

Resurrecting the OFR

Hilary J. Allen *

I. INTRODUCTION	2
II. THE OFFICE OF FINANCIAL RESEARCH: FROM INCEPTION TO 2020	5
<i>A. The Creation of the OFR</i>	5
<i>B. The OFR Under the Obama Administration</i>	8
<i>C. The OFR Under the Trump Administration</i>	10
III. NEW CHALLENGES IN FINANCIAL STABILITY REGULATION	12
<i>A. Climate Change</i>	13
<i>B. Fintech</i>	17
<i>C. Data Problems</i>	21
IV. REBUILDING THE OFR	23
<i>A. Structure</i>	26
<i>B. Data</i>	27
<i>C. Funding</i>	29
<i>D. Staffing</i>	30
<i>E. Interagency Collaboration</i>	33
<i>F. Culture</i>	38
<i>i. Addressing Modelling Limitations and Automation Bias</i>	38
<i>ii. Questioning Financial Stability Orthodoxy</i>	41
<i>iii. Encouraging Innovation</i>	43
V. CONCLUSION	46

* Professor, American University Washington College of Law. Many thanks go to Dick Berner, Gregg Gelzinis, Howell Jackson, Jeremy Kress, Jeff Lubbers, Patricia McCoy, Josephine Sandler Nelson, Christina Skinner, and Rory Van Loo for comments on earlier drafts and helpful conversations, as well as to participants in the American University Washington College of Law Business Law Workshop, the Women in Law & Finance workshop series, Wharton's financial regulation workshop series, and the National Business Law Scholars Conference. All views expressed and all errors are my own.

Resurrecting the OFR

Hilary J. Allen

Financial regulators need new types of expertise to address the systemic threats arising from climate change and fintech innovation. At present, climate, complexity, computer, and data science expertise are largely unrepresented in the financial regulatory agencies, but financial regulation—particularly financial stability regulation—can no longer be fully effective without them. This Article argues that the Office of Financial Research (OFR) should be built up as a hub of these types of interdisciplinary expertise. The OFR will then be equipped to monitor new types of systemic risks, research innovative solutions to those risks, and assist other financial regulatory agencies with technical expertise as the need arises. The staff and other resources of the OFR were decimated under the Trump Administration, but this affords an opportunity to the Biden Administration to rebuild the OFR—not only to fulfill the OFR’s original data collection and analysis functions, but also to address the new sources of systemic risk that have emerged since it was founded in 2010. This Article, therefore, offers detailed proposals for rebuilding the OFR, giving thought to how to structure the OFR’s relationships with other financial regulatory agencies, as well as its staffing, funding, and culture.

I. INTRODUCTION

Threats to the stability of our financial system are evolving, and financial regulation needs to evolve with them. Financial regulators need more than just economic, legal, and accounting expertise to grapple with issues like climate change and the rise of fintech; at the very least, they need to employ climate science, complexity science, data science, and software engineering experts. Scattering this kind of expertise throughout the United States’ fractured financial regulatory architecture would keep that expertise fragmented, cut off from the cross-sectoral collaboration needed to comprehend and respond to systemic risks. Financial stability will benefit if these types of scientific and technological expertise are instead concentrated in an interdisciplinary research hub, and the Office of Financial Research (OFR) is the most obvious agency to serve as that hub. While the OFR was decimated under the Trump Administration, this Article highlights a silver lining: the Biden Administration now has an opportunity to resurrect the OFR as an agency with a broader focus on the new types of vulnerabilities that are emerging in the financial system.

The OFR was created in the aftermath of the 2008 financial crisis as a type of early warning system for emerging systemic risks. Gaps in data availability and analysis had hampered governmental authorities as they tried to grapple with the events of 2008, and so the OFR’s initial focus was on the collection and analysis of transactional and institutional data. This Article argues, however, that the OFR should pursue a broader, more interdisciplinary conception of “financial research.” Financial research can involve many things, including studying the climate risks that the financial system is increasingly

exposed to and the new technologies that the financial industry is adopting. Financial research can also involve experimenting with regulator-driven technological innovations designed to mitigate emerging problems—technological experimentation may also improve the OFR’s core data collection and analysis functions.

Finance is becoming inextricably intertwined with new technologies, and so financial regulators must grapple with those technologies in order to discharge their regulatory functions. In particular, financial stability regulators—who are charged with figuring out how the different parts of the financial system operate together—face a daunting learning curve. They will increasingly need to be able to assess threats posed by machine learning and distributed ledger technologies, for example. Without expertise in these new technologies, threats to financial stability may go unnoticed by the regulatory community.¹ Financial stability is also threatened by climate change. Extreme weather events and other lasting environmental changes (like rising seas) could undermine the value of loans and investments made by banks and overwhelm insurers. Extreme weather events could also compromise vital financial infrastructure needed to process payments and other transactions. Less obviously, policy steps taken to reduce carbon emissions will likely entail a reallocation of capital from emission-heavy businesses to newer greener industries, and this transition could have significant consequences for any financial institutions that are significantly exposed to the former.² Again, without an understanding of climate science, financial stability regulators will be unable to properly discharge their functions. A rebuilt interdisciplinary OFR can help fill this lacuna.

To be clear, the OFR cannot succeed in isolation; the reform efforts advocated for in this Article should be part of a full-court press to revitalize our financial regulatory architecture. In particular, the Biden Administration must rehabilitate the Financial Stability Oversight Council (FSOC), which was hobbled during the Trump Administration.³ The FSOC is charged with responding to any emerging threats that are identified by the OFR’s research,⁴ and so if we want to maximize the impact of the OFR, the FSOC needs more power and resources of its own. A number of proposals have been made to this end, including a bill introduced in 2020 titled the “Systemic Risk Mitigation Act.”⁵ But the OFR should be more than just the research arm of the FSOC—ideally, it

1. For a discussion of fintech’s potential threats for financial stability, see Hilary J. Allen, *Driverless Finance*, 10 HARV. BUS. L. REV. 157, 165 (2020) (discussing algorithm-driven fintech business models); Saule T. Omarova, *New Tech v. New Deal: Fintech as a Systemic Phenomenon*, 36 YALE J. ON REGUL. 735, 735 (2019) (describing how and why specific fintech applications may act as destabilizing mechanisms); FIN. STABILITY BD., ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN FINANCIAL SERVICES: MARKET DEVELOPMENTS AND FINANCIAL STABILITY IMPLICATIONS 8 (2017); FIN. STABILITY BD., FINANCIAL STABILITY IMPLICATIONS FROM FINTECH: SUPERVISORY AND REGULATORY ISSUES THAT MERIT AUTHORITIES’ ATTENTION (2017).

2. For a discussion of these threats, see generally FIN. STABILITY BD., STOCKTAKE OF FINANCIAL AUTHORITIES’ EXPERIENCE IN INCLUDING PHYSICAL AND TRANSITION CLIMATE RISKS AS PART OF THEIR FINANCIAL STABILITY MONITORING (2020); Graham S. Steele, *Confronting the ‘Climate Lehman Moment’: The Case for Macroprudential Climate Regulation*, 30 CORNELL J.L. & PUB. POL’Y 109 (2020); Allison Herren Lee, Comm’r, SEC, Keynote Remarks at PLI’s 52d Annual Institute on Securities Regulation, Playing the Long Game: The Intersection of Climate Change Risk and Financial Regulation (Nov. 5, 2020), <https://www.sec.gov/news/speech/lee-playing-long-game-110520> [https://perma.cc/T9T5-XR8V].

3. *Infra* notes 70–72 and accompanying text.

4. Dodd-Frank Wall Street Reform and Consumer Protection Act, Pub. L. No. 111-203, § 112(a)(1)(C), 124 Stat. 1376, 1395 (2010) (codified as 12 U.S.C. § 5322).

5. Systemic Risk Mitigation Act of 2020, H.R. 6501, 116th Cong. (2020). For further discussion of

would make important contributions through its relationship with other financial regulatory agencies as well. While this Article's recommendations are strongly oriented towards promoting financial stability, they also have relevance for other types of financial regulation relating to capital intermediation and investor and consumer protection.

Unfortunately, even during the Obama Administration, the OFR occasionally faced pushback from other financial regulatory agencies (as well as strong opposition from Republican lawmakers).⁶ In addition, the OFR was never as independent from the Treasury Department as its progenitors would have liked.⁷ Structural reforms can help address some of these concerns—this Article advocates for moving the OFR out of the Treasury Department, amongst other things. More important, though, are the resource and cultural reforms necessary to allow the OFR to achieve its potential. The fact that the OFR was decimated during the Trump Administration (in terms of both personnel and budget) provides something of a clean slate for rebuilding the agency with significant science and technology expertise, as well as the usual economic and legal expertise. Significant hiring of new types of experts will automatically reorient the focus of the OFR to some extent, but other affirmative steps will also be needed to ensure that the OFR develops a culture that is open to assessing the new types of threats to financial stability that will inevitably emerge in the future.

First, steps should be taken to guard against capture in the rebuilt agency, particularly to ensure that OFR personnel are not too deferential to the next generation of risk models adopted by the financial industry. The OFR will also need to encourage a certain level of humility and critical thinking with regard to model output in general—including the output of its own models. This critical, humble approach should also be applied to conventional wisdom about how financial crises spread. While crises have historically been transmitted through contractual relationships and market panics, “whatever can go wrong will go wrong faster and bigger when computers are involved.”⁸ As financial technology becomes more sophisticated (and extreme weather events and other environmental changes threaten physical infrastructure), it increases the possibilities for operational risks to generate and transmit problems through the financial system. However, while we want to encourage a healthy skepticism of technological outputs, we also want the OFR to harness the best of financial technologies in support of its financial stability mission. This will require a culture that supports innovation *by* the regulators and extends grace for the failures that are an inevitable part of the innovation process. This Article will provide recommendations for steps designed to further all of these cultural imperatives.

The remainder of this Article will proceed as follows. Part II sets out a brief history of the OFR from its inception, examining its trajectory under the Obama and Trump administrations. Part II also highlights some of the criticisms that have been leveled at the OFR during its existence. Part III demonstrates that the financial landscape has shifted even since the OFR's creation in 2010, which means that financial stability regulation

possible FSOC reforms, see Hilary J. Allen, *Putting the “Financial Stability” In Financial Stability Oversight Council*, 76 OHIO ST. L.J. 1087 (2015).

6. See *infra* Part II. (discussing the history of the OFR).

7. *Id.*

8. Andrei A. Kirilenko & Andrew W. Lo, *Moore's Law versus Murphy's Law: Algorithmic Trading and Its Discontents*, 27 J. ECON. PERSPS. 51, 52 (2013).

now faces additional challenges that were not contemplated when the OFR was first created. In particular, financial stability regulators now need to engage with the realities of climate change, as well as the innovative technologies that have been adopted as part of the fintech revolution. Perennial challenges in data collection and analysis persist too, and Part III also considers technology's role in addressing these. Part IV provides a blueprint for how the OFR might be resurrected in a way that not only allows it to better fulfill the ambitions of its original proponents, but also to help address the difficulties that financial regulators face when confronting new challenges. Part V concludes.

II. THE OFFICE OF FINANCIAL RESEARCH: FROM INCEPTION TO 2020

A. The Creation of the OFR

The financial crisis of 2008 had many causes, but it was clearly exacerbated by a lack of understanding about where risks had developed, and about how those risks might be transmitted from one part of the financial system to another. While banks were subject to regular oversight by prudential regulators, financial regulators and other government officials knew much less about other types of financial institutions and their activities.⁹ They also had limited understanding of the relationships amongst the different financial institutions that could transmit shocks from one institution to another.¹⁰ For example, if a financial institution defaulted on its contractual obligations, then the ripple effects could be significant—but regulators and government authorities had limited data with which to gauge how large such ripples would be.¹¹ There was also limited understanding of how the trading behavior of highly leveraged financial institutions could roil financial markets and asset prices.¹² In the fall of 2008, fearing new forms of bank runs and fire sales that could drag down the entire financial system, the Federal Reserve constructed a slew of emergency programs to prevent a feared financial apocalypse¹³—but it was often in the dark as it did so.

The genesis of the OFR was a proposal for a “National Institute of Finance” that was made by the aptly-named “Committee to Establish the National Institute of Finance” in light of its members’ concerns that “the Federal Government and the regulatory

9. FIN. CRISIS INQUIRY COMM’N, THE FINANCIAL CRISIS INQUIRY REPORT: FINAL REPORT OF THE NATIONAL COMMISSION ON THE CAUSES OF THE FINANCIAL AND ECONOMIC CRISIS IN THE UNITED STATES xviii (2011).

[The regulatory] approach had opened up gaps in oversight of critical areas with trillions of dollars at risk, such as the shadow banking system and the over-the-counter derivatives markets. In addition, the government permitted financial firms to pick their preferred regulators in what became a race to the weakest supervisor.

10. “There was no comprehensive and strategic plan for containment, because [regulators] lacked a full understanding of the risks and interconnections in the financial markets. Some regulators have conceded this error.” *Id.* at xxi.

11. This dynamic was most evident in the repo market, as discussed in Gary Gorton & Andrew Metrick, *Securitized Banking and the Run on Repo*, 104 J. FIN. ECON. 425, 431–33 (2012).

12. For a discussion of the systemic dimension of asset sales, see Anil K. Kashyap et al., *The Macroprudential Toolkit*, 59 IMF ECON. REV. 145, 147–53 (2011).

