, fuel oil, gasoline, jet kerosene, naphtha, natural gas, electricity, and agricultural products.⁹⁰ These assets, in addition to being some of the most environmentally sensitive exposures on an institution's balance sheet, are often difficult to value and do not have a readily available liquid market in the event that they need to be monetized.⁹¹

Finally, certain climate-exposed commodity transactions are structured as short-term secured contracts (such as repurchase agreements or "repos") using the underlying commodities (such as barrels of oil or metals) as collateral.⁹² A run on certain repo markets was a significant component of the 2008 financial crisis.⁹³ Should certain commodity markets become impaired as a result of climate-related events, it could create financing pressures similar to those that were experienced during the crisis.

⁸⁹ Bank holding companies can trade commodities pursuant to a determination by the Federal Reserve, by regulation or order, that such trading is a permissible "complementary" activity. See 12 U.S.C. § 1843(k)(1)(B).

⁹⁰ See STAFF OF S. PERMANENT SUBCOMM. ON INVESTIGATIONS, 113TH CONG., WALL STREET BANK INVOLVEMENT WITH PHYSICAL COMMODITIES 116 (2014), [https://www.hsgac.senate.gov/imo/media/doc/REPORT-Wall%20Street%20Bank%20Involvement%20With%20Physical%20Commodities%20\(12-5-14\).pdf](https://www.hsgac.senate.gov/imo/media/doc/REPORT-Wall%20Street%20Bank%20Involvement%20With%20Physical%20Commodities%20(12-5-14).pdf) (at the end of 2011, Goldman Sachs held inventories of approximately 2.2 million barrels of crude oil, 245,000 barrels of heating oil, 2 million barrels of jet kerosene, and 106.5 million BTUs of natural gas); see *id.* at 238 (as of 2012, Morgan Stanley held physical inventories of 1.7 million barrels of crude oil, 5.8 million barrels of heating oil, and 6.2 million barrels of gasoline); see also *id.* at 318 (as of 2011, JPMorgan reported holding 6.4 million barrels of crude oil, 3.6 million barrels of heating oil, 900,000 barrels of gasoline, 3.4 million barrels of jet kerosene, and 51.9 billion ft³ of natural gas.).

⁹¹ See Regulations Q and Y; Risk-Based Capital and Other Regulatory Requirements for Activities of Financial Holding Companies Related to Physical Commodities and Risk-Based Capital Requirements for Merchant Banking Investments, 81 Fed. Reg. 67,228 (Sept. 30, 2016) (there is a risk that a bank "may not be able to gain access to markets for a privately held portfolio company after an environmental catastrophe involving the portfolio company"). In 2007, the Chief Financial Officer of Goldman Sachs said that commodities trading is, "a dangerous business to be in even if you are expert." Michael J. Moore, *How Congress Helped Save Goldman Sachs From Itself*, BLOOMBERG (Sept. 28, 2015), <http://www.bloomberg.com/news/articles/2015-09-29/how-congress-helped-save-goldman-sachs-from-glencore-envy>.

⁹² See, e.g., Christian Berthelsen & Sarah Kent, *Citigroup Was Wary of Metals-Backed Loans*, WALL ST. J. (Dec. 21, 2014), <https://www.wsj.com/articles/citigroup-was-wary-of-metals-backed-loans-1419194646> (reporting on a repo contract initiated by Citigroup involving \$270 million of copper and aluminum).

⁹³ See, e.g., Gary B. Gorton, *Slapped in the Face by the Invisible Hand: Banking and the Panic of 2007* (May 9, 2009), <https://ssrn.com/abstract=1401882>.

3. Climate Risk Creates Counterparty Risk and Interconnectedness

Interconnectedness measures the degree of market participants’ exposures to one another.⁹⁴ Climate financial risk is highly interconnected because it is not isolated to a specific financial sector or market.⁹⁵ Through either the direct or indirect transmission channel, climate risk can trigger spillover risks and feedback loops, creating contagion across various portfolios and asset classes simultaneously.⁹⁶ For example, the unwillingness of property and casualty insurers to insure certain properties would have implications for real estate-collateralized lending.⁹⁷ Likewise, solvency issues at property and casualty insurers that lead to an inability to pay claims could impact the credit risk of real property-collateralized loans by banks.⁹⁸

Even financial products that are intended to hedge climate risks can create interconnectedness.⁹⁹ For example, catastrophe bonds are meant to spread catastrophic payment risk to financial actors who are not exposed to such risks and rely on the assumption that such risk is uncorrelated to other financial market risks.¹⁰⁰ However, if climate events coincide with other financial market disruptions, catastrophe bonds could amplify rather than reduce the associated risks.

⁹⁴ *Supra* note 12, at 2.

⁹⁵ See *A Call For Action: Climate Change as a Source of Financial Risk*, NETWORK FOR GREENING FIN. SYS. 2 (Apr. 2019), https://www.banque-france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf (climate financial risks “can have system-wide impacts on financial stability and might adversely affect macroeconomic conditions.”).

⁹⁶ See Lamperti et al., *supra* note 18, at 833 (there is “evidence that climate damages reverberate to the financial system, inducing feedback loops that sharpen macroeconomic damages[.]”); cf. Tarullo, *supra* note 59, at 9–10 (observing that “[s]pillovers may occur not only due to exposures currently on a firm’s books, but also as a result of reactions to stress elsewhere in the system, including other systemically important firms in key markets.”).

⁹⁷ See Bank of England, *supra* note 14, at 22; see also *id.*, at 26 (“Physical risks from increases in global temperatures well in excess of 2°C could not only lead to more extensive physical damage to collateral and other financial assets held by banks, but also to insurance being significantly re-priced, or withdrawn, therefore increasing banking sector exposures.”). For example, there are emerging signs that insurers may be pulling back from insuring properties in certain fire-prone areas of California. See Brown, *supra* note 51 (citing the California Department of Insurance finding that the number of new and renewed homeowners’ insurance policies fell by 8,700 in California counties at greatest risk for wildfires). As noted above, this can lead to knock-on effects for, for example, mortgage markets and assets.

⁹⁸ Bolton et al., *supra* note 12, at 17.

⁹⁹ *Id.*

¹⁰⁰ See Daniel Schwarcz & Steven L. Schwarcz, *Regulating Systemic Risk in Insurance*, 81 U. CHI. L. REV. 1569, 1606–07 (2014). It should be noted that, while the market for catastrophe bonds may not currently rise to the level of systemic importance, its size could well increase in response to demand for more products meant to hedge climate risks, and it is difficult to anticipate the impact of even small financial market disruptions in the midst of broader market stress.

Finally, the three largest asset managers are also the largest shareholders in three of the four largest U.S. banks.¹⁰¹ This exposure can flow two ways: significant losses at bank holding companies would have a detrimental impact on the value of asset managers' holdings, while instability at an asset manager could necessitate fire sales of bank equities leading to distress in the banking sector. Given the significant exposures that each industry has to climate risk, discussed more below, climate-related events can create contagion that spreads from asset managers to banks, or vice versa.

Climate risk has the potential to be a particularly significant source of contagion because a deeply interconnected financial system is layered on top of interconnected economic sectors, which is then layered atop interconnected earth systems.¹⁰² The interdependencies between the sectors and systems that are exposed to the climate, such as energy, water, and agriculture, and those less directly exposed to climate, like the financial sector, "can lead to complex behaviors and outcomes that are difficult to predict."¹⁰³

4. Climate Risk Lacks Sufficient Transparency and Contains a High Degree of Uncertainty

The corporate sector's climate disclosure efforts to date have largely been driven by social responsibility and sustainability rather than financial risk management.¹⁰⁴ In addition, the dirtiest industries largely already comply with disclosure best practices, proving the insufficiency of such measures.¹⁰⁵ Rather than addressing this opacity, the current FSOC has shown no interest in publicly raising the issue of the financial risks of climate change or disseminating any information about it.¹⁰⁶

Information gaps lead to panics and runs, particularly in the absence of shock-absorbing prudential regulations.¹⁰⁷ Opacity about potential ex-

¹⁰¹ See José Azar, Sahil Raina & Martin Schmalz, *Ultimate Ownership and Bank Competition*, 1, 45 (May 4, 2019), <https://ssrn.com/abstract=2710252>. For the fourth bank, Wells Fargo, the Big Three asset managers are three of the four largest shareholders.

¹⁰² Bolton et al., *supra* note 12, at 10.

¹⁰³ U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 23, at 640.

¹⁰⁴ See Task Force on Climate-Related Fin. Disclosures, *supra* note 45, at 55 (reporting that 89% of respondents identified their sustainability or corporate responsibility area as one of the functions driving implementation of climate disclosures).

¹⁰⁵ See Abby Innes, *Market Incentives Are Stacked Against Companies That Try to Care About Climate Change*, LONDON SCH. ECON. BUS. REV. (June 8, 2019), <https://blogs.lse.ac.uk/businessreview/2019/06/08/market-incentives-are-stacked-against-companies-that-try-to-care-about-climate-change/> (100 percent of FTSE 100 electricity, gas, and oil companies are fully aligned with the Task Force on Climate-Related Financial Disclosure recommendations).

¹⁰⁶ For example, the issue of climate change has not been mentioned in any of FSOC's annual reports.

¹⁰⁷ See Kathryn Judge, *Information Gaps and Shadow Banking*, 103 VA. L. REV. 411, 412 (2017).

posures contributes to crises and panics, as it did when regulators and market participants sought to gauge the scale of financial institutions’ exposures to mortgage-related assets in 2008.¹⁰⁸ As demonstrated by the stress testing discussion below, we may know even less about the full extent of the financial system’s vulnerability to climate risk than we did about its subprime mortgage exposures.

The vulnerability of climate science to sudden and abrupt movements, leading to cascading effects, is analogous to our understanding of the manifestations of financial panics.¹⁰⁹ In a climate-driven financial crisis, however, the unpredictability of climate forecasting is compounded by the unpredictable behavior of financial markets.¹¹⁰ This complicated lattice of risk would be difficult to contain if it were to become unstable.¹¹¹

Certain financing decisions by large financial companies exacerbate the uncertainty of climate risk because they involve the direction of significant amounts of capital on the order of billions of dollars to businesses that operate in some of the world’s most important and sensitive biomes.¹¹² While the amounts involved may appear negligible compared

¹⁰⁸ See Sally Bakewell & Thomas Beardsworth, *Regulators Alarmed by Risky Loans, But Don’t Know Who Holds Them*, BLOOMBERG (June 11, 2019) (quoting Potomac River Capital Chief Investment Officer Mark Spindel that “I always remind myself that even the smartest policy maker with the most far-reaching perspective, data and tools was basically blind-sided by the breadth and depth of the housing crisis[.]”); see also FIN. CRISIS INQUIRY COMM’N, *supra* note 10, at 234 (quoting hedge fund manager Jim Chanos that, “the market didn’t grasp the magnitude until spring of ‘07, when the figures began to be published, and then it was as if someone rang a bell, because almost immediately upon the publication of these numbers, journalists began writing about it, and hedge funds began talking about it, and people began speaking about it in the marketplace.”).

¹⁰⁹ *Fin. Crisis Inquiry Comm’n*, 111th Cong. 4 (2010) (statement of Ben S. Bernanke), <https://www.federalreserve.gov/newsevents/testimony/files/bernanke20100902a.pdf> (describing the crisis of 2008 as a “cascade of events”); see also Tarullo, *supra* note 54, at 5 (judging ex ante whether a financial institution threatens financial stability requires “an assessment of whether the firm’s failure would likely have systemic effects during a future stress event, the precise parameters of which cannot be fully known.”).