13. John Weinberg, *The Federal Reserve Credit Programs During the Meltdown*, FED. RSRV. HIST. (Nov. 22, 2015), https://www.federalreservehistory.org/essays/fed_credit_programs [<https://perma.cc/4MLY-ZFLA>].

communities lack the data and lack the research capability to effectively monitor and regulate systemic risk”¹⁴ This Committee recommended that the OFR have both a Data Center and a Research and Analysis Center,¹⁵ with the hope that the OFR would not only collect new sources of data but would develop “the appropriate analytic tools . . . to turn that data into the useful information to be able to really monitor and measure systemic risk”¹⁶ The Committee also recommended that the Institute be self-funded and otherwise free from political influence.¹⁷

The Committee’s proposal was championed by Rhode Island Senator Jack Reed, the driving force behind the creation of the OFR.¹⁸ In his floor statement on the relevant legislation, Senator Reed observed that “[o]ver the past 18 months, we have learned that our regulators did not have the appropriate tools or knowledge to address risks that cut across different markets and sectors of the financial system,” and that those deficiencies could be addressed with a regulatory agency whose mission is “to support the community of financial regulatory agencies by collecting and standardizing the reporting of financial market data; performing applied and essential long-term research; and developing tools for measuring and monitoring systemic risk.”¹⁹ In short, the OFR was designed to help fill the gaps in data availability and analysis that had been exposed during the crisis.

In the same floor statement, Senator Reed also noted another important function of the OFR, which was to support the newly-created Financial Stability Oversight Council (“FSOC”).²⁰ The FSOC was a linchpin of the post-crisis regulatory reform—a council of the heads of existing financial regulatory agencies that was given an express statutory mandate to “respond to emerging threats to the stability of the United States financial system.”²¹ The most powerful authorities granted to the FSOC by Dodd-Frank are the designation powers in Sections 113 and 804. Pursuant to these Sections, the FSOC can vote to subject non-bank financial institutions and financial market utilities that could impact the stability of the financial system to heightened prudential supervision by the Federal Reserve. The FSOC would need data about non-bank institutions and financial market utilities in order to make any such determinations, and the OFR was directed to

14. *Equipping Financial Regulators with the Tools Necessary to Monitor Systemic Risk: Hearing Before the Subcomm. on Sec. & Int’l Trade & Fin. of S. Comm. on Banking, Hous., & Urb. Affs.*, 111th Cong. 14 (2010) [hereinafter Mendelowitz] (statement of Allan I. Mendelowitz, Founding Member, Comm. to Establish the Nat. Inst. of Fin.).

15. *Id.* at 15.

16. *Equipping Financial Regulators with the Tools Necessary to Monitor Systemic Risk: Hearing Before the Subcomm. on Sec. & Int’l Trade & Fin. of S. Comm. on Banking, Hous., & Urb. Affs.*, 111th Cong. 16–17 (2010) (statement of John C. Liechty, Assoc. Prof. of Mktg. & Stats., Smeal Coll. Bus., Penn State Univ., and Founding Member, Comm. to Establish the Nat. Inst. of Fin.).

17. Mendelowitz, *supra* note 14, at 14.

18. Ryan Tracy, *Washington’s \$500 Million Financial-Storm Forecaster Is Foundering*, WALL ST. J. (Feb. 19, 2018, 2:18 PM ET), <https://www.wsj.com/articles/washingtons-500-million-financial-storm-forecaster-is-foundering-1519067903> [<https://perma.cc/FXQ8-7ZBD>].

19. 111 Cong. Rec. S484–500 (Feb. 4, 2010) [hereinafter Reed], <https://www.congress.gov/congressional-record/2010/2/4/senate-section/article/s484-1?q=%7B%22search%22%3A%5B%22%5C%22national+institute+of+finance%5C%22%22%5D%7D&s=2&r=3> [<https://perma.cc/KK4Y-YYGR>] (statement of Sen. Jack F. Reed on the National Institute of Finance Act).

20. *Id.*

21. Dodd-Frank Act § 112(a)(1)(C), 12 U.S.C. § 5322.

supply it.²² as Senator Reed observed “any new regulatory structure [including the FSOC] will be ineffective unless we also equip it with a strong, independent, and well-funded data, research, and analytic capacity to fulfill its mission.”²³

It has been reported that the Committee and Senator Reed faced some opposition from then-Treasury Secretary Timothy Geithner.²⁴ While the OFR *was* ultimately established, Treasury officials apparently succeeded in convincing lawmakers not to make the OFR a stand-alone regulatory body.²⁵ Instead, the OFR was established in 2010 as an agency within the Treasury Department.²⁶ As such, the OFR was never as politically independent as the Committee had hoped. It is hard to gauge the impact of this compromised independence on the efficacy of the OFR, but some Treasury officials were certainly skeptical of an expansive role for the agency: Deputy Secretary Neal Wolin reportedly advised the OFR’s first Director, Richard Berner, “against setting unrealistic goals.”²⁷

The Treasury also retained power over the OFR’s funding. The OFR is not subject to Congressional appropriations; instead, it is funded with fees drawn from the financial industry. Pursuant to Section 155 of Dodd-Frank and a rule promulgated by the Treasury Department thereunder, the OFR’s budget is funded by semi-annual fees paid by covered financial institutions.²⁸ However, while Section 155(d) specifies that such fees will be assessed upon any non-bank financial firm designated as systemically important by the FSOC, as well as all bank holding companies with consolidated total assets of \$250 billion or more,²⁹ the ultimate determinations of which firms will be covered by the assessments, and which of those firms’ assets will be assessable, lie with the Treasury Department.³⁰

Section 152 of Dodd-Frank provides that the OFR will be headed by a single director, to be appointed by the President for a term of six years, by and with the advice and consent of the Senate. Section 153 sets out the purposes and duties of the agency, which are to assist and support the FSOC and its member agencies by:

- (1) collecting data on behalf of the Council, and providing such data to the Council and member agencies;
- (2) standardizing the types and formats of data reported and collected;
- (3) performing applied research and essential long-term research;
- (4) developing tools for risk measurement and monitoring;
- (5) performing other related services;

22. Dodd-Frank Act § 153(a)(1), 12 U.S.C. § 5343 (stating the general purposes of the Council).

23. Reed, *supra* note 19, at S496.

24. Simon Johnson, *The Disappointing Office of Financial Research*, N.Y. TIMES: ECONOMIX (Jan. 30, 2014, 12:01 AM), <https://economix.blogs.nytimes.com/2014/01/30/the-disappointing-office-of-financial-research/> [http://perma.cc/HY2R-SBQQ].

25. *Id.*

26. Dodd-Frank Act §155, 12 U.S.C. § 5345.

27. Tracy, *supra* note 18.

28. *Treasury’s Assessment Program*, OFF. FIN. RSCH., <https://www.financialresearch.gov/strategy-budget/> [https://perma.cc/M76V-9LS3].

29. This threshold was originally \$50 billion, but was raised to \$250 billion by the Economic Growth, Regulatory Relief, and Consumer Protection Act, Pub. L. No. 115-174 § 401 (2018).

30. 31 C.F.R. §§ 150.3–5 (2020).

- (6) making the results of the activities of the Office available to financial regulatory agencies; and
- (7) assisting such member agencies in determining the types and formats of data authorized by this Act to be collected by such member agencies.

The OFR is also directed to report to Congress on any emerging threats to financial stability.³¹

Section 154 of Dodd-Frank establishes two centers within the OFR: the Data Center and the Research and Analysis Center. The Data Center was designed to collect data from a variety of sources, both public and private (including other financial regulatory agencies), in order to facilitate decision-making based on more than just publicly available market information.³² The Data Center was also given specific responsibilities to create databases of financial companies and financial instruments, and to adopt formats and standards for reporting data to the FSOC.³³ The data collected is required to be shared with other financial regulatory agencies, and sharing with the financial industry and the general public is authorized where appropriate.³⁴

The Research and Analysis Center was given a number of duties under Section 154, including to study, measure, and monitor systemic risk, as well as to more generally “conduct, coordinate, and sponsor research to support and improve regulation of financial entities and markets”³⁵ and “maintain expertise in such areas as may be necessary to support specific requests for advice and assistance from financial regulators.”³⁶

B. The OFR Under the Obama Administration

After the Dodd-Frank Act was enacted in 2010, Richard Berner helped stand up the OFR; he was subsequently confirmed as its first Director at the beginning of 2013.³⁷ Almost as soon as it was created, the OFR became a target of Republican lawmakers, some of whom condemned it with hyperbolic rhetoric.³⁸ Former House Financial Services Committee Chair Jeb Hensarling, for example, described the OFR as “Big Brother.” During his tenure as Chair, the Committee released a terrifying video titled “The Office of Financial Research is Watching You,” which misleadingly told viewers that the OFR had access to their personal transaction information.³⁹ The OFR sometimes faced opposition from other financial regulatory agencies as well, a dynamic that is best

31. Dodd-Frank Act § 153(a), 12 U.S.C. § 5343.

32. Dodd-Frank Act § 154(b)(1), 12 U.S.C. § 5344.

33. *Id.* at § 154(b)(2).

34. *Id.* at § 154(b)(5)–(6).

35. *Id.* at § 154(c)(1)(C).

36. *Id.* at § 154(c)(1)(E).

37. Press Release, Off. Fin. Rsch., Richard Berner Confirmed as Director of the Office of Financial Research (Jan. 2, 2013), <https://www.financialresearch.gov/press-releases/2013/01/02/richard-berner-confirmed-as-director-of-the-office-of-financial-research/> [<https://perma.cc/WA6Y-K224>].

38. “The OFR has for years been under attack from congressional Republicans and other critics who claim the agency is unproductive, unnecessary and another form of intrusive government bureaucracy.” Pete Schroeder, *Trump Administration Cuts Staff at Financial Markets Watchdog: Source*, REUTERS (Aug. 8, 2018, 11:37 AM), <https://www.reuters.com/article/us-usa-ofr-cuts/trump-administration-cuts-staff-at-financial-markets-watchdog-source-idUSKBN1KT230> [<https://perma.cc/G4FQ-BRLX>].

39. GOP Financial Services, *The Office of Financial Research is Watching You*, YOUTUBE (Apr. 18, 2012), <https://www.youtube.com/watch?v=F1YWtiW13MM> [<https://perma.cc/FY7Z-R8L7>].

illustrated by the public spat between the SEC and the OFR over the OFR's research on systemic risks in the asset management industry.⁴⁰ Other financial regulatory agencies also reportedly refused to hand over data to the OFR, which limited its efficacy.⁴¹

The OFR thus faced significant obstacles from the moment of its founding, but it did make several notable contributions to financial stability analysis during the Obama Administration. In addition to its ongoing research on systemic vulnerabilities and support for the FSOC's designation activities, the OFR developed a number of new monitoring tools. The Financial System Vulnerabilities Monitor was designed to monitor macroeconomic, market, credit, solvency and leverage, funding and liquidity, and contagion risks, and the interplay amongst them,⁴² with the aim of generating a "heat map" that could serve as an early warning signal of potential vulnerabilities.⁴³ The Financial Stress Index was designed to provide "a daily snapshot of current stress in global financial markets."⁴⁴ These two tools were designed to give complementary perspectives on financial stability (the first looks at the system's susceptibility to shocks, the latter at the possible shocks themselves).⁴⁵

The OFR was also instrumental in developing and promoting the adoption of Legal Entity Identifiers⁴⁶ (the OFR has described these "LEIs" as "like a bar code for identifying entities that engage in financial market transactions").⁴⁷ When regulators and industry participants use the same standardized approach to identifying the counterparties to financial transactions, regulators and other government authorities will have a much clearer picture of exposures to a particular financial institution, which will allow them to better assess possible systemic risks if that institution is foundering.⁴⁸

Despite these advances, many supporters of the OFR's financial stability mission were disappointed in its output. Some of the criticisms focused on the structure of the OFR, arguing that housing the OFR within the Treasury Department politicized it, hobbled its efficacy, and made it beholden to the interests of the financial industry.⁴⁹ Others, including economist Simon Johnson, attacked the OFR for lack of ambition, arguing that a bold new perspective on systemic risk was needed but that the OFR was largely preserving the status quo.⁵⁰ (Shortly after writing that critique, Johnson joined the

40. Tracy, *supra* note 18.

41. *Id.*

42. OFF. FIN. RSCH., ANNUAL REPORT TO CONGRESS 12 (2017), <https://www.financialresearch.gov/annual-reports/files/office-of-financial-research-annual-report-2017.pdf> [<https://perma.cc/SLL5-K82E>].

43. *Id.* at 11.

44. *Id.*

45. *Id.*

46. As of 2015, the OFR had "[I]ed the creation and implementation of the global LEI system to help map connections in the financial system and cut industry costs for cleaning, aggregating, and reporting data. By the end of FY 2014, more than 300,000 LEIs had been issued to requesting institutions in 186 countries, and momentum continues to build." OFF. OF FIN. RSCH., STRATEGIC PLAN: FISCAL YEARS 2015–2019 12 (2015), <https://www.financialresearch.gov/strategy-budget/files/Office-of-Financial-Research-Strategic-Plan-2015-2019.pdf> [<https://perma.cc/BBA4-EGRK>].

47. OFF. FIN. RSCH., 2014 ANNUAL REPORT 3 (2014), <https://www.financialresearch.gov/annual-reports/files/office-of-financial-research-annual-report-2014.pdf> [<https://perma.cc/XGE3-P9EN>].

48. OFF. FIN. RSCH., LEGAL ENTITY IDENTIFIER–FREQUENTLY ASKED QUESTIONS, <https://www.financialresearch.gov/data/legal-entity-identifier-faqs/> [<https://perma.cc/TEVU-98RC>].