¹¹⁰ See Rudebusch, *supra* note 24, at 3 (noting that “prices of equities and long-term financial assets depend on expected future conditions, so even climate risks decades ahead can have near-term financial consequences.”); see also Innes, *supra* note 105; see also Vincent Bielski, *Chaos Scientist Finds Hidden Financial Risks That Regulators Miss*, BLOOMBERG (Oct. 3, 2019), <https://www.bloomberg.com/news/features/2019-10-03/chaos-scientist-finds-hidden-financial-risks-that-regulators-miss> (comparing agent-based modeling in natural sciences as analogous to measuring the complexity of the financial system).

¹¹¹ See Bolton et al., *supra* note 12, at 6 (the “complex chain reactions between degraded ecological conditions and unpredictable social, economic and political responses, with the risk of triggering tipping points,” make climate change a “colossal and potentially irreversible risk of staggering complexity”); see also *Global Financial Stability Report: Lower for Longer*, INT’L MONETARY FUND 83 (Oct. 2019) (the financial risks of climate change “are not linear, and the catastrophic tail risks are not negligible.”).

¹¹² See Global Witness, *Money to Burn* (Sept. 23, 2019), <https://www.globalwitness.org/en/campaigns/forests/money-to-burn-how-iconic-banks-and-investors-fund-the-destruction-of-the-worlds-largest-rainforests/> (finding that from 2013 until 2019, the eight largest U.S. bank

to the scale of the other financing activities outlined above, these “biomes and Earth system processes have variously been conceptualized as ‘sleeping giants’ in the carbon cycle, ‘tipping elements’ in the Earth system, and ‘planetary-scale tipping points’” that have a “disproportionate influence on climate stability[.]”¹¹³ Indeed, recent research suggests that, as a result of climate change, various planetary “tipping points” may now be more likely than previously thought.¹¹⁴

Just as with attempts to presage financial panics, there is a high degree of uncertainty in predictive climate modeling, including the likelihood and magnitude of catastrophic events.¹¹⁵ If anything, climate models are more likely to underestimate the amount of climate change that we will experience over the long term, especially when attempting to predict extreme events based upon past trends.¹¹⁶

holding companies provided more than \$3.5 billion in financing, large U.S. asset managers provided nearly \$1.5 billion, and large U.S. insurers provided more than \$171 million, to six companies that are significant contributors to deforestation in Papua New Guinea, the Congo Basin, and the Brazilian Amazon); *see also* Galaz et al., *supra* note 44, at 299 (finding that the “Big Three” asset managers – BlackRock, Vanguard, and State Street – have nearly \$20 billion in equity, and three of the eight most economically significant bank holding companies – BNY Mellon, State Street, and JPMorgan Chase – invested over \$7 billion, in companies driving climate change in the Brazilian rainforest and boreal forests in Canada and Russia). There are also certain geographic regions that have outsized socioeconomic importance, for example, the five regional “breadbasket” areas that account for about 60 percent of global grain production. *See* Woetzel et al., *supra* note 19, at 19.

¹¹³ Galaz et al., *supra* note 44, at 296 (citations omitted).

¹¹⁴ *See* Lenton et al., *supra* note 54, at 592 (The “evidence is mounting that these events could be more likely than was thought, have high impacts and are interconnected across different biophysical systems, potentially committing the world to long-term irreversible changes.”); *see also id.* at 595 (“Some early results from the latest climate models—run for the [Intergovernmental Panel on Climate Change’s] sixth assessment report, due in 2021—indicate a much larger climate sensitivity (defined as the temperature response to doubling of atmospheric CO₂) than in previous models.”); *see also* Joëlle Gergis, *We are Seeing the Very Worst of Our Scientific Predictions Come to Pass in These Bushfires*, *GUARDIAN* (Jan. 2, 2020), <https://www.theguardian.com/commentisfree/2020/jan/03/we-are-seeing-the-very-worst-of-our-scientific-predictions-come-to-pass-in-these-bushfires> (suggesting that the recent Australian fires raise the question of “whether the Earth system has now breached a tipping point, an irreversible shift in the stability of the planetary system”).

¹¹⁵ *See* Bd. of Governors of the Fed. Reserve Sys., *Complementary Activities, Merchant Banking Activities, and Other Activities of Financial Holding Companies Related to Physical Commodities*, 79 Fed. Reg. 3,329, 3,331 (Jan. 21, 2014) (“The financial crisis demonstrated the effects of market contagion and highlighted the danger of underappreciated tail risks associated with certain activities.”); *see also id.* at 3,333 (“Although the likelihood of a catastrophic event is small in the short term, catastrophes involving physical commodities continue to occur, and the resultant damages are very difficult to measure, even after the event has occurred, and may be extremely large.”); *see also* Tarullo, *supra* note 70, at 8 (“[T]here are considerable difficulties in estimating the possible damages related to environmental or catastrophic incidents[.]”).

¹¹⁶ *See* U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 23, at 102. In particular, financial losses are dependent upon temperature, a factor that is especially sensitive and unpredictable. *See* Bansal et al., *supra* note 46, at 13–14 (“[B]ecause both the frequency and the size

5. Climate Risk is Highly Concentrated, Significant, and Widespread

Climate risk is highly concentrated in the largest U.S. financial institutions, which are major financiers of the industries driving climate change through either lending, underwriting, investing, or some combination of these activities.

From 2016-2018, six of the eight largest U.S. bank holding companies loaned, underwrote, or otherwise financed over \$700 billion to fossil fuel companies, and have accounted for 37 percent of global fossil fuel financing since the Paris Agreement was adopted.¹¹⁷ If the six largest bank holding companies’ aggregate fossil fuel assets were themselves a standalone institution, they would be the seventh largest bank holding company in the nation and would exceed the banking agencies’ consensus asset threshold for a systemically important bank holding company.¹¹⁸

As of 2016, large insurers reported \$528 billion in fossil fuel related investments.¹¹⁹ These investments would, on a standalone basis, be the second-largest U.S. life insurer by assets.¹²⁰ They are roughly equal to the amount of total consolidated assets held by the global insurance company AIG at the time that the FSOC designated it as a nonbank SIFI.¹²¹

One report estimates the “Big Three” asset managers hold at least \$287 billion in fossil fuel investments.¹²² In addition, BlackRock has

of future damages depend on the level of temperature, so does the magnitude of the price of temperature risks.”).

¹¹⁷ See Rainforest Action Network, *supra* note 31, at 4. Over those three years, 33 large global banks financed \$1.9 trillion in fossil fuel projects. *See id.* at 5.

¹¹⁸ See FED. FIN. INSTITUTIONS EXAMINATION COUNCIL, NAT’L INFO. CTR., LARGE HOLDING COMPANIES (data reported as of June 30, 2019), <https://www.ffiec.gov/npw/Institution/TopHoldings>; *see also* Regulatory Capital Rules: Regulatory Capital, Enhanced Supplementary Leverage Ratio Standards for Certain Bank Holding Companies and Their Subsidiary Insured Depository Institutions, 79 Fed. Reg. 24,528, 24,531 (May 1, 2014) (\$700 billion in total assets is consistent with the list of banking organizations that meet the definition of a global systemically important bank).

¹¹⁹ See Int’l Ass’n of Ins. Supervisors & Sustainable Ins. Forum, *supra* note 32, at 68 (citing the California Department of Insurance’s data call for insurers with over \$100 million in premiums).

¹²⁰ See AMERICAN COUNCIL OF LIFE INS., LIFE INSURERS FACT BOOK 98 (2018), <https://www.acli.com/-/media/ACLI/Files/Fact-Books-Public/FullLifeInsurersFactBook2018.ashx?la=en> (as of December 31, 2017, the largest U.S. life insurer, Prudential Financial, had \$596 billion in total assets, and the second-largest U.S. life insurer, MetLife, had \$427 billion in total assets).

¹²¹ See Fin. Stability Oversight Council, Notice and Explanation of the Basis for the Financial Stability Oversight Council’s Rescission of Its Determination Regarding American International Group, Inc. 66 (Sept. 29, 2017), <https://home.treasury.gov/system/files/261/American%20International%20Group%2C%20Inc.%20%28Rescission%29.pdf> (listing total assets of \$548.6 billion on December 31, 2012).

¹²² See Greenfield, *supra* note 34. This estimate likely understates the magnitude of their holdings, however, given that just one fund giant alone recently reported greater fossil fuel

both the largest absolute holdings of thermal coal producers, the highest density of coal holdings, and nearly \$61 billion in equity in four of the largest global oil companies, while Vanguard and State Street are in the top five for thermal coal intensity.¹²³

The size of these financial exposures means that the largest financial institutions are vulnerable to potential climate-related losses in some sectors of the economy that could reach as much as hundreds of billions of dollars per year.¹²⁴ For example, the estimates of potential transition risks for capital markets vary, but they are projected to be quite large across certain sectors.¹²⁵ The financial industry's potential exposures to combined physical and transition risk losses are estimated to be around \$692 billion.¹²⁶ Projecting out to 2100, the costs to the financial system could reach an estimated \$69 trillion just by remaining on a 2°C increase pathway.¹²⁷

The size of the potential losses caused by climate change far exceeds other potential risks that financial regulators view as worthy of heightened scrutiny on the basis of the threats that they may pose to financial stability.¹²⁸ For a sense of the relative size of climate financial risk, consider that the assets exposed to potential losses exceed the entire subprime mortgage market prior to the global financial crisis.¹²⁹ In some

holdings. See Steven Mufson & Rachel Siegel, *BlackRock Makes Climate Change Central to Its Investment Strategy*, WASH. POST (Jan. 14, 2020, 11:37 AM), <https://www.washingtonpost.com/business/2020/01/14/blackrock-letter-climate-change/> (“Vanguard said in December [2019] that its funds included \$319.82 billion in fossil fuel investments.”).

¹²³ See Jahnke, *supra* note 34, at 5–6; see also INST. FOR ENERGY ECON. & FIN. ANALYSIS, *supra* note 48, at 61. BlackRock's thermal coal intensity is approximately 50 percent higher than the fund industry average.

¹²⁴ See FOURTH NAT'L CLIMATE ASSESSMENT, *supra* note 23, at 13; see also INT'L MONETARY FUND, *supra* note 111, at 83 (“Financial risks from climate change are extremely difficult to quantify, but most studies point to very large economic and financial costs.”).

¹²⁵ See INST. FOR ENERGY ECON. & FIN. ANALYSIS, *supra* note 48, at 12; see also INT'L ASS'N OF INS. SUPERVISORS & SUSTAINABLE INS. FORUM, *supra* note 32, at 20; see also NETWORK FOR THE GREENING OF THE FIN. SYS., *supra* note 95, at 17 (estimating transition-related losses ranging from \$1 trillion to \$4 trillion for the energy sector alone, and up to \$20 trillion for the entire economy).

¹²⁶ See CARBON DISCLOSURE PROJECT, MAJOR RISK OR ROSY OPPORTUNITY: ARE COMPANIES READY FOR CLIMATE CHANGE? 34 (2018), <https://www.cdp.net/en/reports/downloads/4588>.

¹²⁷ See INST. FOR ENERGY ECON. & FIN. ANALYSIS, *supra* note 48, at 30.

¹²⁸ See, e.g., FIN. STABILITY OVERSIGHT COUNCIL, 2018 ANNUAL REPORT 107 (2018) (cybersecurity incidents have the potential to impact tens of millions of Americans and result in financial losses of billions of dollars), <https://home.treasury.gov/system/files/261/FSOC2018AnnualReport.pdf>; see also Sally Bakewell & Thomas Beardsworth, *Regulators Alarmed by Risky Loans, But Don't Know Who Holds Them*, BLOOMBERG, <https://www.bloomberg.com/news/articles/2019-06-11/regulators-alarmed-by-risky-loans-but-don-t-know-who-holds-them> (last updated June 11, 2019, 9:40 AM) (citing one estimate of potential losses in the leveraged loan market of approximately \$500 billion).

¹²⁹ See Bernanke, *supra* note 109, at 1–2 (“With more than \$1 trillion in subprime mortgages outstanding, the potential for losses on these loans was large in absolute terms; however,

scenarios, the global economic losses caused by climate change could reach \$23 trillion, three or four times the scale of the 2008 crisis.¹³⁰

In addition to the concentration of climate risks, the reach of climate change is global, which has additional systemic implications.¹³¹ Climate events touch almost all geographic regions: snow and ice in the Northeast, tornadoes in the Midwest, hurricanes in the South, droughts and wildfires in the West, and flooding in all of these regions.¹³² There are also international climate events like earthquakes, tsunamis, and fires that can reverberate across the globe.

To appreciate the potential scope of climate risk, consider the concept of “telecoupling,” that there are “connections between geographically separate biomes and economic activities.”¹³³ There is mounting evidence that reaching climate tipping points in one region can increase the likelihood of reaching them in others.¹³⁴ This is relevant to climate finance because financial investments and decisions have “cross-continental social and ecological effects.”¹³⁵ Indeed, the risks of climate “are not constrained by borders” and “affect economic systems which can transmit and amplify their effects across borders.”¹³⁶

In theory, diversification across geographic regions, industries, and asset classes should offer stability when financial stress is localized. In reality, the global scale and scope of climate change could mean that it cannot be contained as a regional phenomenon or diversified away. The combination of the global scopes of both the climate crisis and the largest financial institutions could actually create exposure and transmit contagion, giving rise to risks that are truly systemic.¹³⁷

judged in relation to the size of global financial markets, prospective subprime losses were clearly not large enough on their own to account for the magnitude of the crisis.”)

¹³⁰ See *Climate dashboard points to 4°C rise despite healthy increase in carbon prices*, SCHRODERS (Oct. 17, 2018), https://www.schroders.com/en/south-africa-insights-inst/markets/climate_dashboard_points_to_4_degree_rise_despite_healthy_increase_in_carbon_prices/.

¹³¹ See INT’L MONETARY FUND, *LOWER FOR LONGER*, *supra* note 111, at 83 (“[T]he far-reaching scope of climate change across sectors and countries adds to the systemic nature of risks.”); see also Rudebusch, *supra* note 24, at 3 (stating that if financial exposures were “broadly correlated across regions or industries, the resulting climate-based risk could threaten the stability of the financial system as a whole and be of macroprudential concern.”).

¹³² See generally FOURTH NAT’L CLIMATE ASSESSMENT, *supra* note 23, at 116–67 (2018) (explaining how climate change will affect specific regions within the United States).

¹³³ Galaz et al., *supra* note 44, at 297.

¹³⁴ See Lenton et al., *supra* note 54, at 594.

¹³⁵ Galaz et al., *supra* note 44, at 297.

¹³⁶ Laybourn-Langton et al., *supra* note 2, at 18.

¹³⁷ See Robert G. Eccles & Svetlana Klimenko, *The Investor Revolution*, May–June 2019 HARV. BUS. REV. (2019), https://hbr.org/2019/05/the-investor-revolution?mod=article_inline (arguing that “firms that have trillions of dollars under management have no hedge against the global economy; in short, they have become too big to let the planet fail.”); see generally Andrew Haldane, *The \$100 Billion Question*, BIS REV. 8 (Mar. 30, 2010), <https://www.bis.org/review/r100406d.pdf>. (observing that “[l]arger portfolios ought to make banks

C. *Climate Financial Risks Can Manifest in Myriad Ways*

The next step in FSOC's evaluation of systemic activities is an inquiry into how risks can be triggered, be transmitted, and impact across financial markets.¹³⁸ The interrelated risks of climate change can manifest and spread in a variety of contexts, including lending; securities, derivatives, and commodities dealing, underwriting, trading, and investing; and insurance underwriting.

Physical risks can increase the credit risk of a loan portfolio through the damage caused by catastrophic climate events. For example, the value of mortgage portfolios can rapidly decline in areas hit by floods, wild fires, and other natural disasters. Loans to agribusiness can lose their value during extended droughts.¹³⁹ These losses could become substantial when a particularly devastating climate event occurs, or when many different events occur either simultaneously or in rapid succession.¹⁴⁰

Transition risks like changes in building and zoning policies and other business practices can also affect the cash flow and appraised value of various types of loans, increasing credit risk.¹⁴¹ Loans to legacy energy companies can lose their value as market forces and public policy make these businesses less economical, introducing a layer of additional risk on top of the typical uncertainty inherent in certain types of fossil fuel businesses.¹⁴²

less prone to idiosyncratic risk to their asset portfolio . . . But if all banks are fully diversified and hold the market portfolio, that means they are all, in effect, holding the same portfolio. All are subject to the same systematic risk factors.”)

¹³⁸ See 12 C.F.R. pt. 30, app A.II.a (2020).

¹³⁹ See, e.g., FED. RESRV. OF MINNEAPOLIS, DROUGHT, PRICES, TOUGH ON DISTRICT FARMERS (Nov. 10, 2017) (explaining how regional drought can affect the ability of borrowers to repay loans).

¹⁴⁰ See Lamperti et al., *supra* note 18, at 829 (“[T]he inability to repay obligations—because of insolvency—generates what are usually referred to as non-performing loans (or bad debt) in the balance sheets of banks and other financial institutions, with possible systemic implications such as those experienced on a global scale during the 2008 financial crisis.”).

¹⁴¹ See, e.g., Christopher Flavelle & John Schwartz, *As Climate Risk Grows, Cities Test a Tough Strategy: Saying ‘No’ to Developers*, N.Y. TIMES (Nov. 19, 2019), <https://www.nytimes.com/2019/11/19/climate/climate-real-estate-developers.html>.

¹⁴² The risks of investments in fossil fuel companies in particular are increasing over time, because, as their revenue declines, the financial engineering that sustains them as attractive investments also opens them up to additional vulnerability: due to the fact that “[e]nergy has been the worst-performing sector of the S&P 500 for more than a decade,” fossil fuel companies are forced to pay additional dividends, but “as the companies throw money at investors through dividends and share buybacks to keep them from fleeing, the payouts have begun to strain their balance sheets.” Bradley Olson & Sarah McFarlane, *Investors to Big Oil: Make It Rain*, WALL ST. J. (Nov. 1, 2019), <https://www.wsj.com/articles/investors-to-big-oil-make-it-rain-11572612256>; see also Watts et al., *supra* note 3 (according to one expert, “there is a scramble among big oil companies to make sure their assets are not the ones left stranded,” and “[t]heir answer is to pump as much as they can, while they still can, to keep delivering shareholder dividends.”); see also INST. FOR ENERGY ECON. & FIN. ANALYSIS, LIVING BEYOND

Transition policies can cause losses to investment assets issued by fossil fuel companies and held in both actively and passively managed funds sponsored by banks, asset managers, and insurers, as markets anticipate the distributional impacts of such policies.

Both transition and physical risks can hit commodities markets and affect the value of institutions’ commodities holdings, including derivatives based upon those commodities. Either of these scenarios could lead to sudden fire sales of securities or commodities tied to industries that are impacted by such policies, as well as derivative instruments tied to either. This could then lead to declines in fund valuations, increases in fund redemptions and/or collateral calls, and the like—in other words, a “climate Minsky moment.”¹⁴³

Finally, insurers can face losses in their traditional insurance businesses as property and casualty companies have when catastrophic weather events like hurricanes have hit coastal areas. As discussed above, increases in insurance premiums, or an unwillingness to insure against certain risks, can impact the value of various assets, including mortgages, business loans, and second-order effects on supply chain functioning.¹⁴⁴

These are just a few examples of the ways in which climate risks can translate into financial risks. A key point here is that we do not know which of these risks may arise, and in what combinations. The nature, degree, and breadth of potential climate risks are what make it singular among other types of systemic risk.

D. *Climate Change Produces Negative Externalities and Creates Moral Hazard*

Negative externalities occur when “[p]rivate parties enjoy the benefits of inefficient activity because they do not have to bear the full cost of

THEIR MEANS: CASH FLOWS OF FIVE OIL MAJORS CAN’T COVER DIVIDENDS, BUYBACKS 1 (Jan. 2020), https://ieefa.org/wp-content/uploads/2020/01/Living-Beyond-Their-Means-Five-Oil-Majors-Cannot-Cover-Dividends_January-2020.pdf (the five oil majors had a \$207 billion cash shortfall for their \$536 billion in shareholder dividends and buybacks since 2010, and funded their distributions primarily by selling assets and borrowing money).

There are other, more esoteric lines of businesses that may also be exposed. For example, Wells Fargo operates a rail car leasing business that has seen a portion of its fleet left idling due to decreases in coal use and declines in commodity prices. See Rachel Louise Ensign, *Banks Own Thousands of Railcars but Don’t Know What to Do With Them*, WALL ST. J. (Dec. 26, 2019), <https://www.wsj.com/articles/banks-own-thousands-of-railcars-but-dont-know-what-to-do-with-them-11577356201>.

¹⁴³ See BANK OF ENGLAND, *supra* note 14, at 24 (in one estimate, a certain transition pathway could result in \$1.6–\$2.3 trillion in global equities value being wiped out, focused on the energy, automobiles, utilities, minerals, and agriculture sectors); See *Forecast Policy Scenario: Equity Markets Impact*, PRINCIPLES FOR RESP. INV., <https://www.unpri.org/inevitable-policy-response/forecast-policy-scenario-equity-markets-impacts/5191.article>.

¹⁴⁴ See McKinsey Global Inst., *supra* note 22, at 117–18.

these activities.”¹⁴⁵ Climate financial risk produces two sets of potent negative externalities. First, there is the carbon pollution that is pumped into the air—the “canonical example” of an externality in economics textbooks—as “[p]olluting companies impose the costs of their activities on a usually unwitting public.”¹⁴⁶ Second, there are the financial costs created by climate change stressing individual companies, threatening failures, runs, panics, and the distress that spreads from the financial system to the broader economy, resulting in public rescues of the financial system.¹⁴⁷

By not adopting effective macroprudential climate policies, financial regulators are exacerbating the so-called “moral hazard” problem for the industries that drive climate change and the institutions that finance them.¹⁴⁸ Allowing large, systemic financial companies to underprice the risk of their investments in (and financing of) climate change-causing industries effectively provides a nontransparent, indirect subsidy.¹⁴⁹ As with all subsidies, this creates a financial incentive to stay on a particular policy path, in this case perpetuating the ongoing direction of massive amounts of capital into climate-change drivers like fossil fuel and deforestation businesses.¹⁵⁰ Again, this self-reinforcing dynamic exacerbates both the physical risks and the transition risks of a climate-driven financial crisis.

A prospective climate-driven financial crisis could cause not just broader economic harm; it could also exacerbate other economic losses if the impairment of the financial system coincided with climate-driven economic harm to certain exposed regions or industries. The ability of the financial sector to support the broader economy in the event of climate-driven losses depends on the degree to which the climate crisis causes credit and other losses to the financial system itself.¹⁵¹

¹⁴⁵ Anat R. Admati, Peter Conti-Brown & Paul Pfleiderer, *Liability Holding Companies*, 59 UCLA L. REV. 852, 861 (2012).

¹⁴⁶ *Id.*

¹⁴⁷ See Governor Daniel K. Tarullo, *Confronting Too Big to Fail* (Oct. 21, 2009) (observing that “government authorities often believe they have little choice but to intervene” in a systemwide panic, and that the government “may provide funds or guarantees to the bank in order to keep it functioning.”).

¹⁴⁸ See Governor Daniel K. Tarullo, *Financial Stability Regulation 2* (Oct. 10, 2012) (moral hazard is “the expectation that, when faced with the prospect of either variant of a major blow to the financial system, government authorities will provide funds or guarantees to the firm to keep it functioning,” which means that creditors “may not price into their credit or investment decisions the full risk associated with those decisions.”).

¹⁴⁹ See Tarullo, *supra* note 147 (implicit government support means large financial institutions “may thus be motivated to take greater risks with the cheaper funds now available to them.”).

¹⁵⁰ See notes 33–38, *supra*, and accompanying text.