49. Johnson, *supra* note 24.

50. *Id.* In a similar vein, Gelzinis has commented that "[m]uch of the OFR's work has focused on the causes of the 2007–2008 financial crisis and the policy response. While this line of research is important, the

OFR's Financial Research Advisory Committee.⁵¹) Another high-profile critic of the OFR during this period was Nassim Taleb, author of the book *Black Swan*. Taleb's contention was that the OFR's analytical models, like those used by the financial industry it was charged with monitoring, could not measure the low-probability, high-consequence events (often referred to as "tail events") that usually cause financial crises.⁵² Taleb asserted further that failure to reckon with the inadequacies of these models would cause regulators to be overconfident about their ability to manage the types of risks that would generate future crashes.⁵³ A somewhat less strident variation of this critique was later articulated by law professor James Hackney,⁵⁴ who remarked upon the OFR's "belief in knowledge as the prescription for uncertainty," and warned that such an approach could create overconfidence in our capacity to predict financial crises.⁵⁵

Some of the inadequacies identified by these critics are structural in nature and could be resolved by structural reform of the OFR—a subject I will return to in Section IV.A. Others are inherent in any analysis of something as uncertain as financial stability risks. For example, overconfidence in models is always a risk, but certain regulatory approaches and organizational cultures are more likely to maintain regulators' humility about what models can and cannot predict and achieve (as will be explored in Section IV.F). Furthermore, any research agency with limited authority will seem unambitious and face challenges in justifying its output, as its results will never be as tangible as those of an agency that is designed to take more concrete actions against private sector entities. However, even the OFR's original architects were disappointed by its lack of ambition,⁵⁶ and—with the support of the FSOC and other financial regulatory agencies—there is certainly scope for the OFR to play a bigger role in financial stability regulation than it did under the Obama administration.

C. The OFR Under the Trump Administration

Unfortunately, during the Trump administration, the OFR was driven in the opposite direction, becoming less effective rather than more. Richard Berner left the OFR at the end of 2017, and the agency did not have a replacement director until Dino Falaschetti—who had previously worked on legislation to repeal the OFR⁵⁷—was sworn in on June 27, 2019. During that interim period, Treasury official Ken Phelan served as acting head

next director should place an emphasis on longer term projects that seek to look around the corner." Gregg Gelzinis, *Trump Nominee for Financial Stability Agency Sought to Eliminate It*, AM. BANKER (July 27, 2018, 10:09 AM), <https://www.americanbanker.com/opinion/trump-nominee-for-financial-stability-agency-sought-to-eliminate-it> [https://perma.cc/P2LG-CS28].

51. "From July 2014 to 2017, Johnson was a member of the Financial Research Advisory Committee of the U.S. Treasury's Office of Financial Research (OFR), within which he chaired the Global Vulnerabilities Working Group." *Simon Johnson*, MIT SLOAN SCH. MGMT., <https://mitsloan.mit.edu/faculty/directory/simon-johnson> [https://perma.cc/9M53-55XM].

52. NASSIM N. TALEB, REPORT ON THE EFFECTIVENESS AND POSSIBLE SIDE EFFECTS OF THE OFFICE OF FINANCIAL RESEARCH (OFR) 1 (2011).

53. *Id.* at 4 ("People cannot gain access to sterile information without acting on it and producing theories from it.").

54. James R. Hackney, *Regulating Through Financial Engineering: The Office of Financial Research and Pull of Models*, 50 LOY. U. CHI. L.J. 695, 703 (2019).

55. *Id.* at 709.

56. Tracy, *supra* note 18.

57. Gelzinis, *supra* note 50.

of the agency, and personnel and other resources at the agency were significantly reduced at the direction of Treasury Secretary Steven Mnuchin.⁵⁸ A round of layoffs was conducted in August of 2018,⁵⁹ and many more personnel were encouraged to leave.⁶⁰ As a result, the agency shrank from over 200 staff in 2016,⁶¹ to 96 in 2019.⁶² During this time, the OFR abandoned some of its cornerstone initiatives, like the Financial System Vulnerabilities Monitor which has not been updated since 2019.⁶³

The OFR's budget was significantly reduced during the Trump administration, at the behest of the OFR's management. While the OFR's budget for 2017 was \$92.9 million,⁶⁴ in 2018 the OFR estimated its funding needs at \$76.956 million.⁶⁵ In 2019, the OFR estimated its funding needs at \$75.271 million, stating "the Budget reflects continued reductions in OFR spending commensurate with the renewed fiscal discipline being applied across the Federal Government."⁶⁶ Because the OFR is currently funded with fees from the financial industry, these budget cuts did not benefit taxpayers broadly but instead served as a reduction in fees charged to the financial industry.⁶⁷ The OFR's budget request from 2019 also noted that "[t]he Budget . . . proposes to impose appropriate Congressional oversight of OFR functions by subjecting its activities to the normal appropriations process beginning in FY 2020."⁶⁸ Putting aside the legality of such a shift (Congressional appropriations do not seem to be anticipated by Section 155 of the Dodd-Frank Act), its advisability is certainly suspect, as I will explore in Section IV.B.

The OFR's efficacy was also undermined in other ways during the Trump Administration. The agency is designed to work hand-in-hand with the FSOC, providing the FSOC with the information and analysis it needs to take action.⁶⁹ Unfortunately, the

58. Gregg Gelzinis, *Strengthening the Regulation and Oversight of Shadow Banks*, CENT. AM. PROGRESS (Jul. 18, 2019, 12:01 AM), <https://www.americanprogress.org/issues/economy/reports/2019/07/18/471564/strengthening-regulation-oversight-shadow-banks/> [<https://perma.cc/2KNZ-Z96C>].

59. Schroeder, *supra* note 38.

60. Tracy, *supra* note 18 ("If you're not happy here, you should leave," Craig Phillips, a counselor to Treasury Secretary Steven Mnuchin, told the staff.).

61. Schroeder, *supra* note 38.

62. OFFICE OF FINANCIAL RESEARCH, ANNUAL REPORT TO CONGRESS 60 (2019), <https://www.financialresearch.gov/annual-reports/files/OFR-Annual-Report-2019.pdf> [<https://perma.cc/89HP-THUH>].

63. *Financial System Vulnerabilities Monitor*, OFF. FIN. RSCH., <https://www.financialresearch.gov/financial-vulnerabilities/#/historical-view> [<https://perma.cc/TE5A-CTBE>].

64. OFFICE OF FINANCIAL RESEARCH, ANNUAL REPORT TO CONGRESS 54 (2017), <https://www.financialresearch.gov/annual-reports/files/office-of-financial-research-annual-report-2017.pdf> [<https://perma.cc/4TCX-C8PB>].

65. OFFICE OF FINANCIAL RESEARCH, CONGRESSIONAL JUSTIFICATION FOR APPROPRIATIONS AND ANNUAL PERFORMANCE REPORT AND PLAN 3 (2018), <https://www.treasury.gov/about/budget-performance/CJ18/18.%20OFR%20-%20FY%202018%20CJ.pdf> [<https://perma.cc/D64R-EGS6>].

66. OFFICE OF FINANCIAL RESEARCH, DEPT. OF THE TREASURY, CONGRESSIONAL BUDGET JUSTIFICATION AND ANNUAL PERFORMANCE REPORT AND PLAN 3 (2019), <https://www.treasury.gov/about/budget-performance/CJ19/18.%20OFR%20-%20FY%202019%20CJ.pdf> [<https://perma.cc/APG2-3YAU>].

67. Gelzinis, *supra* note 58.

68. OFFICE OF FINANCIAL RESEARCH, DEPT. OF THE TREASURY, *supra* note 66.

69. Under the Trump Administration, the OFR has been directed to largely restrict its focus to supporting the FSOC, so a weakened FSOC makes the OFR even less useful. Greg Feldberg, *Don't Dismantle the Post-Crisis Early Warning System*, BROOKINGS (Nov. 21, 2018), <https://www.brookings.edu/research/dont-dismantle-the-post-crisis-early-warning-system/> [<https://perma.cc/C6SK-U5QZ>].

FSOC was largely denuded of its primary legal weapon during the Trump Administration.⁷⁰ While the FSOC can make recommendations to financial regulatory agencies about how they should regulate systemically risky activities, this power lacks real teeth and has rarely been used.⁷¹ Instead, the FSOC's most powerful authority is to designate non-bank financial institutions and financial market utilities as systemically important and in so doing, submit them to heightened regulation by the Federal Reserve. However, under the Trump Administration, the FSOC abandoned the use of this designation power for non-bank financial institutions (although it is still in place for financial market utilities).⁷² By undermining the FSOC that would be responsible for implementing many of the fruits of the OFR's research, the ability for that research to be translated into concrete financial stability measures has also been undermined.

III. NEW CHALLENGES IN FINANCIAL STABILITY REGULATION

"Financial stability" describes a state where the institutions and markets that comprise our financial system are able to continue providing the risk management, capital intermediation, and payment services on which the broader economy relies.⁷³ Financial stability means more than just the absence of a financial crisis—it also requires a level of robustness that allows the system to absorb shocks and continue serving its socially useful functions.⁷⁴ The OFR qualifies as a financial stability regulator because it is directed to use its research functions to address the risks that arise for the system as a whole as a result of the interactions of institutional and market activities.⁷⁵ However, financial stability regulation is neither an easy nor a well-defined task: one of the better descriptions of what such regulation entails comes from Martin Hellwig, who observed that such regulators should be asking "how different developments fit together and where the unseen risks might be hidden."⁷⁶ This is in many respects a data-driven task, and therefore, one that the OFR is well suited to. However, Hellwig also cautioned that "we must recognize that systemic risk transcends the scope of macroeconomic modeling as well as the supervisors' assessments of individual institutions."⁷⁷ Thus, the OFR must be careful not to be too slavish in following its analytical models or to focus only on well-established channels for transmitting risks through the financial system. The financial

70. For a catalogue of the FSOC's limited powers, see Allen, *supra* note 5, at 1115.

71. *Id.* at 1116–19.

72. Jeremy C. Kress et al., *Why Dismantling Nonbank SIFI Regulation Is a Serious Mistake*, COLUM. L. SCH.: BLUE SKY BLOG (Dec. 19, 2018, 12:05 AM), <https://clsbluesky.law.columbia.edu/2018/12/19/why-dismantling-nonbank-sifi-regulation-is-a-serious-mistake/> [<https://perma.cc/H3BE-5BJT>] ("FSOC effectively ended entity-based nonbank SIFI regulation by October 2018.").

73. Hilary J. Allen, *What is "Financial Stability"? The Need for Some Common Language in International Financial Regulation*, 45 GEO. J. INT'L L. 929, 945–47 (2014).

74. *Id.* at 943.

75. Section 153(a) of Dodd-Frank provides that "The purpose of the [OFR] is to support the [FSOC] in fulfilling the purposes and duties of the [FSOC]," and Section 112(a)(1)(A) provides that the FSOC's purposes include "to identify risks to the financial stability of the United States that could arise from the material financial distress or failure, or ongoing activities, of large, inter-connected bank holding companies or nonbank financial companies, or that could arise outside the financial services marketplace." (codified at 12 U.S.C. § 5343 and 5322).

76. MARTIN HELLWIG, FINANCIAL STABILITY AND MONETARY POLICY 20 (2015), https://www.coll.mpg.de/pdf_dat/2015_10online.pdf [<https://perma.cc/4CCF-9CH5>].

77. *Id.* at 17.

system will never stop evolving, and new threats to that system will never stop emerging.

Financial stability now faces many new threats that either didn't exist or weren't acknowledged when the OFR was created in 2010. This Section will give a brief overview of the implications of climate change for financial stability, and the new technologies that are being incorporated into the financial industry. It will also consider the implications of technological developments for the OFR's core data collection and analysis functions. Of course, climate change and new technologies aren't the only new challenges confronting financial stability regulators. We should always remain humble about our ability to identify the next generation of systemic risks—the onset of the Covid-19 pandemic certainly stressed the financial system,⁷⁸ and so perhaps the OFR should consider hiring epidemiologists and other health experts. The pandemic is also likely to exacerbate income inequality,⁷⁹ and that inequality may ultimately turn out to pose systemic risks in and of itself⁸⁰ (although the issue of income inequality is at least one that falls within the domain of economic expertise, which is well-represented in financial regulatory agencies). This Article will focus on climate and technological change, though: it is already clear that these could generate systemic problems, and that new kinds of resources not typically found in financial regulatory agencies will be needed to mitigate such problems. Section IV will then explore how a resurrected OFR could be a solution to the resource deficiencies currently impeding our ability to deal with these emerging systemic risks.

A. Climate Change

Since the OFR was created in 2010, increasing attention has been paid to the threat that climate change may pose to the stability of our financial system. The financial system forms only one part of the broader, highly interconnected, adaptive, and complex system that is our economy. That system has social, ecological, and technological components,⁸¹ and the financial system cannot be entirely insulated from the other components—including the ecological and economic disruptions likely to be brought about by climate change. The interactions of components within complex adaptive systems are very difficult to predict,⁸² so it is difficult to say with any certainty what the precise impact of climate change on financial stability, and our economy more broadly, will be. However, policymakers and scholars have so far identified two categories of risks that have the potential to disrupt the financial system: physical risk and transition

78. Paul Tucker, *Time to Look Again at the Financial System's Dangerous Faultlines*, FIN. TIMES (Jan. 19, 2021), <https://www.ft.com/content/0d848d03-7d66-4a76-a4f2-8f09980747fa> [<https://perma.cc/7HFA-B3D3>].

79. See, e.g., Noah Smith, *Six Ways the Coronavirus Will Make Inequality Worse*, BLOOMBERG (May 13, 2020), <https://www.bloomberg.com/opinion/articles/2020-05-13/six-ways-coronavirus-will-make-u-s-inequality-worse> [<https://perma.cc/9G7D-YA3D>].

80. See Atif Mian et al., *Indebted Demand*, 136 Q.J. ECON. 2243, 2267–68 (2021), <https://academic.oup.com/qje/article/136/4/2243/6164883> [<https://perma.cc/JSK9-QX3N>] (although the issue of income inequality is at least one that falls within the domain of economic expertise, which is well-represented in financial regulatory agencies).

81. For a discussion of SETS, see generally J.B. Ruhl, *Governing Cascade Failures in Complex Social-Ecological-Technological Systems: Framing Context, Strategies, and Challenges*, 22 VAND. J. ENT. & TECH. L. 407 (2020).