¹⁵¹ See Lamperti et al., *supra* note 18, at 830 (“[T]he ability of the banking sector to alleviate the direct implications of climate impacts on firms weakens from the cumulated effects of non-performing loans.”).

One strain of post-crisis thinking argues that adequately addressing systemic risk requires public actors to have a broad range of tools and discretion to act to rescue the financial system and the specific actors within it.¹⁵² I have argued elsewhere that post hoc measures are insufficient and that ex ante measures are essential.¹⁵³ While I will discuss below why ex ante regulation is also needed in the context of climate financial risk, it is worth considering the prospect that public authorities may ultimately become the “climate rescuers of last resort.”¹⁵⁴

Unless climate risks are properly priced through macroprudential regulations, the culmination of these externalities will result in significant public costs. Such costs may include, but are not limited to, the costs of mitigating climate change-driven physical destruction, relocating large populations away from climate-damaged regions, as well as economic rescues in the form of aid packages for areas that rely on fossil fuels or deforestation and buyouts of investors in industries that are currently being propped up by the carbon bubble. These and other public expenditures related to the physical and financial damage of a climate crisis are essentially bailouts that provide a windfall to shareholders and executives of the very companies currently driving the climate crisis at the expense of the public.¹⁵⁵ This bailout will further exacerbate economic inequality, social unrest, and other economic, political, and social problems.

Even worse, however, climate bailout would do nothing to alleviate the underlying problem, as large-scale asset purchases, quantitative easing, and other extraordinary measures have no ability to remove carbon from the atmosphere once it has been released.¹⁵⁶

It should also be noted that, as the risks of climate change become increasingly clear, private institutions may seek to shift the financial burden to U.S. taxpayers. For example, the United States has \$600 billion in real property value located within one mile of the coast, currently covered under the National Flood Insurance Program, but which will not be

¹⁵² See, e.g., Bernanke et al., *supra* note 7.

¹⁵³ See Graham Steele, *Emergency Guarantee Authority: Not Letting a Crisis Go to Waste*, COLUM. L. SCH. BLUE SKY BLOG (May 15, 2019), <https://clsbluesky.law.columbia.edu/2019/05/15/emergency-guarantee-authority-not-letting-a-crisis-go-to-waste/>.

¹⁵⁴ BOLTON et al., *supra* note 12, at 9.

¹⁵⁵ See Lamperti et al., *supra* note 18, at 829 (arguing that as a result of climate-induced financial crises, “[r]escuing insolvent banks will cause an additional fiscal burden of approximately 5–15 percent of gross domestic product per year”); see also Tarullo, *supra* note 147, ¶ 5 (stating that the prospect of government support means “management and shareholders of the too-big-to-fail institution may, in turn, regard themselves as holding a kind of put option” to the U.S. government).

¹⁵⁶ BOLTON et al., *supra* note 12, at 47 (stating that a climate-driven financial crisis has a “key difference from an ordinary financial crisis, because the accumulation of atmospheric CO₂ beyond certain thresholds can lead to irreversible impacts, meaning that the biophysical causes of the crisis will be difficult if not impossible to undo at a later stage.”).

viable in coming decades absent intensive investments in climate adaptation.¹⁵⁷ In addition, one study suggests that mortgage lenders in areas hit by billion dollar climate events do not stop lending in those areas following such events, but rather shift mortgage risk via securitization to the taxpayer-backed government sponsored enterprises (GSEs).¹⁵⁸

As a result, the only truly effective approach to climate financial risk mitigation in regulators' ambit is through *ex ante*, preventative measures.¹⁵⁹

* * *

In sum, the combination of all of the various potential climate risks leaves us vulnerable to a “green swan” event—a climate-driven, fat-tail event with a catastrophic impact that could not be predicted in advance.¹⁶⁰ Given the systemic nature of climate financial risk, financial regulators have responsibilities that lie at the intersection of climate change and the financial system, and authorities that can be used to incorporate robust preventative measures. As I will now discuss, financial stability regulation requires an inherently forward-looking, predictive approach,¹⁶¹ and preventing a climate-induced financial requires a strong presumption that there is a high likelihood that one or multiple climate crises will manifest, and do so sooner than anticipated.¹⁶²

¹⁵⁷ See INT’L ASS’N OF INS. SUPERVISORS & SUSTAINABLE INS. FORUM, *supra* note 32, at 17.

¹⁵⁸ See Amine Ouazad & Matthew E. Kahn, *Mortgage Finance in the Face of Rising Climate Risk* 6 (Nat’l Bureau of Econ. Rsch., Working Paper No. 26322, 2019).

¹⁵⁹ See Mufson & Siegel, *supra* note 122, ¶ 14 (quoting BlackRock CEO Larry Fink that “[w]e don’t have a Federal Reserve to stabilize the world like in the five or six financial crises that occurred during my 40 years in finance . . . This is bigger, it requires more planning, it requires more public and private connections together to solve these problems.”).

¹⁶⁰ BOLTON et al., *supra* note 12, at 3. Proving the aptness of applying this analogy in the context of climate change, Nassim Nicholas Taleb, who coined the term “black swan,” said that “[w]e never see black swans coming, but when they do arrive, they profoundly shape our world.” Nassim Nicholas Taleb, *Learning to Love Volatility*, WALL ST. J. (Nov. 16, 2012), https://www.wsj.com/articles/SB10001424127887324735104578120953311383448?mod=article_inline (describing “black swans” as “large events that are both unexpected and highly consequential.”).

¹⁶¹ See *MetLife Inc. v. Fin. Stability Oversight Council*, 177 F. Supp.3d, at 237–38 (holding in part that the Court could not find severe alteration to financial marked functioning without a preemptive, well-reasoned predictive analysis by the Financial Stability Oversight Council).

¹⁶² See Lenton et al., *supra* note 54, at 595 (stating that “given its huge impact and irreversible nature, any serious risk assessment must consider the evidence, however limited our understanding [of a global climate tipping point] might still be.”). Consider the model of the “planetary boundaries” framework developed by the Stockholm Resilience Centre as a means to understand the nature of climate risks. The planetary boundaries model uses the concepts of thresholds, where human activity pushes a natural system beyond its stable state and causes an abrupt and possibly irreversible change in the functioning of the system, boundaries that estimate a safe distance from those thresholds, and a high degree of uncertainty in the quantifica-

III. EFFECTIVE MACROPRUDENTIAL REGULATION WOULD ADDRESS THE SYSTEMIC RISKS OF CLIMATE CHANGE

Passed in 2010 in response to the global financial crisis of 2008, the Dodd-Frank Act was intended both to prevent “recurrence of the same problems” that gave rise to the financial crisis and to create a “new regulatory framework that can respond to the challenges of a 21st century marketplace.”¹⁶³ There should be little doubt that, although it has echoes of past financial crises, climate change presents the very type of new challenge that Dodd-Frank was intended to address.¹⁶⁴ That is why many of the new mechanisms established under the Dodd-Frank Act can be appropriately deployed by federal regulators to mitigate the financial risks of climate change that threaten the stability of the financial system.

One of the benefits of the evolving field of systemic risk regulation is that the legal framework and the tools contained therein are based upon relatively novel understandings of risk and grants of authority, meaning that financial regulators have wide discretion to act. That is not to say that they are completely immune from legal challenge, just that regulators have the advantage of a relatively blank legal slate, provided they follow proper procedures and engage in rigorous analysis of the prospective systemic risks.¹⁶⁵

A. *The Dodd-Frank Act Provides a Framework for Using Macroprudential Regulation to Address Systemic Risk*

Although regulators have arguably long had a responsibility to protect the stability of the financial system,¹⁶⁶ the Dodd-Frank Act sought to create a “new framework to prevent a recurrence or mitigate the impact of financial crises that could cripple financial markets and damage the economy.”¹⁶⁷

tion of both the thresholds and boundaries. See INST. FOR PUB. POL’Y RSCH., *supra* note 2, at 11.

¹⁶³ S. REP. NO. 111-176, at 42 (2010).

¹⁶⁴ *Id.*

¹⁶⁵ See *MetLife Inc.*, 177 F. Supp.3d, at 223 (holding that the FSOC is required to follow its own established guidance and to consider the costs of its determination).

¹⁶⁶ See Saule Omarova, *New Tech v. New Deal: Fintech as a Systemic Phenomenon*, 36 YALE J. ON REG. 735, 749 (2019) (stating that the so-called “New Deal settlement” in financial regulation “vests substantive control over the allocation of risks and returns in financial markets in private actors operating on a micro-level and assigns the responsibility for ensuring financial stability to public actors operating on a macro-level.”); see also Tarullo, *supra* note 148, at 1 (arguing that “[m]uch of the New Deal legislation that defined the financial regulatory structure for more than 40 years was in direct response to what we would today call systemic concerns . . . Twenty years before the New Deal, the creation of the Federal Reserve had been intended at least as much as a financial stability measure as an instrument of monetary policy.”).

¹⁶⁷ S. REP. NO. 111-176, at 2.

The post-crisis financial reform legislation codifies the terms “financial stability” and “systemic risk” into law, but it offers no comprehensive definitions and delegates significant discretionary authority to regulatory agencies to determine the meaning of those terms and the measures to be taken to address them.¹⁶⁸ As noted above, it has been somewhat further articulated in regulation.¹⁶⁹ Nonetheless, the significant discretion afforded to regulators under the Dodd-Frank Act allows concerned financial regulators to marshal significant authorities to implement a robust agenda of macroprudential climate regulations.¹⁷⁰

The approach taken by regulators to implement the Dodd-Frank Act’s new responsibilities of mitigating systemic risk and preserving financial stability is known as macroprudential regulation.¹⁷¹ Macroprudential regulation attempts to anticipate emerging risks, account for interlinkages across the financial sector, and regulate system-wide risks in a comprehensive manner.¹⁷²

The first source of macroprudential regulation in the Dodd-Frank Act is the Financial Stability Oversight Council (FSOC), a multi-agency

¹⁶⁸ See Tarullo *supra* note 148, at 3 (noting that “Dodd-Frank creates a legal and institutional framework within which financial stability regulation is to be developed but, with a couple of notable exceptions, it does not delineate the steps that should actually be taken to promote financial stability.”); see also *id.* at 9 (stating that the Office of Financial Research “defines financial stability descriptively rather than analytically, ‘that the financial system is operating sufficiently to provide its basic functions for the economy even under stress[.]’”).

¹⁶⁹ See Part II.C, *supra* (citing 12 C.F.R. pt. 30, app A.II.a).

¹⁷⁰ Interestingly, and perhaps ironically, this discretion has typically been seen as a weakness in the law. See Cheyenne Hopkins, ‘New’ Powers in Reg Reform Feel Familiar, AM. BANKER (Apr. 5, 2010), <https://www.americanbanker.com/news/new-powers-in-reg-reform-feel-familiar> (observing that the “most highlighted provisions of both the House and Senate [financial reform] bills would give regulators authority they already have, and so far have largely ignored.”); see also Jesse Eisinger, *A Strategy in the Fight Over Dodd-Frank: Go Big*, N.Y. TIMES (Jan. 14, 2015), <https://dealbook.nytimes.com/2015/01/14/a-strategy-in-the-fight-over-financial-reform-go-big/> (referring to the Dodd-Frank Act as “a law of incremental tinkering with existing rules.”).

¹⁷¹ Macroprudential regulation is loosely defined as “an effort to control the social costs associated with excessive balance sheet shrinkage on the part of multiple financial institutions hit with a common shock.” Samuel G. Hanson, Anil K. Kashyap & Jeremy C. Stein, *A Macroprudential Approach to Financial Regulation*, 25 J. ECON. PERSP. 3, 5 (2011); see also Ben S. Bernanke, *Implementing a Macroprudential Approach to Supervision and Regulation* at 2, Bernanke Remarks to the 47th Annual Conference on Bank Structure and Competition (May 5, 2011), <https://www.federalreserve.gov/newsevents/speech/files/bernanke20110505a.pdf> (arguing that the goal of macroprudential regulation is “minimiz[ing] the risk of financial disruptions that are sufficiently severe to inflict significant damage on the broader economy.”).