82. CHARLES PERROW, *NORMAL ACCIDENTS: LIVING WITH HIGH-RISK TECHNOLOGIES* 5 (1999) (ebook).

risk.⁸³

The Financial Stability Board, an influential international body that monitors threats to financial stability, has defined physical risk as “the possibility that the economic costs and financial losses from the increasing severity and frequency of extreme climate change-related weather events might erode the value of financial assets, and/or increase liabilities.”⁸⁴ Physical risks are most obviously of concern to the insurance industry, but they could also affect property that serves as collateral for loans if such property is threatened by rising seas, fires, hurricanes, or any other manner of extreme weather or lasting environmental change.⁸⁵ If collateral proves to be vulnerable, the financial institutions that extended the secured loans could find themselves exposed to significant losses in the event of borrower default—and borrower default could be made more likely by climate-related uncertainties (including an inability to renew insurance policies on the collateral property).⁸⁶ While we are not able to predict with specificity any events that will generate such physical risks, the possibility of some form of physical risk manifesting—and of having unexpected spillover effects—is sufficiently high that climate change should be of significant interest to financial stability regulators.

The Financial Stability Board characterizes transition risks as those relating “to the process of adjustment towards a low-carbon economy, including shifts in policies designed to mitigate and adapt to climate change, which would affect the value of financial assets and liabilities.”⁸⁷ Investments in and loans to fossil fuel-related businesses are obvious candidates for assets that would be vulnerable to policy shifts regarding carbon-producing activities, as are commodity swaps. However, we may ultimately be surprised by seemingly unrelated assets suffering from transition risks—the spillover effects of a global phenomenon like climate change response are likely to produce unexpected correlations amongst asset classes.⁸⁸ Policy shifts with regard to these assets will not necessarily be gradual: should these assets be compromised by swift political action (which may come on the heels of a manifestation of physical risk), the financial institutions that invested in them could fail.⁸⁹ And government policy is not the only potential source of transition risk. Assets could also be compromised following the invention of a new and superior green technology that quickly renders existing industries obsolete, or by retail investors’ increasing focus on environmental issues and subsequent rejection of carbon-intensive industries.⁹⁰

83. See e.g., Steele, *supra* note 2, at 115 (noting, in the climate change context, “the leading analyses largely focus on physical risk and transition risks”).

84. FIN. STABILITY BD., *supra* note 2, at 2.

85. *Id.* at 7.

86. Steele, *supra* note 2, at 115, 119.

87. FIN. STABILITY BD., *supra* note 2, at 2.

88. Steele, *supra* note 2, at 129.

89. “Carbon emissions have to decline by 45% from 2010 levels over the next decade in order to reach net zero by 2050. This requires a massive reallocation of capital. If some companies and industries fail to adjust to this new world, they will fail to exist.” Mark Carney, Governor of Bank of Eng., *Open Letter on Climate-Related Financial Risks*, BANK OF ENG. (Apr. 17, 2019), <https://www.bankofengland.co.uk/news/2019/april/open-letter-on-climate-related-financial-risks> [<https://perma.cc/3CCL-AFBY>].

90. On the subject of changing investor preferences, see generally Michal Barzuza et al., *Shareholder Value(s): Index Fund ESG Activism and the New Millennial Corporate Governance*, 93 S. CAL. L. REV. 1243 (2020).

If a systemically important insurer or lender were to fail because of its exposure to physical or transition risks, its contractual counterparties would be harmed, and perhaps even fail themselves, potentially dragging down *their* counterparties like dominos.⁹¹ Because contractual relationships amongst financial institutions can serve as transmission belts that spread problems throughout the financial system, financial stability regulation typically focuses on the largest financial institutions that are more likely to have contractual relationships with other financial institutions.⁹² However, the simultaneous failure of many smaller financial institutions could have a similarly systemic impact.⁹³ Financial institutions (large and small) are unlikely to simply accept the inevitability of failure, though. In an attempt to preserve their solvency, financial institutions that had invested in the affected assets would seek to sell them off *en masse*, which would put further downward pressure on the price of such assets, potentially requiring still more institutions to divest of their holdings in a vicious cycle sometimes referred to as a “fire sale externality.”⁹⁴ If assets compromised by physical or transition risks were to become impossible to sell because of uncertainty as to their value, strapped financial institutions could then be forced to sell off other types of assets in order to remain solvent, transmitting the panic to other markets and instigating more fire sales.⁹⁵

As financial institutions become compromised through these channels, their ability to provide the capital intermediation services on which the broader economy depends, most notably the provision of credit, is also compromised.⁹⁶ The financial system also provides important “plumbing” services, such as the processing of payments and trades, that are essential to economic growth. The physical infrastructure involved in providing these types of financial services is vulnerable to extreme weather events, and this is another potential (but often overlooked) source of systemic risk.⁹⁷ Operational problems are usually considered to be idiosyncratic problems for the institution experiencing them, with few spillover effects. However, if an extreme weather event were to cause a piece of financial infrastructure to fail, those who typically use the compromised infrastructure may switch to alternative infrastructures, and in doing so overload the alternatives, forcing more users to overload any remaining alternatives in yet another vicious cycle.⁹⁸ To get a sense of the infrastructure that is vulnerable to overloading, regulators would

91. Regarding the transmission of risks by institutions, see Steven L. Schwarcz, *Systemic Risk*, 97 GEO. L.J. 193, 201 (2008).

92. Regulatory capital requirements, for example, are higher for the largest banks because of the heightened risk they pose to financial stability. See *2019 List of Global Systemically Important Banks (G-SIBs)*, FIN. STABILITY BD. (Nov. 22, 2019), <https://www.fsb.org/wp-content/uploads/P221119-1.pdf> [<https://perma.cc/JVP8-9FZN>]

93. “[T]he weakest link in the financial stability chain might be *small*, rather than large, financial intermediaries.” Eric S. Rosengren, President & CEO of the Federal Reserve Bank of Boston, Keynote Remarks at the Stanford Finance Forum, Graduate School of Business, Stanford University: Defining Financial Stability, and Some Policy Implications of Applying the Definition 9 (Jun. 3, 2011), <https://www.bostonfed.org/news-and-events/speeches/defining-financial-stability-and-some-policy-implications-of-applying-the-definition.aspx> [<https://perma.cc/J62E-RTC4>].

94. For a discussion of fire sale dynamics, see Kashyap, *supra* note 12.

95. *Id.*

96. Ben S. Bernanke, *The Real Effects of Disrupted Credit: Evidence from the Global Financial Crisis*, 2018 BROOKINGS PAPERS ON ECON. ACTIVITY 251.

97. Christina Parajon Skinner, *Central Banks and Climate Change*, 74 VAND. L. REV. 1301, 1315 (2021).

98. For a discussion of cascading operational failures in the financial system, see Hilary J. Allen, *Payments Failure*, 62 B.C. L. REV. 453, 469 (2021).

need to review the business continuity plans of individual financial institutions in order to determine the steps they plan to take in the event of an outage. Unfortunately, “[t]here is no single financial regulator with sight lines into the IT infrastructure of the entire financial sector or umbrella jurisdiction to address the sectoral threat.”⁹⁹

Despite the urgency of climate change and its potential impact on financial stability, financial regulators in the United States were conspicuously hesitant to confront these issues during the Trump Administration.¹⁰⁰ Instead, financial stability risks associated with climate change were largely left to the private markets to manage—but private market participants lack incentives to promote the stability of the financial system, even if they know enough about the climate-related risks at hand to quantify and price them (which they often do not).¹⁰¹ There were, however, more concerted efforts to manage climate-related financial stability threats at the international level during this period. For example, a network of central banks and financial regulators known as the Network for Greening the Financial System (“NGFS”) promulgated recommendations for addressing climate-related systemic risks. These recommendations encourage regulators to “collaborate to bridge the data gaps to enhance the assessment of climate-related risks” and “build in-house capacity and share knowledge with other stakeholders on management of climate-related financial risks.”¹⁰² The first and most concrete of the NGFS’s recommendations is to “integrate the monitoring of climate-related financial risks into day-to-day supervisory work, financial stability monitoring and board risk management.”¹⁰³

In December of 2020, the Federal Reserve finally joined the NGFS,¹⁰⁴ and it now seems increasingly likely that physical and transition risks will be reflected in calculations of capital and margin requirements for climate change-affected assets.¹⁰⁵ Stress tests that incorporate climate scenarios are also a likely tool for assessing how resilient financial institutions are to those risks.¹⁰⁶ New types of expertise, particularly

99. Jeremy C. Kress et al., *Regulating Entities and Activities: Complementary Approaches to Nonbank Systemic Risk*, 92 S. CAL. L. REV. 1455, 1520 (2019).

100. Steele, *supra* note 2, at 152.

101. For further elaboration on this point, see generally Madison Condon, *Market Myopia’s Climate Bubble*, UTAH L. REV. (forthcoming 2021).

102. Carney, *supra* note 89.

103. *Id.*

104. Press Release, Bd. of Governors of the Fed. Rsr. Sys., Federal Reserve Board Announces It Has Formally Joined the Network of Central Banks and Supervisors for Greening the Financial System, or NGFS, as a Member (Dec. 15, 2020), <https://www.federalreserve.gov/newsevents/pressreleases/bcreg20201215a.htm> [<https://perma.cc/VH8Q-749W>].

105. At least for financial institutions operating in the EU, “the financial industry is well aware that bank capital requirements will soon reflect climate risk, even though regulators themselves haven’t yet spelled out their intentions.” Frances Schwartzkopff, *A Warming Planet Is about to Revolutionize How Banks Define Risk*, FIN. POST (May 31, 2021), <https://financialpost.com/commodities/energy/oil-gas/a-warming-planet-is-about-to-revolutionize-how-banks-define-risk> [<https://perma.cc/WS6V-YXUF>].

106. Gregg Gelzinis & Graham Steele, *Climate Change Threatens the Stability of the Financial System*, CTR. FOR AM. PROGRESS (Nov. 21, 2019), https://cdn.americanprogress.org/content/uploads/2019/11/20072438/Climate-Change-Financial-Stability-brief.pdf?_ga=2.190241067.187054642.1601052962-604474383.1601052962 [<https://perma.cc/HJ7D-79CE>]; *The 2021 Biennial Exploratory Scenario on the Financial Risks from Climate Change*, BANK OF ENG. (Dec. 18, 2019), <https://www.bankofengland.co.uk/paper/2019/biennial-exploratory-scenario-climate-change-discussion-paper> [<https://perma.cc/B9NR-MYSB>].

the involvement of climate scientists and environmental economists, will be needed in order to devise new capital and margin requirements and create climate-related stress test scenarios.¹⁰⁷ Because attempts to understand the interplay of extreme weather events and financial panics will necessitate an appreciation of how complex adaptive social-ecological-technological systems behave, expertise in complexity science will also be helpful in refining these regulatory strategies. For example, complexity scientists would probably counsel against implementing regulatory capital requirements that are tied too closely to particular physical and transitional risks, because we lack precise information about the likely consequences and feedback effects of those risks occurring. Instead, simpler rules that require financial institutions to fund themselves with more equity overall are likely to be a better response to the general uncertainty surrounding climate-related threats to financial stability.¹⁰⁸

Capital and margin regulations are long-standing regulatory tools for moderating risk-taking in the financial system. Stress testing has been widely embraced since the last financial crisis. However, climate change may also require *sui generis* approaches to financial stability regulation. Steele, for example, has suggested that limitations on financial institutions' portfolios of carbon-related assets, or divestiture orders for such assets, may be appropriate.¹⁰⁹ Such moves would be politically divisive, and as such should be grounded in strong scientific analysis. Scientific expertise will similarly be required if the Federal Reserve seeks to actively promote the greening of our economy by following the lead of other central banks and investing in "green" bonds while divesting of bonds issued by high emission jurisdictions¹¹⁰—both in order to value those investments and to justify the Federal Reserve's policy.¹¹¹

B. Fintech

In addition to grappling with the realities of climate change, financial regulators face another new regulatory challenge in the form of fintech innovation. The fintech revolution has been characterized by the adoption of new technologies—most notably, distributed ledger technology and machine learning.¹¹² Distributed ledger technology is the technology underlying the cryptoassets that have exploded in popularity in recent years. At its core, a distributed ledger is a record of transactions that is hosted by a dispersed group of computers or servers.¹¹³ This makes the ledger more robust, unharmed even if an individual server fails, and it is crucial that the ledger be robust because it is not only a record of crypto transactions, it is also needed to process them.¹¹⁴

107. Gelzinis & Steele, *supra* note 106.

108. Andrew G. Haldane, Exec. Dir., Fin. Stability, Bank of Eng. & Vasileios Madouros, Economist, Bank of Eng., Speech at the Federal Reserve Bank of Kansas City's 366th Economic Policy Symposium, The Changing Policy Landscape: The Dog and the Frisbee (Aug. 31, 2012), <https://www.bis.org/review/r120905a.pdf> [<https://perma.cc/8YAL-UNC4>].

109. Steele, *supra* note 2, at 150–51.

110. Skinner, *supra* note 97, at 8.

111. *Id.* at 67.

112. For an overview of fintech technologies, see Allen, *supra* note 1, at 166.

113. See PRIMAVERA DE FILIPPI & AARON WRIGHT, BLOCKCHAIN AND THE LAW: THE RULE OF CODE 2 (2018) (discussing the way in which blockchains operate through collective management on peer-to-peer networks).