¹⁷² See *id.* at 2–3 (“[B]ecause of the highly interconnected nature of our financial system, macroprudential oversight must be concerned with all major segments of the financial sector, including financial institutions, markets, and infrastructures; it must also place particular emphasis on understanding the complex linkages and interdependencies among institutions and markets, as these linkages determine how instability may be propagated throughout the system.”); see also Tarullo, *supra* note 59, at 7 (claiming that macroprudential regulation “considers interlinkages and interdependencies among firms and markets that could threaten the financial system in a crisis.”).

council tasked with identifying emerging systemic risks and providing for their comprehensive regulation.¹⁷³ FSOB has the authority to designate a nonbank financial company to be supervised by the Federal Reserve and subject to enhanced regulation if the “material financial distress at the U.S. nonbank financial company, or the nature, scope, size, scale, concentration, interconnectedness, or mix of the activities . . . could pose a threat to the financial stability of the United States,” based upon a set of factors.¹⁷⁴ Nonbank financial companies designated by FSOB that are subject to enhanced supervision and prudential standards are commonly referred to as systemically important financial institutions (SIFIs).¹⁷⁵

The second source of macroprudential regulation is section 165 of the Dodd-Frank Act, which requires the Federal Reserve to craft “enhanced . . . prudential standards” for the largest bank holding companies and any designated nonbank SIFIs.¹⁷⁶ Section 165 authorizes the Federal Reserve to establish these prudential standards in order to “prevent or mitigate risks to the financial stability of the United States that could arise from the material financial distress or failure, or ongoing activities, of large, interconnected financial institutions[.]”¹⁷⁷

¹⁷³ See Johnson & Weiss, *supra* note 58, at 4–5.

¹⁷⁴ 12 U.S.C. §§ 5323(a)(1)–(2). These factors include: leverage; off-balance-sheet exposures; the nature, scope, scale, concentration, interconnectedness, and mix of the company’s activities; amount of assets; and the amount and types of the company’s liabilities.

¹⁷⁵ *Reducing the Moral Hazard Posed by Systemically Important Financial Institutions*, FIN. STABILITY BD. 1 (Oct. 2010), https://www.fsb.org/wp-content/uploads/r_101111a.pdf.

¹⁷⁶ See 12 U.S.C. § 5365. There are currently no companies identified as nonbank SIFIs. An amendment to the law has changed the provision’s applicability, but it clearly applies to all bank holding companies with \$250 billion or more in total assets, and could apply to bank holding companies with \$100 billion or more in assets. It is important to note that the measure of “total consolidated assets” has been interpreted to include assets under management. See Definitions of “Predominantly Engaged in Financial Activities” and “Significant” Nonbank Financial Company and Bank Holding Company, 78 Fed. Reg. 20,756, 20,774 (Apr. 5, 2013). See David W. Perkins, et. al., Cong. Research Serv., *Economic Growth, Regulatory Relief, and Consumer Protection Act (P.L. 115-174) and Selected Policy Issues 32–35* (2018).

¹⁷⁷ See 12 U.S.C. § 5365(a)(1). This provision can be interpreted as providing Federal Reserve with a financial stability mandate, at least one of a secondary nature. See *Enhanced Prudential Standards for Bank Holding Companies and Foreign Banking Organizations*, 79 Fed. Reg. 17,240, 17,263 (Mar. 27, 2014); see also Saule T. Omarova & Margaret E. Tahyar, *That Which We Call A Bank: Revisiting the History of Bank Holding Company Regulation in the United States*, 31 REV. BANKING & FIN. L. 113, 129 (2011) (“[T]he post-crisis reform is reinventing the [Bank Holding Company Act] . . . as the basic infrastructure for systemic risk regulation across the entire financial services sector.”); see also Tarullo, *supra* note 148, at 4 (citing section 165 as a provision where “financial stability is used as a stated goal motivating a new regulatory or supervisory authority without itself being the standard used in the realization of that authority.”).

By failing to use this authority to address the systemic risks of climate change, the Federal Reserve is arguably neglecting this important mandate. See Patrick Honohan, *Should Monetary Policy Take Inequality and Climate Change into Account?* 2 (Peterson Inst. for Int’l Econ., Working Paper No. 19-18, 2019), <https://www.piie.com/sites/default/files/documents/>

Investments in assets that drive climate change, including fossil fuels and industries that engage in deforestation, create systemic risk that can properly be addressed using macroprudential regulation under section 165 of Dodd-Frank.¹⁷⁸

B. *Macroprudential Regulation Would Address Systemic Climate Financial Risks*

As discussed in the preceding sections, the financial risks of climate change are spread across the financial system, through both direct and indirect exposures. These risks have complex interlinkages across different segments of an institution's balance sheet; from one type of financial institution to another; and through exposures from one industry sector to another. A macroprudential approach to the financial risks of climate change would address the concentration of climate change-driving financial activities in the largest financial institutions, measure and mitigate potential climate change-driven losses across institutions' balance sheets, and seek to manage a transition away from those risks in a manner that protects both financial institutions and the economy as whole. Regulators would incorporate the risks of climate change-causing activities and climate-driven events into prudential regulations on the basis of their potential implications for financial stability.

Under a comprehensive macroprudential approach to climate regulation, insurance companies and asset managers would be subject to federal supervision and regulation by the Federal Reserve through designation as non-bank SIFIs by the FSOC, on the basis that their mix of activities, in this case their financing of climate change-driving industries, pose a threat to the financial stability of the United States.¹⁷⁹ Those nonbank SIFIs, and the largest bank holding companies that are already regulated and supervised by the Federal Reserve, would then be subject to the following suite of regulations by the Federal Reserve under section 165 to mitigate climate financial risk.

wp19-18.pdf (“[S]econdary mandates, whether explicit or implicit, of central banks arguably warrant attention to large systemic issues like climate change and inequality, to the extent that these can be significantly influenced without detracting from the primary goals of monetary policy.”).

¹⁷⁸ See Lamperti et al., *supra* note 18, at 833 (stating that there is “a central role for macroprudential policies in managing climate-induced financial risks, which might be integrated in a more comprehensive set of adaptation and mitigation interventions.”).

¹⁷⁹ Some have proposed specifically enumerating climate as an “activity” for which the FSOC screens its SIFI designation determinations. See Marcin Cecot, *Climate Emergency and Central Banks* 5 (Dec. 12, 2019), <https://ssrn.com/abstract=3509012>. Though not a prerequisite for action, taking the formal step of issuing guidance, through the notice and comment process, may buttress the FSOC's chances of prevailing in any potential legal challenge. At the same time, it should also be noted that there is a strong general case for designating these institutions as SIFIs, not solely on the basis of their climate footprints. See note 63, *supra*.

1. Capital

Capital regulation is a central component of macroprudential regulation,¹⁸⁰ and is the first standard required by section 165.¹⁸¹ Banks are required to have minimum ratios of capital to assets, known as Risk-Based Capital, while other institutions use other measures like solvency, which are conceptually similar.¹⁸² Capital requirements rely upon a system of “risk weights” for measuring an institution’s assets that make up the denominator in a capital ratio.¹⁸³ A 100 percent risk weighting means a dollar-for-dollar representation of an asset in the denominator, and so on.

Climate change is increasing the riskiness of certain financial assets,¹⁸⁴ but capital rules and regulations do not capture that risk. While the studies of data and modeling are limited in this regard and will require further development,¹⁸⁵ capital rules can be updated to increase risk weights on the basis of climate risk to reflect the potential for capital-intensive losses based on financial climate risks.¹⁸⁶ Risk weights could be increased for loans and investments in climate change-driving assets, as well as credit exposures to sectors that are vulnerable to the effects of climate change.¹⁸⁷ These risk weights would apply, at a minimum, to all financing of the industries that encompass the 100 producers that, as of

¹⁸⁰ See Hanson et al., *supra* note 171, at 7–12.

¹⁸¹ See 12 U.S.C. § 5365(b)(1)(A)(i). In addition to section 165, the Federal Reserve also has authority under the Bank Holding Company Act to issue regulations and orders, including capital requirements, for bank holding companies, and authority under the Federal Deposit Insurance Act to require a bank holding company to cease and desist its engagement in any unsafe or unsound practices. See 12 U.S.C. §§ 1844, 1818(b)(1), (3). The Federal Reserve can also establish capital requirements for a small group of insurers that own thrift banks. See 12 U.S.C. §§ 1467a, 5412.

Finally, under the Securities Exchange and at the Commodity Exchange Act, the SEC and CFTC can establish capital requirements for legal entities that deal securities and derivatives, respectively, including subsidiaries of nonbanks like asset managers and insurers. See 15 U.S.C. § 78o-10(e)(1)(B); see also 7 U.S.C. § 6(e).

¹⁸² See 12 U.S.C. § 5365.

¹⁸³ FED. RESERVE BD., BASEL II CAPITAL ACCORD, PREAMBLE - V. CALCULATION OF RISK-WEIGHTED ASSETS, (proposed Sept. 5, 2006).

¹⁸⁴ See Rhodium Group, *supra* note 45, at 10 (noting that climate change has made commercial real estate more vulnerable to high wind and flooding exposure, and higher energy costs).

¹⁸⁵ See NETWORK FOR THE GREENING OF THE FIN. SYS., *supra* note 95, at 26–27.

¹⁸⁶ See Lamperti et al., *supra* note 18, at 831 (“[C]apital requirements can counterbalance eventual excessive or reluctant credit provision, accounting for the impacts of climate damages on firms’ solvency.”); see also George Hay, *Fiddling with Bank Capital Can Help the Planet*, REUTERS BREAKING VIEWS, (Sept. 27, 2019, 6:21 AM), <https://www.reuters.com/article/us-natixis-climate-breakingviews/breakingviews-fiddling-with-bank-capital-can-help-the-planet-idUSKBN1WC11P>.

¹⁸⁷ See, e.g., Ochoa et al., *supra* note 46, at 42. For example, in 2016 the Federal Reserve proposed significant risk weights for certain types of investments, tied to bank holding companies’ liability under environmental laws, ranging from 300 percent to 1,250 percent. See 81 Fed. Reg., at 67, 227–28.

2017, accounted for 71 percent of global industrial greenhouse gas emissions,¹⁸⁸ as well as agribusinesses operating in areas that are sensitive to deforestation, to better reflect the true costs and risks from the climate impacts of these investments.¹⁸⁹

While there are arguments for also providing a capital reduction for assets tied to green energy sectors, there are both policy reasons and empirical challenges that suggest that the proper approach, at least in the near term, would be to focus on increasing the risk factor for “dirty” investments.¹⁹⁰

2. Stress Testing

Under section 165, the Federal Reserve, in coordination with the appropriate primary financial regulatory agencies and the Federal Insurance Office (FIO), conducts “stress tests” of non-bank SIFIs and large bank holding companies to ensure that they have the necessary capital to absorb losses as a result of adverse economic conditions.¹⁹¹

¹⁸⁸ See CARBON DISCLOSURE PROJECT, CDP CARBON MAJORS REPORT 2017, at 8 (2017), <https://www.cdp.net/en/reports/downloads/2327>. In an example of the practicality of such an approach, in its proposed rule for physical commodities, the Federal Reserve would have required bank holding companies to apply higher risk weights for its commodity holdings that are subject to certain federal and state environmental protection and safety laws, as identified by the bank itself. See 81 Fed. Reg., at 67, 227.