114. CHRIS JAIKARAN, CONG. RSCH SERV., R45116, BLOCKCHAIN: BACKGROUND AND POLICY ISSUES 4–

Essentially, the transaction doesn't occur unless the ledger is updated to reflect the transaction. Each distributed ledger has its own protocol for determining which transactions will be approved and added to the ledger, with some verification procedures being much more complicated than others.¹¹⁵ Financial assets that are recorded on a distributed ledger are often governed by smart contracts: algorithms that are designed to self-execute the preprogrammed rights and obligations of the parties involved.¹¹⁶

Machine learning is a type of artificial intelligence that creates its own decision-making rules by studying large data sets and then follows those rules in executing an assigned task.¹¹⁷ The decision-making rules that are developed will depend on the data with which the algorithm is trained, so the involvement of a good data scientist is crucial to the process.¹¹⁸ The algorithm's ultimate decision-making rules will also depend on the learning approach of the algorithm itself—different types of machine learning algorithms have their benefits and drawbacks.¹¹⁹ In general, though, the probabilistic approach of machine learning means that these algorithms are likely to be flummoxed by low-probability events. Unfortunately, low-probability but high-consequence tail events are precisely the types of events that tend to trigger financial crises.¹²⁰

For a long time, the financial stability implications of these new technologies were largely ignored (although I and a few others sounded the alarm on several of their attributes).¹²¹ People are now starting to talk about the financial stability implications of cryptoassets,¹²² but the conversation about the risks involved is still pretty amorphous. One thing we should be concerned about is the speed involved: distributed ledger technology facilitates rapid, automated execution of the smart contracts hosted on those ledgers—even if forbearance were in the interest of the parties themselves, or the financial system as a whole.¹²³ Professor Pistor has observed that “the elasticity of law

5 (Feb. 28, 2018).

115. *Id.*

116. Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 DUKE L.J. 313, 333 (2017).

117. David Lehr & Paul Ohm, *Playing with the Data: What Legal Scholars Should Learn About Machine Learning*, 51 U.C. DAVIS L. REV. 653, 655 (2017).

118. For a discussion of the impact of data scientists on the working of machine learning algorithms, see *id.* at 670.

119. *Id.* at 690. For example, because machine learning algorithms make sense of data in terms of statistics and probabilities, their decisions can seem bizarre and unpredictable to humans (who tend to rely on narratives to make sense of the world). Decision-tree machine learning algorithms are somewhat better at generating outcomes that can be explained to humans, but they also have a tendency to become more tied to idiosyncrasies in their training data, which compromises their ability to work with real-world data (as well as being potentially more time-consuming and expensive to program and run). *Id.* at 693.

120. Allen, *supra* note 1, at 174.

121. *Id.*; Omarova, *supra* note 1; FIN. STABILITY BD., ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN FINANCIAL SERVICES: MARKET DEVELOPMENTS AND FINANCIAL STABILITY IMPLICATIONS 8 (2017); FIN. STABILITY BD., FINANCIAL STABILITY IMPLICATIONS FROM FINTECH: SUPERVISORY AND REGULATORY ISSUES THAT MERIT AUTHORITIES' ATTENTION (2017).

122. In its Financial Stability Report issued in May of 2021, the Federal Reserve mentioned that from February to April it had surveyed “24 market contacts, including professionals at broker-dealers, investors, political advisory firms, and academics,” and more than 20% of those surveyed identified cryptocurrencies/stablecoins as potential shocks to the financial system over the next 12-18 months. BD. OF GOVERNORS. OF THE FED. RSRV. SYS., FINANCIAL STABILITY REPORT, 62–63 (2021), <https://www.federalreserve.gov/publications/files/financial-stability-report-20210506.pdf> [<https://perma.cc/8JPL-XQJC>].

123. Allen, *supra* note 1, at 180.

has proved time and again critical for avoiding a complete financial meltdown.”¹²⁴ If the speedy self-execution of smart contracts deprives the financial system of some of that elasticity, runs and fire sales of financial assets (disruptions that have been central to past financial crises) could become more commonplace and severe.¹²⁵ The scale of such disruptions could also be increased by the ease with which cryptoassets can proliferate. As Professor Omarova has noted, “[t]he fact that . . . the underlying asset is a digital token, as opposed to shares in operating companies or barrels of oil, potentially removes any ‘natural’ limits . . . on the ability of market participants to scale up trading in these continuously synthesized cryptoassets.”¹²⁶

The complexity of the governance structures of many distributed ledgers ensures that attempts to unwind problematic transactions would take time—and perhaps come too late to avoid systemic consequences.¹²⁷ Such an unwieldy governance structure also ensures that purely technical problems with the ledger will be hard to fix; an operational problem may freeze transaction processing until sufficient nodes agree to revise the ledger’s operating code.¹²⁸ Operational risks more generally are becoming more of a financial stability issue as the technology behind the delivery of financial services becomes more complex: technological failures could overload the remaining financial market infrastructure in a cascading failure that renders the financial system unable to discharge the functions on which the broader economy relies.¹²⁹

Another financial stability risk is that machine learning can be used to make financial decisions that are coordinated on a scale that is potentially greater than ever before. Machine learning is increasingly being used internally at financial institutions, including large banks and insurers, to manage their own financial risks,¹³⁰ as well as to select investments for retail investors in a business model known as “robo-investing.”¹³¹ If countless people are relying on the same or similar machine learning algorithms exposed to the same or similar data, then they may all deal with similar financial assets in the same or similar ways.¹³² Pre-existing tendencies towards herd behavior can therefore be exacerbated, with runs and fire sales potentially operating on a greater scale than we saw during 2008. Such coordinated behavior is likely to be particularly pernicious during low-probability but high-consequence tail events, which machine learning algorithms typically underestimate.¹³³

Thus far, these types of risks have not received enough attention. Many think of

124. Katharina Pistor, *A Legal Theory of Finance*, 41 J. COMPAR. ECON. 315, 321 (2013).

125. Allen, *supra* note 1, at 182.

126. Omarova, *supra* note 1, at 775.

127. Allen, *supra* note 1, at 180–82.

128. Allen, *supra* note 98, at 502.

129. *Id.* at 469.

130. A recent global survey of the use of artificial intelligence in financial services found that “Risk management is the usage domain with the highest current AI implementation rates” CAMBRIDGE CTR. ALT. FIN. & WORLD ECON. F., TRANSFORMING PARADIGMS: A GLOBAL AI IN FINANCIAL SERVICES SURVEY 11 (2020), http://www3.weforum.org/docs/WEF_AI_in_Financial_Services_Survey.pdf [<https://perma.cc/8VWF-ACVR>].

131. See Ayn de Jesus, *Robo-Advisors and Artificial Intelligence—Comparing 5 Current Apps*, EMERI (Nov. 24, 2019), <https://perma.cc/RS3A-J5VC> (providing a general background on robo-advisor firms).

132. Rory Van Loo, *Making Innovation More Competitive: The Case of Fintech*, 65 UCLA L. REV. 232, 235, 251 (2018).

133. Allen, *supra* note 1, at 185–86.

these technologies, and of fintech in general, as the exclusive province of small startup companies—and therefore as “too small to care.”¹³⁴ This lack of concern is misguided, though, and potentially dangerous; these technologies are increasingly being used throughout the financial industry, including by the largest and most systemically important financial firms.¹³⁵ J.P. Morgan, for example, developed a “JPM Coin” that is a cryptoasset that operates on a distributed ledger¹³⁶ and recently started using JPM Coin to process repo transactions.¹³⁷ BlackRock is incorporating machine learning into its risk management offerings, which are relied upon by large numbers of financial institutions.¹³⁸ Financial regulators cannot regulate these technologies unless they understand them, and as I have argued previously, regulatory interventions will increasingly have to take a technological form¹³⁹—a phenomenon that is coming to be known as “suptech.”

Suptech (a portmanteau of “supervisory technology”) refers to innovation by financial regulators that is informed by the same technological advances—like machine learning and distributed ledger technology—that are integral to fintech products and services being produced by the private sector.¹⁴⁰ While much of the experimentation with suptech has so far been reactive, in the sense that it is being developed in order to help regulators process the voluminous amounts of data now being reported by financial institutions and markets,¹⁴¹ it could and should also take a more proactive form in the future. Of the proactive experimentation that we’ve seen so far, most has been oriented towards real-time detection of fraud and money laundering.¹⁴² There has been very

134. The term “too small to care” was coined in Douglas W. Arner et al., *FinTech, RegTech, and the Reconceptualization of Financial Regulation*, 37 NW. J. INT’L L. & BUS. 371, 403 (2017). The term is a play on, and the opposite of, the concept of “too big to fail.”

135. “The finance sector is one of the keenest investors in emerging technology. Just shy of two-thirds (64 percent) of financial services leaders expect to be mass AI adopters within the next two years. The industry is also ahead of others with blockchain—enabling faster processing and quicker settlement of trades.” Jia J. Low, *Developers Now Make Up a Quarter of Goldman Sachs’ Workforce*, TECHHQ (Feb. 14, 2020), <https://techhq.com/2020/02/developers-now-make-up-quarter-of-goldman-sachs-workforce/> [<https://perma.cc/5LS4-SYB7>].

136. See *J.P. Morgan Creates Digital Coin for Payments*, J.P. MORGAN (Feb. 1, 2021), <https://www.jpmorgan.com/global/news/digital-coin-payments> [<https://perma.cc/9YZH-3D5C>] (announcing in 2019 that “J.P. Morgan became the first global bank to design a network to facilitate instantaneous payments using blockchain technology . . .”).

137. Sebastian Sinclair, *Goldman Sachs Taps JPMorgan’s Private Blockchain for Repo Trade: Report*, COINDESK (Jun. 22, 2021), <https://www.coindesk.com/markets/2021/06/22/goldman-sachs-taps-jpmorgans-private-blockchain-for-repo-trade-report/> [<https://perma.cc/8HWN-A644>]. “Repurchase agreements, or repos for short, are a type of loan where financial institutions sell collateralized securities in a contract only to buy them back at an inflated price at some other date, usually overnight.” *Id.* For a discussion of the fragilities associated with repos, see Gorton & Metrick, *supra* note 11.

138. See *Artificial Intelligence and Machine Learning in Asset Management*, BLACKROCK (Oct. 2019), <https://www.blackrock.com/corporate/literature/whitepaper/viewpoint-artificial-intelligence-machine-learning-asset-management-october-2019.pdf> [<https://perma.cc/J2YR-7AS9>] (discussing the benefits of AI and ML from both an operational efficiency and client/portfolio perspective).

139. See generally Hilary J. Allen, *Experimental Strategies for Regulating Fintech*, 3 J.L. & INNOVATION 1, 28 (2020).

140. *Id.* at 26.

141. See Simone di Castri et al., *The Suptech Generations*, 19 FIN. STABILITY INST. 1, 16 (2019), <https://www.bis.org/fsi/publ/insights19.pdf> [<https://perma.cc/8DRD-EMZX>] (finding “[s]uptech tools are applied mainly in misconduct analysis, reporting and data management”).

142. *Id.* at 11–12.

limited experimentation with using supotech in service of financial stability. In particular, there has been no real consideration of how supotech might be used to respond to the new financial stability risks posed by fintech innovations.¹⁴³ However, there are a number of compelling use cases. For example, problems arising from the speedy self-execution of smart contracts could be addressed by programming in a circuit breaker that a regulator could trigger.¹⁴⁴ Or regulators could explore the types of machine learning algorithms and data set parameters that are more likely to take the possibility of tail events seriously and consider mandating their use.¹⁴⁵ There are undoubtedly many more opportunities in this vein.

Suptech experimentation will not be possible, however, unless financial regulators develop new types of technological expertise. Furthermore, as finance becomes more technologically driven, even the more traditional forms of financial regulation will require this technological expertise.¹⁴⁶ For example, oversight of a financial institution will be compromised if regulators don't understand the machine learning technology the institution is using to manage its risks; oversight of financial markets will be compromised if regulators don't understand how distributed ledgers validate and process transactions. Without expertise of their own, regulators will become increasingly beholden to the industry's own explanations of how the technology works—a trend that can cause regulators to internalize the industry's positive attitude towards the technology and neglect its risks.¹⁴⁷

C. Data Problems

The previous Part offered a snapshot of financial stability risks emerging from new technologies. In addition to creating new risks, technological change is also undercutting the OFR's core functions of data collection and analysis. The private sector is increasingly adopting “technologies that could revolutionize the collection, management, sharing, and dissemination of financial data,”¹⁴⁸ and regulators will need to develop their own technological expertise if they want to continue to be able to access and analyze private sector data in the future.¹⁴⁹ The technological prowess of U.S. financial regulators

143. Allen, *supra* note 139, at 28–29.

144. Allen, *supra* note 1, at 197.

145. *Id.* at 200.

146. Saule T. Omarova, *Technology v. Technocracy: Fintech as a Regulatory Challenge*, 6 J. FIN. REG. 75, 97 (2020) (discussing the speed/velocity challenge facing the financial system).

147. See Hilary J. Allen, *A New Philosophy for Financial Stability Regulation*, 45 LOY. U. CHI. L.J. 173, 223 (2013) (arguing regulators should take a precautionary approach to the information they receive from the financial industry).

148. GREG FELDBERG, BROOKINGS, *FIXING FINANCIAL DATA TO ASSESS SYSTEMIC RISK 5* (2020), <https://www.brookings.edu/wp-content/uploads/2020/12/ES-12.4.20-Feldberg.pdf> [<https://perma.cc/WH27-8MW9>].

149. For example, in assessing loans, some lenders have mentioned using:

information drawn from bank account transactions such as utility or rent payments, other recurring transactions, and electronic records of deposit and withdrawal transaction. Other items mentioned include insurance claims, credit card transactions, consumer's occupation or details about their education, their use of mobile phones and related activities, Internet footprints, online shopping habit, investment choice, and so on.