¹⁸⁹ See Campiglio et al., *supra* note 1, at 464 (“Implementing a more comprehensive assessment of risk could instead lead to a higher capital requirement on carbon-intensive assets, in consideration of their higher transition risks.”). The Network for the Greening of the Financial System has recommended “possibly consider integrating” updates to Basel 3’s capital regulations to account for climate risk. NETWORK FOR THE GREENING OF THE FIN. SYS., *supra* note 95, at 23. This concept has been described as a “penalizing factor.” See, e.g., Myriam Vander Stichele, *Overview: Climate-Friendly Finance, Ctr. for Research on Multinational Corps.*, (Sept. 27, 2019), <https://www.somo.nl/eu-initiatives-to-regulate-financing-of-climate-friendly-activities-a-short-overview/>. No jurisdiction has done so to date, see NETWORK FOR THE GREENING OF THE FIN. SYS., *supra* note 83, at 26, and at the same time banks are by and large failing to integrate the financial risks of climate into their deal-level financial analyses, see Oliver Wyman, *Climate Change Managing a New Financial Risk*, at 14 (Feb. 2019), https://www.oliverwyman.com/content/dam/oliver-wyman/v2/publications/2019/feb/Oliver_Wyman_Climate_Change_Managing_A_New_Financial_Risk_paper.pdf.

¹⁹⁰ See Campiglio et al., *supra* note 1, at 465 (“[T]here is the danger that reducing capital requirements on bank loans to low-carbon investments could jeopardize prudential policy objectives,” and because “the role of capital requirements is to mitigate risks; their design should thus remain risk-based.”). Indeed, one of the most salient criticisms of the risk-based capital regime is that it provides generous weightings to politically popular investments. See Anat R. Admati, *Containing the Debt Crisis*, N.Y. TIMES (Jan. 8, 2014), <https://www.nytimes.com/roomfordebate/2011/05/23/is-there-any-hope-for-greeces-debt-problem/containing-the-debt-crisis> (noting that Greek bonds received a zero risk weight under international capital agreements).

¹⁹¹ See 12 U.S.C. § 5365(i)(1)(A). BHCs \$100 billion to \$250 billion in assets will still be stress tested every other year. These firms must also conduct their own internally run stress tests and report results to their regulators.

While the Federal Reserve has tested a range of recession scenarios and incorporated specific stringent scenarios for the largest global banks,¹⁹² supervisory stress tests have not incorporated climate-related losses and regulators have not sufficiently modeled basic climate risks.¹⁹³ Climate stress testing requires a robust understanding of the interplay between various climate scenarios, their impacts on diverse industries and geographic regions, the interconnections within the financial system, and the impacts across various aspects of an institution’s balance sheet.¹⁹⁴ At a minimum, regulators could incorporate a series of scenarios involving climate shocks and transition pathways into agency-run supervisory stress tests.¹⁹⁵

¹⁹² Beginning in 2014, bank holding companies with large trading operations were required to include a global market shock as part of their stress scenarios, and to conduct a stress test of their trading books, private-equity positions, and counterparty exposures. Also, eight bank holding companies with substantial trading or custodial operations were required to incorporate into their stress scenarios a scenario in which their largest counterparty defaults on its trades. Five bank holding companies are subject to the global market shock scenario, and eight bank holding companies subject to the counterparty default scenario. *See Federal Reserve Board releases scenarios for 2018 Comprehensive Capital Analysis and Review (CCAR) and Dodd-Frank Act stress test exercises and issues instructions to firms participating in CCAR*, FED. RSRV. (Feb. 1, 2018, 4:00 PM), <https://www.federalreserve.gov/newsevents/pressreleases/bcreg20180201a.htm>.

¹⁹³ *See* NETWORK FOR THE GREENING OF THE FIN. SYS., *supra* note 95, at 14. Indeed, Federal Reserve Chair Jerome Powell recently said that, because the next financial crisis may arise “in a messy and unexpected way,” banks must “be ready not just for expected risks, but for unexpected ones,” and as a result, stress tests “will need to . . . explore even quite unlikely scenarios.” Jerome H. Powell, Chair of the Board of Governors of the Federal Reserve System, Welcoming remarks: Stress Testing: A Discussion and Review 2 (July 9, 2019), <https://www.federalreserve.gov/newsevents/speech/files/powell20190709a.pdf>. Former Federal Reserve Governor Tarullo has noted, however, that the current design of the stress tests has two particular vulnerabilities: “neither regulators nor bankers can count on anticipating correctly what the next source of severe stress will be,” and the tests fail to “project second-order effects, such as the impact of fire sales or liquidity squeezes” that amplify financial shocks. Daniel K. Tarullo, Americans for Financial Reform on Big Bank Regulation under the Trump Administration: Taking the Stress Out of Stress Testing 5 (May 21, 2019), <https://ourfinancialsecurity.org/wp-content/uploads/2019/05/Tarullo-AFR-Talk.pdf>. He further described projecting second-order effects as a “a significant modeling challenge” and that the public has not “heard anything suggesting progress, or even that it’s still a priority.” *Id.* Measuring second-order effects is a particular challenge in the context of climate risks. *See* Tobias Adrian, Financial Counsellor and Director of the Monetary and Capital Markets Department, Remarks to International Monetary Fund Joint Workshop by the IMF and De Nederlandsche Bank on Stress-Testing for Climate-Related Risks: Stress-Testing for the Transition to a Low-Carbon Economy (Apr. 15, 2019), <https://www.imf.org/en/News/Articles/2019/04/10/sp04102019-stress-testing-for-the-transition-to-a-low-carbon-economy>.

¹⁹⁴ *See* Campiglio et al., *supra* note 1, at 463 (“[A]n integrated evaluation of climate-related financial risks cannot rely only on static snapshots: it requires the modelling of the dynamic interactions between the macroeconomy, the financial system, climate change and environmental policies.”).

¹⁹⁵ *See* INT’L MONETARY FUND, *supra* note 111, at 91 (recommending that “[p]olicymakers should incorporate ESG principles, and climate-related financial risks in particular, into financial stability monitoring and assessment and into microsupervision (such as stress testing).”); *see also* NETWORK FOR THE GREENING OF THE FIN. SYS., *supra* note 95, at 24.

Regulators learned the pitfalls of relying on industry-run projections before the financial crisis, when risk measurement and capital calculations were outsourced to banks' and credit ratings agencies' proprietary modeling.¹⁹⁶ Experience shows us that, left to their own devices, financial institutions do not always effectively self-regulate, particularly as it relates to catastrophic risks.¹⁹⁷ The need for robust climate stress testing to be conducted by supervisors is evidenced by the internal scenarios used by the largest and most sophisticated banks, which are not currently accounting for the full range of possible crisis scenarios.¹⁹⁸

In addition to conducting climate stress testing, the loss projections resulting from those tests should be integrated into companies' minimum capital ratios and capital planning processes. This would ensure that companies' capital allocation decisions accurately reflect the financial risks posed by fossil fuel and deforestation financing activities and the climate change that results from that financing.

3. Margin

Section 165 of the Dodd-Frank Act allows the Federal Reserve to implement any other macroprudential standards that it "determines are appropriate."¹⁹⁹ This provides the Federal Reserve with broad authority to use prudential standards to limit fossil fuel investments on the basis of their prospective risks to financial stability.

Transactions that involve securities and derivatives require institutions to post a certain amount of assets, known as margin, to their counterparties to protect against their projected credit exposure. So-

The Governor of the Bank of England has already announced that it intends to incorporate different climate scenarios as well as policy pathways into its stress testing regime, but also noted that this practice "needs to go global." Mark Carney, Remarks at the U.N. Climate Summit 3 (Sept. 23, 2019), <https://www.bankofengland.co.uk/-/media/boe/files/speech/2019/remarks-given-during-the-un-secretary-generals-climate-actions-summit-2019-mark-carney.pdf>.

¹⁹⁶ See Erik Gerding, *Code, Crash, and Open Source: The Outsourcing of Financial Regulation to Risk Models and the Global Financial Crisis*, 84 WASH. L. REV. 127, 155–57 (2009).

¹⁹⁷ See PERMANENT SUBCOMM. ON INVESTIGATIONS, *supra* note 90, at 237 (noting that a "comparison of the level of Morgan Stanley's capital and insurance reserves against estimated costs associated with 'extreme loss scenarios,'" found that, "like its peers, 'the potential loss exceeds capital and insurance' by \$1 billion to \$15 billion.").

¹⁹⁸ See Task Force on Climate-Related Fin. Disclosures, *supra* note 45, at 69–71 (describing the assumptions made by Citigroup to test climate resiliency); see also Buckley et. al., *supra* note 48, at 10 (noting that asset manager BlackRock currently only acknowledges physical risk). Even the most forward-thinking stress tests model long-term and orderly transition scenarios, de-emphasizing idiosyncratic and disorderly event-driven shocks. See Wyman, *supra* note 189, at 12–13. For example, surveys show that banks are conducting their own stress tests, but are largely doing so in the context of their corporate social responsibility work, not as a core financial risk management function. See *id.* at 16.

¹⁹⁹ 12 U.S.C. § 5365(b)(1)(B)(iv).

called “haircuts” establish the value of the margin collateral that must be posted.

The purpose of margin requirements is to restrict the portion of securities purchases that can be made using borrowed money, a practice that limits the amount of leverage that can build up within these financial markets.²⁰⁰ In the climate context, adding leverage to financial contracts that involve fossil fuel assets adds debt that both hastens potential defaults and amplifies the size of losses if issuing companies experience stranded assets, financial distress, or bankruptcy.

Stringent margin requirements should be imposed on transactions that involve securities and derivatives tied to, at a minimum, the big 100 corporate emitters, deforestation-related agribusinesses, and fossil fuels and other climate-damaging commodities.²⁰¹ Ideally, they would apply to both the calculation of credit exposures of such transactions as well as the haircuts applied to collateral.²⁰² Such rules would help to reduce the likelihood and the cost of a “climate Minsky moment” hitting financial markets, and likely apply to more transactions that one might initially expect.²⁰³

Applying margin requirements on a sector-specific basis is consistent with other policy recommendations that would apply haircuts to the collateral used in central bank transactions.²⁰⁴ In that sense, it is a private-sector analogue to a public transaction framework.

²⁰⁰ See Hanson et al., *supra* note 171, at 15–16 (margin requirements are a “broad-based regulation” to “impose similar capital standards on a given type of credit exposure[.]”).

²⁰¹ The Federal Reserve also has the authority under the Exchange Act to set margin requirements on the purchases of certain securities, such as stocks, in certain private transactions. See 15 U.S.C. § 78g. It can also delegate this authority to the SEC and CFTC.

Separately, under the Securities Exchange Act and at the Commodity Exchange Act, the SEC and CFTC can establish margin requirements for legal entities that deal securities and derivatives, respectively, including subsidiaries of nonbanks like asset managers and insurers. See 15 U.S.C. § 78o–10(e)(1)(B); see also 7 U.S.C. § 6(e).

²⁰² Calculating the credit exposure of a derivative contract is generally requires adding the current credit exposure of the contract to a projection known as the derivative’s potential future exposure, two measures that rely heavily upon a variety of formulas and factors, all of which derive their values from a series of assumptions. See 12 C.F.R. § 217.34.

²⁰³ See notes 74–93, *supra*, and accompanying text.

²⁰⁴ See Campiglio et al., *supra* note 1, at 466 (“Central banks could . . . consider incorporating climate-related risks explicitly in determining the list of eligible collateral and the size of the haircut.”). Such requirements could also be analogized as a capital markets equivalent of the banking regulators’ reserve-based lending requirements for oil and gas loans. Indeed, some large banks are reportedly already tightening both their valuations of oil and gas reserves that serve as the basis for reserve-based lending to oil and gas companies, as well as the covenants on their loans to oil and gas companies. See David French & Jessica Resnick-Ault, *Small U.S. Oil and Gas Companies Get Cold Shoulder From Large Banks*, REUTERS (Oct. 27, 2019), <https://www.reuters.com/article/us-usa-oil-lending/small-u-s-oil-and-gas-companies-get-cold-shoulder-from-large-banks-idUSKBN1X70BF>.

4. Portfolio Limits

While the preceding prudential regulations would impact the risks and returns of climate financing, regulators might seek to institute more sweeping restrictions. Such an approach would be consistent with “a key lesson of the crisis,” according to Chairman Bernanke, that addressing systemic risks through macroprudential regulation may require “remedies that . . . could well be more far-reaching and more structural in nature.”²⁰⁵

Using the broad discretionary grant of the “deems appropriate” authority in section 165, regulators could limit the overall size or growth on the allowable amount of climate change-related assets in lending and investment portfolios.²⁰⁶ Alternatively, limits could be set on loan and investment portfolios (such as total portfolio CO₂ emissions or entire sector exclusions) to limit climate financial risks.²⁰⁷ Concentration limits have been recognized as an effective measure to reduce potential risks to financial stability.²⁰⁸ Such an approach may also be more consistent with the numerous warnings of the imperative of preventing further investment in such industries.²⁰⁹

5. Divestiture

Section 121 of Dodd-Frank empowers the Federal Reserve to determine that a bank holding company or nonbank SIFI poses a “grave threat to the financial stability of the United States.”²¹⁰ With the FSOC’s approval, the Federal Reserve can take a host of remedial actions, including imposing limitations on an institution’s activities, prohibiting activities,

²⁰⁵ Bernanke, *supra* note 171, at 3–4.

²⁰⁶ See Cecot, *supra* note 179, at 5 (proposing “limit[ing] exposure of financial institutions to carbon-intensive assets that would lose value in any abrupt transition towards lower-carbon alternatives”); see also Rogerson, *supra* note 33, at 27 (recommending financial institutions implement financing policies to limit the growth of assets tied to deforestation).

The Federal Reserve has separate authority under the Federal Deposit Insurance Act to restrict the asset growth of bank holding companies, subject to Federal Reserve-imposed conditions. See 12 U.S.C. § 1818(b)(1), (3).

The SEC also has authority under the Investment Company Act to restrict the composition of mutual funds, exchange-traded funds, and other funds. See, e.g., Securities & Exchange Comm’n, Investment Company Liquidity Risk Management Programs, 81 Fed. Reg. 82, 142 (Nov. 18, 2016).

²⁰⁷ See Wyman, *supra* note 189, at 16.

²⁰⁸ Fin. Stability Oversight Council, Authority To Require Supervision and Regulation of Certain Nonbank Financial Companies, 84 Fed. Reg. 9, 028, 9, 031 (Mar. 13, 2019) (“Regulatory requirements . . . such as an asset concentration limit or repayment test, may reduce the potential risk to financial stability[.]”).

²⁰⁹ See Campiglio et al., *supra* note 1, at 462 (“[M]eeting the 2°C temperature threshold will probably require a large portion of existing reserves of oil, gas and coal to remain in the ground[.]”).

²¹⁰ 12 U.S.C. § 5331(a) (2012).

or forcing asset divestiture.²¹¹ While this authority contains some built-in procedural complexity, a Federal Reserve determined to mitigate climate risks could use it to force the largest, most systemic bank holding companies, insurers, and asset managers to divest of their climate change-causing assets.²¹²

6. Activities-based Regulations

Under section 120 of Dodd-Frank, the FSOC can also make recommendations to financial regulators to apply prudential standards for specific activities that “could create or increase the risk of significant liquidity, credit, or other problems spreading” across the financial system or in low-income, minority, or underserved communities.²¹³ This section 120 authority is non-binding, meaning that it should not solely be relied upon to address systemic risk.²¹⁴ However, the FSOC could use this provision as a last resort, a way to “name and shame” agencies into regulating activities that fall within their jurisdictions.

For example, the FSOC could urge the SEC to use its authority to suspend or revoke the ability of a credit rating agency to rate any class or subclass of securities, as a way to compel the rating agencies to enforce standards of due diligence in the rating of securities that are tied to climate change.²¹⁵ This would ensure that the credit rating agencies have policies and practices in place to properly evaluate the financial risks of climate change, price in those risks, and ensure that they are reflected in the credit ratings of securities, especially those issued by fossil fuel companies and commodities companies responsible for deforestation.

²¹¹ See 12 U.S.C. § 5331(a)(3)–(5) (2012). The Federal Reserve could also unilaterally restrict bank holding companies’ physical commodities activities. Using section 4 of the Banking Holding Company Act, the Federal Reserve could prohibit bank holding companies’ ownership of, and investment in, oil products, natural gas products, coal, electricity, agricultural products, and associated businesses on the basis that those activities “pose a substantial risk to the safety or soundness of depository institutions or the financial system generally[.]” 12 U.S.C. § 1843(k)(1) (2012).

²¹² Separately, section 5 of the Bank Holding Company Act empowers the Federal Reserve to force a bank holding company to divest of any subsidiary that “constitutes a serious risk to the financial safety, soundness, or stability” of a bank. 12 U.S.C. § 1844(e) (2012). This is a more permissive legal threshold than section 121 and could be used to force a bank holding company to sell lines of business that have substantial investments in climate change-driving business. See, e.g., Dan Freed, *Wells Fargo Energy Investment Unit Sought Risky Deals, Faces Losses*, REUTERS (Apr. 13, 2016), <https://www.reuters.com/article/us-wells-fargo-energy-idUSKCN0XA09K>.

²¹³ 12 U.S.C. § 5330(a) (2006).

²¹⁴ See generally Kress et al., *supra* note 60.

²¹⁵ See 15 U.S.C. § 78o–7(d)(2)(B)(i) (2006). The role of credit ratings was found to be one of “systemic importance” and in the “national public interest, as credit rating agencies are central to capital formation, investor confidence, and the efficient performance of the United States economy.” Dodd-Frank Wall Street Reform and Consumer Protection Act, Pub. L. No. 111-203, § 931(1), 124 Stat. 1376, 1871 (2010).

This authority also has a role to play, alongside SIFI designations, in ensuring that assets and activities do not merely migrate from regulated industries and financial actors to the less-regulated “shadow banking” sector.²¹⁶ Comprehensive macroprudential rules would follow risks wherever they migrate, for example, should banks sell climate-exposed assets to entities like private equity funds.

* * *

It is important to view these macroprudential measures as the first step in climate risk mitigation. In addition to addressing the role of financial institutions in *creating* climate risk, policy makers must also make the financial institutions more resilient to the *effects* of climate change. However, recalibrating the potential risks of asset classes, communities, and entire geographic regions that are most vulnerable to climate change raises issues of socioeconomic and racial equity and inclusion. Any such measures would need to be part of a more comprehensive investment plan that ensures the most vulnerable communities are being made more climate resilient.²¹⁷

C. *The United States’ Response to a Prospective Climate Financial Crisis Has Yet to Address the Systemic Nature of the Risks Involved*

In the face of the growing evidence of the financial costs of climate change, and a growing international effort to address the potential risks of a climate-driven financial crisis, U.S. regulators are departing from international conventional wisdom and exhibiting behaviors reminiscent of the pre-2008 crisis period.

European financial regulators have argued forcefully that climate change presents a financial risk that must be tackled and that “financial policymakers and prudential supervisors . . . cannot ignore the obvious risks before our eyes.”²¹⁸ It is fair to say that this is now the consensus of international financial regulators as embodied by a coalition of foreign central banks, the Network for the Greening of the Financial System, which has issued a call to action.²¹⁹ Despite the international consensus,

²¹⁶ See Bernanke, *supra* note 171, at 16–17; see also Johnson & Weiss, *supra* note 58, at 2–5 (one of the purposes of the FSOC is to fill regulatory gaps).

²¹⁷ See Jesse M. Keenan & Elizabeth Mattiuzzi, *Climate Adaptation Investment and the Community Reinvestment Act*, FED. RESRV. BANK S.F. COMMUNITY DEV. (June 16, 2019), <https://doi.org/10.24148/cdrb2019-05>.

²¹⁸ Mark Carney, François Villeroy de Galhau & Frank Elderson, *Open Letter on Climate-Related Financial Risks*, BANK ENGLAND (Apr. 17, 2019), <https://www.bankofengland.co.uk/news/2019/april/open-letter-on-climate-related-financial-risks>.

²¹⁹ NETWORK FOR THE GREENING OF THE FIN. SYS., *supra* note 95, at 19 (asserting that “climate science leaves little doubt: action to mitigate and adapt to climate change is needed

United States regulators have lagged behind their international counterparts in considering the financial risks associated with climate change and fashioning an approach to mitigating such risks, arguing that it is outside of their core regulatory mandate.²²⁰

When it comes to supervisory authority and financial stability, there is little meaningful distinction in the responsibilities of the Federal Reserve and a foreign central bank like the Bank of England.²²¹ Given the significant role of U.S. financial institutions in providing capital to climate change-driving activities, the financial case for macroprudential climate may be even stronger in the U.S. than in some of the other countries that have joined the international effort to prevent a financial climate crisis.²²²

A traditional view of bank supervision posits that regulators' sole responsibility is ensuring that supervised entities merely have risk management policies and procedures in place without questioning underlying credit and business decisions. Yet, some regulators have made a compelling case for rethinking this model.²²³ For example, the Federal Reserve recently reviewed banks' involvement in physical commodities and proposed new substantive regulations in response to recent catastrophic en-

now.”). The Australian central bank, in a country heavily reliant on fossil fuels, recently said that “climate change could emerge as a risk to financial stability if it is not properly managed, or if the size of climate-related losses increased materially” and that “[f]inancial regulators have a role to play in ensuring that climate risks are effectively managed by financial institutions.” Financial Stability Review, RSRV. BANK AUSTRALIA 59–60 (Oct. 2019), <https://www.rba.gov.au/publications/fsr/2019/oct/pdf/financial-stability-review-2019-10.pdf>.

²²⁰ See Laura Alix, *On Climate Risk, U.S. Regulators at Odds with Global Counterparts*, AM. BANKER (May 8, 2019), <https://www.americanbanker.com/news/on-climate-risk-us-regulators-at-odds-with-global-counterparts>; see also Lydia DePillis, *Most Economic Forecasts Have a Big Blind Spot: Climate Change*, CNN: MONEY (Aug. 17, 2018), <https://money.cnn.com/2018/08/17/news/economy/climate-change-economic-forecasts/index.html> (reporting the statement by Federal Reserve Board Chair Jerome Powell that climate change is, “something that is entrusted to other agencies,” and “it’s just not clear that it’s really in our ambit.”); see also *S. Banking Hearing on Oversight of Fin. Reguls. before S. Banking, Hous., Urb. Affs. Comm.* (May 15, 2019) (statement by Federal Reserve Vice Chair for Supervision Randal Quarles that he is “not a meteorologist or a climate scientist.”), <https://www.c-span.org/video/?460737-1/senate-banking-hearing-oversight-financial-regulators&start=2956>.

²²¹ See Campiglio et al., *supra* note 1, at 466 (“If climate-related financial risks are found to be material to the stability of the financial system, this could ultimately justify the implementation of measures aimed at mitigating them across all central banking operations.”).

²²² In this sense, the centrality of fossil fuels to the U.S. economy and the U.S. financial system may create additional political economy challenges that undermine a persuasive empirical case for macroprudential climate regulation. See, e.g., John Noël, *Stranglehold: Oil & Gas Money is Choking Our Democracy*, CLEAN WATER ACTION (2017) <https://www.cleanwateraction.org/sites/default/files/docs/publications/Stanglehold%20-%20Clean%20Water%20Action%208-23-17.pdf>.