Julapa Jagtiani & Catharine Lemieux, *The Roles of Alternative Data and Machine Learning in Fintech Lending: Evidence from the LendingClub Consumer Platform*, (Fed. Rsr. Bank Phila., Working Paper No. 18-15, Rev.

is already falling behind that of their foreign counterparts, as well as the private sector.¹⁵⁰ Because technological advances are occurring at an exponential rate, U.S. regulators may struggle to catch up if they wait too long to start using new technological tools to engage with data.¹⁵¹

The financial crisis of 2007–08 provided abundant examples of the problems that can flow from inadequate data collection and analysis, but there have been more recent illustrations as well. As an example, we can consider the chaos in the U.S. Treasuries market that followed the onset of the Covid-19 pandemic in March 2020. As Professor Yesha Yadav describes it,

[T]he-then \$17 trillion market for U.S. government bonds (‘Treasuries’) was brought to the brink of failure. Because investors rely on Treasuries to keep them safe during crises, the potential collapse of Treasuries presented an unthinkable doomsday scenario for global markets and the U.S. economy Facing the possibility that this unshakable market could fail, the Federal Reserve (the Fed) stepped in with over one trillion dollars of immediate stabilizing support.¹⁵²

Without a clear picture of which financial institutions were selling Treasuries or which were significantly exposed (directly or indirectly) to the turbulence in the Treasuries market, the Federal Reserve was left to follow a “one-size-fits-all” emergency response playbook, offering wide-ranging support to the financial markets in order to avoid financial instability.¹⁵³ Greg Feldberg, a former OFR economist, has argued that with better data, a more targeted and effective response might have been possible.¹⁵⁴ In any event, efforts to understand what happened—and to prevent it from happening again—have been undermined by a lack of data. As a result, confidence in the Treasuries market has been undermined, which is highly problematic given the importance of the market to the stability of the financial system.¹⁵⁵

To maximize their ability to detect and respond to systemic risks in the future, financial regulators will need to be able to access and share the data necessary to mitigate risks to the financial system—ideally in real-time.¹⁵⁶ This will require standardization of data reporting formats across different regulatory agencies as well as across different industries in the private sector.¹⁵⁷ Importantly, it will also necessitate ways of keeping

2019), <https://www.philadelphiafed.org/-/media/research-and-data/publications/working-papers/2018/wp18-15r.pdf> [<https://perma.cc/82LE-PDJS>].

150. FELDBERG, *supra* note 148.

151. JO ANN BAREFOOT, ALL. FOR INNOVATIVE REGUL., A REGTECH MANIFESTO: REDESIGNING FINANCIAL REGULATION FOR THE DIGITAL AGE 21 (2020) (predicting that “[r]egulation will lag even-further behind unless the regulatory system can, itself, achieve exponential rates of change They will face the regulatory equivalent of fixing an airplane while flying it.”).

152. Yesha Yadav, *The Failed Regulation of U.S. Treasury Markets*, 121 COLUM. L. REV. 1173, 1175–76 (2021) (emphasis added) (citations omitted).

153. FELDBERG, *supra* note 148, at 4–5.

154. *Id.*

155. “Treasury market disruptions of this kind are alarming for two reasons: (1) Treasury markets constitute the recognized systemic bulwark against risk and uncertainty, designed to provide a safe haven in turbulent times; and (2) their workings interconnect deeply with other markets like those for equities, bonds, and derivatives.” Yadav, *supra* note 152, at 1230.

156. BAREFOOT, *supra* note 151, at 31.

157. FELDBERG, *supra* note 148, at 10.

data secure even as it is shared.¹⁵⁸ In many instances, this will require technological innovation that is a departure from legacy data collection and reporting systems. In a document titled “The Regtech Manifesto,” JoAnn Barefoot has called for the creation of a “digitally-native” approach to financial regulation that is free of the baggage of these legacy systems.¹⁵⁹ She describes the digitally-native approach as what “we would adopt if we could start with a clean slate and use today’s vast data and powerful analytical technology, which did not exist when the current systems were put in place.”¹⁶⁰ Regulators cannot devise an innovative data collection and analysis system, however, without the necessary technical expertise.

IV. REBUILDING THE OFR

While the OFR’s ability to analyze and research threats to financial stability was undermined by staffing and budget cuts during the Trump Administration, the Biden Administration now has the opportunity to rebuild the OFR. This Part will consider how to resurrect the agency in a way that will not only fulfill the potential envisaged by the OFR’s initial proponents but also address some of the pressing new problems that financial regulators are facing. The OFR already has the legal authority to engage in the technological and climate-related research activities proposed in this Article.¹⁶¹ The most significant challenges lie in ensuring support from other parts of the government, amassing resources, and building the necessary organizational culture. This Part will engage with these issues.

With the benefit of the expertise of climate scientists (and environmental economists), the OFR’s traditional role as data gatherer could be expanded to identify and address gaps in the data available on climate-related risks, and it could also help develop analytical methods to assess vulnerabilities using that data.¹⁶² For example, the OFR could take the lead in developing climate-related hypothetical scenarios to facilitate stress testing of the resilience of individual financial institutions and the system as a whole to physical and transition risks.¹⁶³ In addition, a Financial Stability Board survey identified that there is a lack of data readily available about the physical location of assets, and that this data is necessary for assessing physical risks.¹⁶⁴ Just as the OFR took a leading role in the LEI project, helping to create an international standard for references to financial entities, the OFR could spearhead a project to standardize reporting of asset locations around the world.

158. *Id.* at 4.

159. BAREFOOT, *supra* note 151, at 11.

160. *Id.*

161. The OFR is authorized to engage in “performing applied research and essential long-term research” by Section 153(a)(3) of Dodd-Frank (these activities could alternatively be characterized as “performing other related services,” as authorized by Section 153(a)(5) of Dodd-Frank). More specifically, the OFR’s Research and Analysis Center is authorized by Section 154(c)(1)(C) of Dodd-Frank to “maintain expertise in such areas as may be necessary to support specific requests for advice and assistance from financial regulators.” (codified as 12 U.S.C. §§ 5343–5344).

162. For a discussion of the need for new data and analytical methods to respond to climate-related financial risks, see FIN. STABILITY BD., FSB ROADMAP FOR ADDRESSING CLIMATE RELATED FINANCIAL RISKS (2021).

163. Carney, *supra* note 89.

164. FIN. STABILITY BD., *supra* note 2, at 13.

The OFR could also spearhead a similar project to create internationally consistent identifiers for technology vendors, who are becoming increasingly critical to the provision of financial services with the rise of fintech.¹⁶⁵ A revitalized OFR could also serve as a hub of expertise about machine learning and distributed ledger technology, as well as other new fintech innovations that are bound to evolve. Andrew Tutt has argued for a centralized, subject-matter agnostic “FDA for Algorithms” because “[m]achine-learning algorithms will pose systematic, complex challenges that will transcend the technology with which they are associated,” and “[p]lacing regulatory jurisdiction in multiple agencies would only make the problems of tunnel vision, random agenda selection, and inconsistency more acute.”¹⁶⁶ While it is not entirely clear that oversight of financial algorithms should be conducted by the same agency that oversees the algorithms used in, say, airplanes, Tutt’s arguments certainly are compelling, and militate for at least concentrating expertise regarding *financial* algorithms in a single regulatory body. With expertise in machine learning and other new technologies (and with the support of other regulatory agencies), the OFR would be well-placed to spearhead the development of new approaches to the collection and use of financial data that are usable throughout the financial system.¹⁶⁷

Currently, though, many of the employees in financial regulatory agencies do not have any background in mathematics or statistics, let alone in the climate science, complexity science, software engineering, or data science fields necessary to fully grasp and respond to the current generation of financial stability risks. Unfortunately, these types of expertise are both new and “hot,” so there are limited personnel available with the necessary skills, and competition even within the private sector is fierce.¹⁶⁸ It simply does not seem feasible for each of the many financial regulatory agencies in the United States to hire their own cadre of climate specialists, data scientists, complexity scientists, and software engineers, and attempts to try to staff these positions with specialists willing to work for government salaries may ultimately lead to regulatory agencies continually poaching from one another.¹⁶⁹ However, it might be feasible for the OFR to develop a hub of this kind of expertise. The OFR would still have to compete with the private sector for talent, but at least it wouldn’t have to compete with the other financial regulatory agencies.

Although some financial regulatory agencies have already implemented innovation hubs (like the CFTC’s LabCFTC and FDITECH at the FDIC),¹⁷⁰ simply hiring a few

165. For a discussion of the financial stability concerns relating to increased use of vendors, see FIN. STABILITY BD., REGULATORY AND SUPERVISORY ISSUES RELATING TO OUTSOURCING AND THIRD-PARTY RELATIONSHIPS (2020).

166. Andrew Tutt, *An FDA for Algorithms*, 69 ADMIN. L. REV. 83, 114 (2017).

167. See FELDBERG, *supra* note 148, at 4 (calling for the Biden Administration to prioritize financial data collection, regulation, and management).

168. Yueh-Ping (Alex) Yang & Cheng-Yun Tsang, *RegTech and the New Era of Financial Regulators: Envisaging More Public-Private Partnership Models of Financial Regulators*, 21 U. PA. J. BUS. L. 354, 360–61 (2018).

169. For example, in 2014, the head of the OCC’s quantitative analyst staff said that “his team recently poached a senior quant from another agency.” Lauren Tara LaCapra, *Exclusive: U.S. Banking Regulators Hire Math Geeks of their Own*, REUTERS (May 8, 2014, 3:08 PM), [https://perma.cc/74NF-HJVK].

170. See, e.g., *LabCFTC Overview*, CFTC, <https://www.cftc.gov/LabCFTC/Overview/index.htm> [https://perma.cc/4BKQ-TUJ4]; *Why FDITECH*, FDITECH, <https://www.fdic.gov/fditech/index.html> [https://perma.cc/TF27-A372].

tech experts per hub will not resolve the expertise deficit identified in this Article. Even in the private sector, there is sometimes a disconnect between the people who have specialized expertise and those who lack it. For example, in one survey conducted in the aftermath of the 2008 crisis, two-thirds of quants (quantitative analysts who use complex mathematical models to calculate risks and price assets) working in the financial industry felt that their supervisors did not understand the work that they did.¹⁷¹ That disconnect with specialists will certainly persist in financial regulatory agencies, particularly if the few technical experts there are surrounded primarily by lawyers, accountants, and economists.¹⁷²

As then-Professor Warren and Professor Bar-Gil explored in the law review article that spawned the creation of the Consumer Financial Protection Bureau, when a particular regulatory activity does not gel with an agency's own perception of its mission and how it should be discharged, that activity will be largely ignored.¹⁷³ Scientists and technologists embedded in larger agencies may therefore find their work undermined, and the reverse is also possible. Professor Omarova has argued that if software engineers, data scientists, and other technologists become too prominent within our existing financial regulatory agencies, that "may dangerously weaken individual agencies' institutional cohesion and their ability to foster a strong mission-focused culture."¹⁷⁴ These issues can be addressed, or at least mitigated, if the technical expertise is concentrated in a single body like the OFR, with other financial regulatory agencies remaining focused on their primary missions.

Concentrating expertise in the OFR will also have other salutary effects. A contributing cause of the 2008 crisis, and an impetus for the creation of the OFR (and FSOC) in the first place, was the silo mentality that encouraged individual regulatory agencies to ignore threats emerging outside of their immediate jurisdiction. If new types of experts were to be scattered amongst the different financial regulatory agencies, collaboration would be cumbersome and the silo mentality might persist.¹⁷⁵ By instead consolidating new forms of expertise in a body like the OFR that is highly attuned to systemic issues, it is less likely that those experts will miss cross-cutting issues that could impact disparate parts of the financial system.¹⁷⁶

171. See *Quants Say Bosses Don't Understand Them*, FINEXTRA (Nov. 4, 2009), <https://www.finextra.com/news/fullstory.aspx?newsitemid=20697> [<https://perma.cc/U6HR-PEVD>] (reporting on a survey polling almost 400 quants and risk professionals). For a further discussion of disconnects between quants and their supervisors, see Thomas H. Davenport, *Keep Up with Your Quants*, HARV. BUS. REV., July–Aug. 2013, <https://hbr.org/2013/07/keep-up-with-your-quants> [<https://perma.cc/HL33-VFQU>].

172. Omarova, *supra* note 146, at 101.

173. See Oren Bar-Gill & Elizabeth Warren, *Making Credit Safer*, 157 U. PA. L. REV. 1, 90–91 (2008) (arguing that banking agencies are charged with maintaining bank profitability and thus first and foremost concerned with the interests of banks rather than their customers).

174. Omarova, *supra* note 146, at 101.

175. See BAREFOOT, *supra* note 151.

The multiple federal financial agencies in the U.S. have several formal channels for routine communication and cooperation, but most of their work happens within their individual agency walls. This is partly because it is easier, and usually faster, for each to do things alone. It is also due to their varying histories, missions and cultures, including deep organizational pride at all of these entities.

Id. at 80.

176. Tutt, *supra* note 166, at 117.

Developing a strong corpus of interdisciplinary expertise in the OFR can also help combat regulatory capture. In the absence of such expertise, regulators may become beholden to the industry's explanations of how it will be affected by climate change and how machine learning and distributed ledger technologies work. Not only does this dependence make it very challenging for regulators to identify budding systemic risks; it can also encourage them to take on the worldview of those doing the explaining—perhaps to the point where they start to prioritize the interests of the industry they regulate over the interests of the public they serve.¹⁷⁷ Some degree of capture is perhaps inevitable—even when regulators have the relevant expertise, they may be dazzled into deference by the wealth and credentials of private-sector experts.¹⁷⁸ Regulators who lack the necessary expertise (or who are undermined by other regulators who lack the necessary expertise) are likely to be much more susceptible, though.

A. Structure

In order to make the OFR an effective expertise hub, structural changes should be pursued to make the OFR more independent. Political independence has traditionally been seen as important for financial regulatory agencies because “when elected politicians are given free rein, they often choose policies that confer short-term advantages to some key voter groups but lead to long-term harms to society at large.”¹⁷⁹ However, anger over the financial crisis of 2008 (and the regulatory failures that contributed to it) made financial regulation more politically salient, and the traditional preference for financial regulatory independence was reversed—or at least limited.¹⁸⁰ Around the world, elected officials were given more active roles in financial regulation,¹⁸¹ and the location of the OFR in the Treasury department can be seen as part of that trend.