²²³ See, e.g., Thomas M. Hoenig, Vice Chairman of FDIC, Remarks on Bank Supervision by FDIC (Mar. 18, 2016), <https://www.fdic.gov/news/news/speeches/spmar1816.pdf> (calling for full-scope examinations and statistical sampling in large banks examinations).

vironmental events and lessons learned from the financial crisis.²²⁴ This response to the potential catastrophic risks of physical commodities is an implicit acknowledgement that effective supervision and regulation requires an understanding of the risks inherent in the businesses to which financial institutions provide capital.²²⁵

The case for a regulatory intervention is further strengthened by the fact that even the industries that should be ahead of the curve, like insurance, have been unprepared for (and therefore have been quite vulnerable to) various sources of catastrophic risk.²²⁶ For example, in August 1992, Hurricane Andrew caused \$15.5 billion in losses, resulting in nine insurer insolvencies and prompting insurers and reinsurers to increase the number, availability, and capability of catastrophic models.²²⁷ As discussed above, the consequences of climate change have only worsened since that episode.

CONCLUSION

Before the 2008 financial crisis, regulators and policymakers lacked an appreciation for the full scale and scope of the exposures before the housing crisis²²⁸ and dismissed as “anecdotal” and “misguided” the con-

²²⁴ See Complementary Activities, Merchant Banking Activities, and Other Activities of Financial Holding Companies Related to Physical Commodities, 79 Fed. Reg. 3329 (proposed Jan. 21, 2014); see also Regulations Q and Y; Risk-Based Capital and Other Regulatory Requirements, 81 Fed. Reg. 67220 (proposed Sept. 30, 2016).

²²⁵ In fact, the Federal Reserve has placed significant constraints on the business conduct of third parties engaging in certain business relationships with bank holding companies, such as oil transport, and made revisions to banking regulations in response to perceived weaknesses in industry standards. See 79 Fed. Reg., at 3330 n.7 (“[T]hird parties that transport oil must be a member of a protection and indemnity club, carry the maximum insurance for oil pollution available from the club and have substantial amounts of additional oil pollution insurance from creditworthy insurance companies, use vessels of less than a certain age, use vessels approved by a major international oil company, and use vessels that have appropriate oil spill response plans and equipment.”); see also *id.* at 3332 (“[T]he oil spill involving the Deepwater Horizon drilling unit suggests that current industry safety policies and procedures may not prevent a major environmental disaster and may call into question the effectiveness of such procedures.”).

²²⁶ See Schwarcz & Schwarcz, *supra* note 100, at 1611 (“Some insurers, for instance, do surprisingly little to mitigate catastrophe risks that have not occurred in the recent past (consistent with the availability heuristic, a commonly understood behavioral bias.”). This is a particular concern, given that insurance is an industry that issues policies that are “typically payable only upon the occurrence of a certain idiosyncratic trigger event not tied to economic cycles,” and should therefore have more reliable modeling capacity than most industry actors. *Finding the Right Capital Regulation for Insurers Before the Financial Institutions and Consumer Protection Subcommittees of the Senate Banking, Housing and Urban Affairs Committee*, S. Hrg. 113-350 (Mar. 11, 2014) (testimony of Michael W. Mahaffey, Chief Risk Officer of the Nationwide Mutual Insurance Company), <https://www.banking.senate.gov/imo/media/doc/MahaffeyTestimony31114.pdf>.

²²⁷ See Int’l Ass’n of Ins. Supervisors, *supra* note 32, at 54.

²²⁸ See FIN. CRISIS INQUIRY COMM’N, *supra* note 10, at 308 (regulators “underestimated what systemic risk would be in the marketplace”); see also Randal K. Quarles, Remarks of

cerns raised by academics and community groups about unregulated derivatives and subprime lending.²²⁹ In other cases, “many top officials and regulators were reluctant to challenge the profitable and powerful financial industry.”²³⁰ As a result, what seemed like isolated risks quickly became a financial crisis.²³¹ In failing to fully appreciate the potential risks of climate change and their responsibility to mitigate them, regulators’ current approach is reminiscent of the pre-crisis period.²³² Much as there were warnings of the dangers of the subprime mortgage bubble, over 11,000 climate scientists recently warned, “clearly and unequivocally that planet Earth is facing a climate emergency.”²³³

As this Article demonstrates, we are indeed running the risk of another financial crisis, this time caused by climate change. How could we not be? Leaving aside the analysis laid out above, it should be self-evident that a crisis that threatens the stability of our entire planet would, by extension, also threaten the stability of our financial system.²³⁴ Just as finance is responsible for perpetuating the risks of climate change, finance has a role to play in addressing such risks.²³⁵ A comprehensive plan for preventing a climate crisis must contemplate a role for macroprudential climate regulation as a tool to mitigate the risks of, and harms caused by, a possible “climate Lehman moment.”

Financial regulators have broad authority that can be used to require financial institutions to internalize the financial risks associated with

Treasury Under Secretary for Domestic Finance to the Money Marketeers, U.S. DEP’T TREASURY (May 10, 2006), <https://www.treasury.gov/press-center/press-releases/Pages/js4248.aspx> (arguing that, “[r]egardless of where one falls out in this debate, a broad-based decline in house prices would almost certainly exert a noticeable drag on economic activity . . . I have to say that I do not think this is a likely scenario . . . [T]he potential tail risks I’ve talked about today are just that—possibilities but not likely outcomes. Fundamentally, the economy is strong, the financial sector is healthy, and our future looks bright.”).

²²⁹ FIN. CRISIS INQUIRY COMM’N, *supra* note 10, at 16; *see also* Justin Lahart, *Mr. Rajan Was Unpopular (But Prescient) at Greenspan Party*, WALL ST. J. (Jan. 2, 2009), <http://www.wsj.com/articles/SB123086154114948151>.

²³⁰ FIN. CRISIS INQUIRY COMM’N, *supra* note 10, at 9.

²³¹ *See* Bernanke, *supra* note 109, at 4 (an important lesson of the 2008 financial crisis was that “problems that may be individually manageable can set off a crisis when the financial system is sufficiently vulnerable.”).

²³² The issue of past patterns and probabilities posing a challenge for future predictions is known as an “epistemological obstacle” requiring an “epistemological break.” *See* Bolton et al., *supra* note 12, at 21–22.

²³³ William J. Ripple, Christopher Wolf, Thomas M. Newsome, Phoebe Barnard & William R. Moomaw, *World Scientists’ Warning of a Climate Emergency*, BIOSCIENCE (Nov. 5, 2019), <https://doi.org/10.1093/biosci/biz088>.

²³⁴ *See* Lenton et al., *supra* note 54, at 595; *see also* Bolton et al., *supra* note 12, at 3 (“[C]limate catastrophes are even more serious than most systemic financial crises: they could pose an existential threat to humanity, as increasingly emphasized by climate scientists.”).

²³⁵ *See* FOURTH NAT’L CLIMATE ASSESSMENT, *supra* note 23, at 64 (“A significant portion of climate risk can be addressed by integrating climate adaptation into existing investments, policies, and practices,” including financial risk reporting and capital investment planning).

lending and investments that drive climate change. These authorities can be deployed on the basis that climate change is associated with significant risks to financial stability—risks for which lenders do not currently account.²³⁶ More accurately pricing the physical risks associated with climate change can better reveal the full cost of current climate practices while more accurately pricing the transition risks associated with holding carbon assets can remove the subsidy for fossil fuel investments in an orderly manner.²³⁷ This could lead to capital being re-directed to green energy financing,²³⁸ both mitigating climate change and addressing potential frictions in the transition process. By not adopting effective macroprudential climate policies, financial regulators are providing a nontransparent, indirect subsidy to climate change-causing industries.

While macroprudential climate regulation is a necessary step, it should not be viewed as a sufficient one. Further thought must also be given to the impacts of any transition upon the most economically- and climate-vulnerable communities. To address these policy questions, careful transition planning requires a combination of other measures such as community investment mandates and public spending programs in addition to macroprudential regulation. Addressing such issues as part of a comprehensive climate program should not, however, prevent near-term action to address the investments and activities that play the most significant role in driving climate change.²³⁹

Failing to incorporate climate change into macroprudential regulation is effectively a wager that none of the possible scenarios above will come to pass. This is a risky bet. By ignoring their responsibility to safeguard financial stability, regulators are allowing financial institutions to continue directing massive amounts of capital into climate-change drivers like fossil fuel and deforestation businesses, further driving a carbon

²³⁶ See INT'L MONETARY FUND, *supra* note 111, at 83 (noting that “[i]n the transition to a cleaner-energy economy, a sudden reassessment of valuations in exposed sectors could occur to the extent that asset prices do not fully internalize the risks posed by climate change.”).

²³⁷ Macroprudential climate regulation is only one component of a comprehensive climate plan, and would likely require pairing with other macroeconomic tools to shift the markets for clean energy investment. See, e.g., Honohan, *supra* note 177 (proposing that public authorities fund clean energy through “green” bond purchases); see also MIKE KONCZAL & J.W. MASON, A NEW DIRECTION FOR THE FEDERAL RESERVE 42, (Roosevelt Inst., 2017), <https://rooseveltinstitute.org/wp-content/uploads/2017/11/Monetary-Policy-Toolkit-Report-1.pdf> (recommending that the Federal Reserve “purchase debt issued to finance investments that address climate change, including the development of non-carbon energy sources and building retrofits to reduce energy use.”).

²³⁸ See Campiglio et al., *supra* note 1, at 464 (arguing that, if macroprudential regulation “leads to an increase in the cost of financing high-carbon activities, it could also have the effect of redirecting lending towards low-carbon activities.”).

²³⁹ See Woetzel et al., *supra* note 22, at 119 (“[D]ecarbonization investments will need to be considered in parallel with adaptation investments, particularly in the transition to renewable energy.”).

bubble.²⁴⁰ This exacerbates climate financial risk, and with it the fragility of the financial system. In addition, further regulatory delay will only increase the costs of climate change²⁴¹ by increasing both the severity of the damage done to, and by, the climate, as well as the disorderly nature of any transition.²⁴²

As with any asset bubble, the most vulnerable communities will likely pay the highest price when the carbon bubble bursts.²⁴³ It is important to remember that the most vulnerable frontline communities are also the most affected by the impacts of climate change.²⁴⁴ As a result, there is a strong argument that macroprudential climate regulation would help to both address a current systemic injustice as well as prevent a potential future one.

²⁴⁰ For example, the largest U.S. bank holding companies are extending more than \$140 billion in credit to energy companies. See Rachel Louise Ensign, *Banks Face New Headache on Oil Loans*, WALL ST. J. (Apr. 12, 2016), <http://www.wsj.com/articles/banks-face-massive-new-headache-on-oil-loans-1460453401>. This is roughly equivalent to the average estimated annual investment needed in the U.S. clean energy sector from 2010–50 in order to sustain a 2°C scenario. See Wyman, *supra* note 189, at 5.

²⁴¹ See Ochoa et al., *supra* note 46, at 15.

²⁴² See Bank of England, *supra* note 14, at 26 (“Late, abrupt and significant policy action aimed at reducing greenhouse gas emissions would also significantly increase credit and market risks, particularly in carbon-intensive sectors.”).

²⁴³ For example, manufacturing and construction jobs are particularly vulnerable to recessions. See Christopher J. Goodman & Steven M. Mance, *Employment Loss and the 2007–09 Recession: An Overview*, MONTHLY LAB. REV. (Apr. 2011), <https://www.bls.gov/opub/mlr/2011/04/art1full.pdf>. Also, younger, less educated, and minority families suffered the greatest wealth declines during the financial crisis. See William R. Emmons & Bryan J. Noeth, *Household Financial Stability: Who Suffered the Most from the Crisis*, REG’L ECON. 11 (July 2012), https://www.stlouisfed.org/~media/files/pdfs/publications/pub_assets/pdf/re/2012/c/financial_stability.pdf.

²⁴⁴ See H. Res. 109, *supra* note 16, at 4 (“[C]limate change, pollution, and environmental destruction have exacerbated systemic racial, regional, social, environmental, and economic injustices . . . by disproportionately affecting indigenous peoples, communities of color, migrant communities, deindustrialized communities, depopulated rural communities, the poor, low-income workers, women, the elderly, the unhoused, people with disabilities, and youth[.]”).