The damage done to the OFR under the Trump Administration demonstrates all too clearly, though, the perils of allowing political control over financial stability regulation—regulation which benefits society at large but is often strongly opposed by large and well-connected financial firms.¹⁸² Even in less extreme political situations, “[i]dentifying financial stability risks and data gaps means saying things that are unpopular. That mission requires more independence, not less.”¹⁸³ If the OFR is to truly fulfill its potential as a hub of financial stability expertise, it should be removed from the Treasury Department. Ideally, the OFR would work as a stand-alone agency, but if there is significant resistance to this, the OFR could work as an independent department within the Federal Reserve System (similar to the Consumer Financial Protection Bureau).

Removing the OFR from the Treasury Department would require legislative action—this change could be effected as part of an omnibus financial reform bill, similar

177. Allen, *supra* note 5, at 1102. For a survey on the administrative law literature on informational and cultural capture, see J. Jonas Anderson, *Court Capture*, 59 B.C. L. REV. 1543, 1560–63 (2018).

178. See James Kwak, *Cultural Capital and the Financial Crisis*, in PREVENTING REGULATORY CAPTURE: SPECIAL INTEREST INFLUENCE AND HOW TO LIMIT IT 71, 86–89 (Daniel Carpenter & David Moss eds., 2014).

179. Stavros Gadinis, *From Independence to Politics in Financial Regulation*, 101 CALIF. L. REV. 327, 340 (2013).

180. *Id.* at 344.

181. *Id.* at 332.

182. Allen, *supra* note 5, at 1102.

183. Feldberg, *supra* note 69.

in form (if not in content) to the Economic Growth, Regulatory Relief, and Consumer Protection Act passed in 2018. The same legislation could be used to make the Director of the OFR a voting member of the FSOC (currently, the Director serves as a non-voting member,¹⁸⁴ which limits their influence on financial stability policy). Such a step would afford the OFR a greater ability to shine as a stand-alone research body designed to assist *all* of the financial regulatory agencies (whereas the Trump administration treated it as a mere adjunct to, or crutch for, the FSOC).¹⁸⁵

If political support for such legislative change cannot be achieved, the OFR Director would remain a non-voting member of the FSOC, and the OFR would remain part of the Treasury Department. The existing regulatory structure is not necessarily anathema to an effective OFR, though. The OFR is already authorized by Section 153(a) of Dodd-Frank to provide direct assistance to other financial regulatory agencies, and a supportive Treasury Secretary could certainly help the OFR to fulfill its promise. A supportive Treasury Secretary could also help the OFR by rehabilitating the FSOC. Although this Article has argued that the OFR should be more than just an adjunct to the FSOC, the FSOC *is* a natural candidate for implementing much of the OFR's work. Unfortunately, the FSOC, too, was diminished under the Trump Administration.¹⁸⁶

The support of the Treasury Secretary, who serves as chair of the FSOC, is critical to the success of any attempt to revitalize it. A number of proposals have been made to strengthen the FSOC: one recent effort is the Systemic Risk Mitigation bill introduced in 2020.¹⁸⁷ This bill proposes, amongst other things, to give the FSOC a substantial staff of its own, to revitalize and bolster the FSOC's power to designate nonbank financial institutions for heightened regulation, and to give it new powers to regulate financial activities that pose a threat to financial stability.¹⁸⁸ These efforts would provide a clear path for the OFR's work to inform the regulation of private sector entities and activities. The bill also has a specific focus on climate change, calling for the establishment of a climate change subcommittee of the FSOC.¹⁸⁹ This would provide an outlet for the work of climate scientists hired by the OFR.

B. Data

This Article has already argued that regulators will need to take a more comprehensive, technologically-informed approach to data collection and analysis going forward.¹⁹⁰ Even less ambitious research activities will require that the OFR have access to data, however, and unfortunately the OFR has often had trouble accessing the data that is central to its mission.¹⁹¹ If reform legislation is enacted, it would be helpful to include

184. The Director is explicitly listed as a nonvoting member in the Dodd-Frank Act § 111(b)(2)(A) (codified as 12 U.S.C. § 5321).

185. “[T]he Trump administration refocused the Office’s mission to narrowly respond to data and analysis requests from FSOC and Treasury.” FELDBERG, *supra* note 148, at 14.

186. See *supra* notes 69–72 and accompanying text (describing how the Trump Administration gutted the FSOC).

187. Systemic Risk Mitigation Act, *supra* note 5.

188. *Id.* §§ 3–4.

189. *Id.* § 7.

190. *Supra* Part III.C.

191. “[R]egulators still do not share enough data. Each agency collects data from specific institutions and markets on a confidential basis for supervisory purposes. But those data need to be combined for the OFR and

a clear statutory direction to other financial regulators requiring them to share data with the OFR, given the difficulties that the OFR has had in obtaining such information in the past.¹⁹² Even in the absence of such a legislative amendment, though, Dodd-Frank already provides indirect authorization for the OFR to collect data from other agencies: Section 153(a)(1) directs the OFR to collect data on behalf of the FSOC, and Section 112(a)(1)(A) directs the FSOC to collect data from other agencies. The FSOC and the OFR working together could therefore compel the production of data from regulatory agencies—but suasion would be preferable and some of this Article’s other proposals might encourage agencies to be more forthcoming with their data.

A salutary side-effect of housing scientific and technological expertise in the OFR, for example, might be that it would introduce reciprocity into the OFR’s relationships with the other financial regulatory agencies. The OFR would continue to need data from them but would now be in a position to offer scientific and technological expertise in return. For example, the investor protection rules administered by the Securities and Exchange Commission will increasingly require regulators to compare disclosure documents with computer code to see if the disclosure is an accurate depiction of the code that forms the investment.¹⁹³ The consumer protection laws administered by the Consumer Financial Protection Bureau and banking regulatory agencies will increasingly require regulators to determine, amongst other things, if machine learning algorithms are discriminating against protected classes when they choose to whom and on what terms to extend credit.¹⁹⁴ The banking regulatory agencies and the Securities and Exchange Commission will soon need to mandate and review disclosures about the climate risks that banks and other securities issuers face,¹⁹⁵ and they will need expertise in climate and complexity science in order to discharge this task. A rebuilt OFR could lend expertise to assist with all of these challenges, ideally creating a more collaborative relationship amongst the agencies that promote data sharing.

In any event, to the extent that past roadblocks to data sharing amongst agencies were motivated by practicalities rather than turf wars (i.e., agencies simply hadn’t collated data in easily shared formats), there is now reason for cautious optimism. New technological developments in securing and standardizing data may allay some fears of hacking and other practical concerns about sharing data.¹⁹⁶ In addition, legislation

FSOC to track risks across markets.” Feldberg, *supra* note 69.

192. See *supra* note 41 and accompanying text. For more on this reform proposal, see Gelzinis, *supra* note 58. A provision to this effect was included in Section 5 of the proposed Systemic Risk Mitigation Act, which proposes to amend Section 153(b) of Dodd-Frank (12 U.S.C. § 5343) to “require any member agency to produce such data and other information as the Director may determine necessary to carry out the duties of the Office.” Systemic Risk Mitigation Act, *supra* note 5.

193. For a discussion of the discrepancies between the disclosure and the reality of financial assets memorialized in computer code, see generally Shaanan Cohny et al., *Coin-Operated Capitalism*, 119 COLUM. L. REV. 591 (2019).

194. For a discussion of bias in machine learning, see Solon Barocas & Andrew D. Selbst, *Big Data’s Disparate Impact*, 104 CALIF. L. REV. 671, 677–93 (2016); see also Kristin N. Johnson et al., *Artificial Intelligence, Machine Learning, and Bias in Finance: Toward Responsible Innovation*, 88 FORDHAM L. REV. 499, 510–12 (2019).

195. Lee, *supra* note 2. For further discussion of the difficulties that the SEC faces in dealing with disclosure of environmental and other sustainability-related risks, see generally Virginia E. Harper Ho, *Nonfinancial Risk Disclosure & The Costs of Private Ordering*, 55 AM. BUS. L.J. 407 (2018).

196. For a discussion of new approaches to data security, such as homomorphic encryption and zero-knowledge proofs, which may allow regulators to access confidential data without having to collect or store it,

enacted in 2018 now requires the appointment of Chief Data Officers to many financial regulatory agencies—having senior personnel to coordinate data strategies may make future data sharing easier.¹⁹⁷

When it comes to seeking data from the private sector, the OFR already has the power under Section 153(f) of Dodd-Frank to subpoena data from financial institutions. Private-sector data is central to determining and analyzing sources of systemic risk, and the OFR has been criticized for its reluctance to exercise this power in the past.¹⁹⁸ Data requests from the OFR will almost certainly be unpopular with the financial industry (and may even attract litigation), but there are ways of making private sector compliance more likely. In particular, private sector institutions may be more forthcoming with data if they face a credible threat of being designated as systemically important (or having their activities so designated) by the FSOC—and thus of being subjected to heightened regulation—if they resist.¹⁹⁹ If attempts to strengthen the FSOC’s designation powers as discussed in Part IV.A are successful, the next OFR Director may have a stronger position from which to exercise the subpoena power.

C. Funding

In addition to data, the OFR will also need money. Section 155 of Dodd-Frank allows the OFR to fund itself with amounts assessed from large private-sector financial institutions.²⁰⁰ While OFR leadership under the Trump Administration had expressed a desire to shift towards a funding model where the OFR is reliant on Congressional appropriations for funding,²⁰¹ the experience of financial regulatory agencies (like the SEC) that are already subject to such a funding model suggests that this will most likely be a negative change for the OFR. For example, Professor Velikonja conducted an empirical study of securities enforcement by the SEC and found that:

All the collected evidence suggests that congressional oversight as practiced today engenders several negative consequences for securities enforcement. It shifts enforcement priorities, possibly deflects prosecution away from politically-connected firms, and leads the SEC to report statistics to obscure rather than to illuminate. It seems plausible that less congressional oversight would yield better results, while more congressional oversight would be counterproductive.²⁰²

Introducing more politics into the OFR’s mission will likely be similarly counterproductive, especially if it leads to an obfuscation of data about the largest, most

see BAREFOOT, *supra* note 151, at 61.

197. 44 U.S.C. § 3520. For a discussion of the new requirements, see FELDBERG, *supra* note 148, at 5.

198. See Gelzinis, *supra* note 50. For a broader critique of business regulators’ tendency to neglect data collection in the information age, see generally Rory Van Loo, *The Missing Regulatory State: Monitoring Businesses in an Age of Surveillance*, 72 VAND. L. REV. 1563, 1565–603 (2019).

199. For a discussion of FSOC’s designation power operating as “regulation by threat”, see Daniel Schwarcz & David Zaring, *Regulation by Threat: Dodd-Frank and the Nonbank Problem*, 84 U. CHI. L. REV. 1813, 1817 (2017).

200. See *supra* notes 26–29 and accompanying text (discussing the opposition to the OFR and the OFR’s lack of power over its funding).

201. OFF. FIN. RSCH., DEP’T. OF THE TREASURY, *supra* note 68 and accompanying text.

202. Urska Velikonja, *Politics in Securities Enforcement*, 50 GA. L. REV. 17, 39 (2015) (emphasis added).

politically connected financial firms. The congressional appropriations process may also be particularly difficult for a research-focused agency, which may struggle to demonstrate its value to Congress, especially when the nature of that research concerns financial stability. I have previously argued that it is particularly hard to quantify the benefits of financial stability regulation “because it is difficult to prove that [it] will succeed. It is also difficult to determine how likely a financial crisis would be to occur in the absence of any such [regulation], and virtually impossible to predict the depth of social harm that such crisis would inflict.”²⁰³ As a result, Congressional oversight is likely to further shrink the resources available to the OFR at a time when the OFR needs expanded resources to enable it to address climate change and new financial technologies, amongst other things.

Section 155 should therefore remain largely unchanged.²⁰⁴ However, Section 155(d) provides that the OFR’s funding assessment is implemented by way of a rule adopted by the Treasury Secretary, rather than the OFR itself, and this should be revised as part of any package of legislative reforms in order to bolster the OFR’s independence. If such legislative change is not possible, this underscores the necessity of a supportive Treasury Secretary. If legislative change *is* possible, other reforms to consider include a reversal of the Economic Growth, Regulatory Relief, and Consumer Protection Act’s changes to Section 155, which restricted OFR funding assessments to the very largest financial institutions.²⁰⁵ Finally, changes like the Systemic Risk Mitigation bill’s proposal to set a minimum floor for the amount of OFR funding to be assessed from the private sector would be welcome.²⁰⁶

D. Staffing

The OFR should maintain its industry-funded model, but even then, its resources will be dwarfed by those of the financial industry it is charged with monitoring. As a result, hiring talented staff will always be a challenge. This problem is not unfamiliar to financial regulatory agencies: following the last financial crisis, for example, regulators sought to keep up with the financial industry by hiring their own quants. However, as one journalist put it, “experienced quants that can earn upwards of \$500,000 on Wall Street aren’t necessarily willing to work for the \$80,000 to \$175,000 a year the OCC is offering.”²⁰⁷ Now, however, the OFR will have to compete with the private sector not just for the mathematical expertise that characterized earlier generations of private sector quants, but also for new types of in-demand expertise.

Take Goldman Sachs. Former CEO Lloyd Blankfein repeatedly referred to it as a “tech company,”²⁰⁸ and in February 2020 Goldman Sachs estimated that it employed 10,000 software developers—a quarter of its total workforce.²⁰⁹ More generally, a recent

203. Allen, *supra* note 147, at 177.

204. 12 U.S.C. § 5345.

205. Economic Growth, Regulatory Relief, and Consumer Protection Act, *supra* note 29.

206. Systemic Risk Mitigation Act, *supra* note 5.

207. LaCapra, *supra* note 169.

208. Jonathan Marino, *Goldman Sachs is a Tech Company*, BUS. INSIDER (Apr. 12, 2015, 8:20 AM), <https://www.businessinsider.com/goldman-sachs-has-more-engineers-than-facebook-2015-4> [https://perma.cc/7MZC-FD5X].

209. Jia Jen Low, *Developers Now Make Up a Quarter of Goldman Sachs’ Workforce*, TECHHQ (Feb. 14, 2020), <https://techhq.com/2020/02/developers-now-make-up-quarter-of-goldman-sachs-workforce/>

survey of financial institutions and fintechs found that many of the firms committed to developing their machine learning capabilities have formed dedicated data analytics departments to work alongside their IT departments.²¹⁰ When it comes to data scientists and software engineers, regulators will need to compete for talent not only with the financial industry but also with the likes of Google. Google is so aggressive in hiring from what is a relatively small pool that even established financial institutions have indicated that they are struggling to attract sufficient expertise to implement machine learning applications.²¹¹ Competition will also be stiff for climate scientists. The Bureau of Labor and Statistics projects that

[e]mployment of environmental scientists and specialists is projected to grow 8 percent from 2019 to 2029, much faster than the average for all occupations. Heightened public interest in the hazards facing the environment, as well as increasing demands placed on the environment by population growth, are expected to spur demand for environmental scientists and specialists.²¹²

A partial solution to hiring difficulties would involve regulators partnering with universities with strong climate science, data science, complexity science, or software engineering departments.²¹³ MIT's Andrew Lo, for example, worked pro bono with the OCC to help it develop its own quantitative models in the past.²¹⁴ This type of arrangement is already anticipated by Section 152(i) of Dodd-Frank, which expressly authorizes the OFR to implement an academic fellowship program, and such partnerships with academic institutions may be particularly useful for developing cutting edge supotech tools.²¹⁵ There are also other avenues that the OFR could pursue in order to collaborate with academic and other experts. The Intergovernmental Personnel Act, for example, authorizes federal government agencies to temporarily hire employees of academic institutions, governmental bodies, and other organizations deemed eligible by the agency.²¹⁶ Personnel exchanges with foreign regulatory counterparts may also be helpful—particularly with countries like the United Kingdom and Singapore, where financial regulators have more aggressively embraced new technologies.²¹⁷

The OFR could also leverage academic expertise by establishing a financial stability-oriented equivalent to the Social Security Administration's Retirement and Disability Research Consortium. That Consortium is "a university-based, grant-funded research organization with the mission of conducting a broad program of research,

[<https://perma.cc/YFG6-D9GR>].

210. CAMBRIDGE CTR. ALT. FIN. & WORLD ECON. F., *supra* note 130, at 34.

211. *Id.* at 51.

212. *Occupational Outlook Handbook: Environmental Scientists and Specialists*, U.S. BUREAU LAB. & STAT. (Sept. 1, 2020), <https://www.bls.gov/ooh/life-physical-and-social-science/environmental-scientists-and-specialists.htm> [<https://perma.cc/843G-V5WL>].

213. Yang & Tsang, *supra* note 168, at 400.

214. See LaCapra, *supra* note 169 (reporting on federal regulators' financial engineering recruitment drive).

215. "Academic partnerships, meanwhile, can be fruitful for exploratory projects on the cutting edge of supotech research." di Castri et al., *supra* note 141, at 15.

216. Policy, Data, Oversight: Hiring Information, U.S. OFF. PERS. MGMT, <https://www.opm.gov/policy-data-oversight/hiring-information/intergovernment-personnel-act/#url=Overview> [<https://perma.cc/5VWD-L2CT>].

217. BAREFOOT, *supra* note 151, at 75.

training, and dissemination” that is considered to have been extremely successful in “bring[ing] together the academic and policy communities to increase objective, policy-relevant research and inform the public and policymakers about alternative policies and their consequences.”²¹⁸ The Social Security Administration issues a memorandum each year, setting out research priorities that it would like the Consortium to pursue, and it collaborates directly with Consortium researchers on “quick turn-around projects . . . to answer high-priority and often unanticipated policy questions.”²¹⁹ The OFR could consider emulating this grant-based approach to encourage more research on pressing financial stability issues.

While the OFR should certainly pursue these types of avenues for leveraging external expertise, permanent technology expertise is also needed in-house.²²⁰ It is, therefore, vital that the OFR hire climate scientists, data scientists, complexity scientists, and software engineers, and that it be able to pay them something approaching the market rate. Fortunately, financial regulatory agencies are not tied to the same compensation schedules that cap the pay of most executive agency employees,²²¹ and so they have some flexibility to pay higher salaries. To be precise, the OFR is authorized by Section 152(d)(2) of Dodd-Frank to set employee salaries “without regard to chapter 51 or subchapter III of chapter 53 of title 5, United States Code, relating to classification of positions and General Schedule pay rates.”²²² Even with this flexibility, though, it will be difficult for the OFR to compete with the private sector on salary alone. The OFR will therefore have to compete in other ways, stressing the virtues of public service and the opportunities to contribute to something important and exciting. This will always be something of a “chicken and egg” problem. The OFR will be more attractive to prospective employees if it already employs a skilled and innovative workforce, and so the early hires will be the most important and the most challenging.

Over time, it is possible that the cohort of available public-minded scientists and technologists will expand with new academic programs and generational shifts. In recent years, banks have sometimes struggled to hire millennials: this has been attributed in part to millennials’ formative experience with the 2008 financial crisis, and in part to a generational idealism that has encouraged them to seek out more public-minded professions.²²³ To seek out the next generation of employees, the OFR could recruit directly from campus (in recent years, some universities have also pioneered programs that stress the importance of interdisciplinary collaboration; these could be especially

218. Paul S. Davies & T. Lynn Fisher, *The Retirement Research Consortium: Past, Present, and Future*, 69 SOC. SEC. BULLETIN 27, 28 (2009).

219. *Id.* at 30.

220. CAMBRIDGE CTR. ALT. FIN. & WORLD ECON. F., *supra* note 130, at 52. It is also worth noting that Google and other large tech firms are increasingly seeking to hire from academia, reducing the pool of academics that the OFR could potentially borrow from.

221. “Under Title 5 of the U.S. Code, the financial regulatory agencies have the flexibility to establish their own compensation programs without regard to various statutory provisions on classification and pay for executive branch agencies.” U.S. GOV’T ACCOUNTABILITY OFF., GAO-07-678, FINANCIAL REGULATORS: AGENCIES HAVE IMPLEMENTED KEY PERFORMANCE MANAGEMENT PRACTICES, BUT OPPORTUNITIES FOR IMPROVEMENT EXIST 7 (2007), <https://www.gao.gov/assets/270/262244.pdf> [<https://perma.cc/ZKP8-VB4J>].

222. 12 U.S.C. § 5342(d)(2).

223. *Banks are Finding it Harder to Attract Young Recruits*, ECONOMIST (May 4, 2017), <https://www.economist.com/special-report/2017/05/04/banks-are-finding-it-harder-to-attract-young-recruits> [<https://perma.cc/Z7UU-AGM5>].

fruitful places for recruitment).²²⁴ The OFR could even consider creative approaches like college debt forgiveness for scientific and technological graduates that go straight into government service. In the short-term, though, it seems safe to assume that only a subset of skilled personnel will be sufficiently public-minded to accept less than what they can earn in the private sector. In these circumstances, it seems counterproductive for each financial regulatory agency to try to compete with one another to attract their own experts.²²⁵

Limited resources should be maximized by concentrating this type of expertise in the OFR, but it should also be made accessible to other financial regulatory agencies. For example, a banking regulator might request that an OFR staff member accompany them to an on-site examination, to lend their expertise in examining the bank's machine learning-driven risk models. Or the SEC's Division of Corporate Finance might forward a disclosure document that it is reviewing to the OFR, to seek the expertise of a climate scientist on climate-related disclosures. Before this can happen, though, the OFR will need to agree with the other agencies on the circumstances in which it can provide them with support, and how it will triage requests from the various different agencies. It is therefore important to consider possible avenues for communication and collaboration between the relevant agencies.

E. Interagency Collaboration

For the OFR to be effective as a hub of expertise, it will need to be able to communicate effectively with all of the different spokes—the many U.S. financial regulatory agencies. These include the Federal Reserve, the Office of the Comptroller of the Currency, the Securities and Exchange Commission, the Commodity Futures Trading Commission, the Federal Deposit Insurance Corporation, and the Consumer Financial Protection Bureau, as well as the many state-based banking, securities, and insurance supervisory agencies. A number of measures could be encouraged to ensure a robust dialogue with those agencies, including the establishment of interagency task forces and joint research projects (most of the federal financial regulatory agencies would have an interest in the use of distributed ledgers in providing financial services, for example). In addition, a secondment program could be established to ensure that employees from each of the federal agencies, as well as employees from rotating representative state agencies, are working at the OFR at any given time.

In an influential administrative law article, Professors Freeman and Rossi catalogued the possible modalities of interagency cooperation, ranging from less to more formal.²²⁶ Interagency task forces and joint research projects can certainly be established through informal interagency consultation, however, “because of its ad hoc nature, informal coordination can also prove somewhat limited and transitory.”²²⁷ In some instances, it is helpful to use more formal structures to facilitate expertise sharing amongst regulatory agencies. Memoranda of Understanding are likely the best, although admittedly not

224. BAREFOOT, *supra* note 151, at 74.

225. *See supra* note 169 and accompanying text (discussing the difficulty staffing these positions).

226. Jody Freeman & Jim Rossi, *Agency Coordination in Shared Regulatory Space*, 125 HARV. L. REV. 1131, 1155–81 (2012).

227. *Id.* at 1156.

perfect, vehicles for doing so.²²⁸ Memoranda of Understanding (MOUs) have been used by agencies in the past to agree to commit personnel to collaborating on a common mission.²²⁹ That common mission could take the form of say, establishing a task force to study the likely impact of extreme weather events on physical infrastructure relied upon by different financial markets. To highlight another possibility, a MOU could establish a cross-agency research project requiring all of the financial regulatory agencies to collaborate on developing a real-time data reporting system that can be used by both the regulatory agencies and the private sector.²³⁰ There is precedent for a data-related MOU at the OFR: in 2014, the OFR and the Commodity Futures Trading Commission signed an MOU, agreeing to work together to improve the quality and utility of data collected from swap data repositories.²³¹ As part of that process, the agencies created a “staff-level Interagency Data Quality and Analytics Working Group” committing staff from each agency to work together on the project.²³²

Future OFR MOUs could sometimes require the involvement of senior personnel to ensure that interagency projects are given appropriate attention and prominence.²³³ MOUs could also be used to establish the *sequencing* of interagency projects, which could help address some of the challenges that regulators face when approaching new threats to financial stability. Regulation of new threats will inevitably be somewhat experimental, pushing the boundaries of established regulatory authority. Professors Conti-Brown and Wishnick have argued that experimental regulation is more defensible when it is less coercive, and they have characterized “research” as being the least coercive form of regulatory activity.²³⁴ The OFR, as a research agency without supervision or enforcement powers of its own, is uniquely suited to non-coercive experimentation and innovation. MOUs might therefore establish a sequence for interagency projects where the OFR does cutting-edge early work that can serve as the

228. Freeman and Rossi note some of the drawbacks of MOUs:

Agencies may negotiate MOUs but then let them languish, sometimes for years. Moreover, despite their often being quite detailed and substantive, these agreements are generally not legally enforceable. And they may prove unstable across administrations, or even throughout the life of a single administration, since disgruntled agencies can block implementation simply by refusing to cooperate.

Id. at 1165 (citations omitted).

229. *Id.* at 1162.

230. See BAREFOOT, *supra* note 151.

This is the future of financial regulation. Financial companies will generate the needed information in digitized forms that are easy and inexpensive to create, to share and to analyze. They will use this data for their own risk management and, where appropriate, will make it accessible to their regulators, often in real time and as complete data sets. As discussed later, these information systems will be fully “interoperable,” so that data can automatically flow across varied systems.

Id. at 30.

231. Press Release, Commodity Futures Trading Comm’n & Off. Fin. Rsch., OFR Sign Memorandum of Understanding to Improve Data Quality (Mar. 31, 2014), <https://cftc.gov/PressRoom/PressReleases/6899-14> [<https://perma.cc/9QV5-W567>].

232. *Id.*

233. For a discussion of a Department of Defense and Department of Homeland Security MOU that included such a stipulation, see Freeman & Rossi, *supra* note 226, at 1163.

234. Peter Conti-Brown & David A. Wishnick, *Technocratic Pragmatism, Bureaucratic Expertise, and the Federal Reserve*, 130 YALE L.J. 636, 664 (2021).

foundation for other agencies' more coercive rulemaking, supervision, and enforcement activities (which may have to pass through a notice-and-comment rulemaking process, or other administrative law procedure used to establish the legitimacy of more coercive activities).²³⁵

MOUs could also be used to establish an OFR secondment program as a complementary avenue for sharing expertise between the OFR and other regulatory agencies. A precedent for this kind of program can be found in the European Union, where experts working for national administrative bodies (usually in scientific fields) have opportunities to work for the European Union as part of the Seconded National Expert ("SNE") program.²³⁶ Such secondments typically operate for a pre-agreed period of between six months and two years, with some opportunities for extension.²³⁷ These SNEs may not perform senior management functions while seconded;²³⁸ instead, their articulated role is "to bring to the Commission their experience of the issues they are used to dealing with where they normally work and to take back to their home administration the knowledge of Community issues which they acquire during their secondment."²³⁹ The experts continue to be paid by their usual employer while they are seconded.

These features of the SNE program could be duplicated for an OFR secondment program, in order to open up lines of communication among financial regulatory agencies.²⁴⁰ However, unlike most of the experts who participate in the SNE program, secondees to the OFR should not be expected to have science or technology backgrounds, although they should be reasonably tech savvy and be willing to think analytically and engage with those from different disciplines. The primary functions of OFR secondees would be to raise research questions, as well as to partner with the permanent technical experts employed by the OFR to develop technological solutions (including supotech applications and new risk modeling approaches) to those questions. The highly technical OFR workforce may sometimes lose sight of the broader policy goals that financial regulation is designed to achieve;²⁴¹ the seconded employees should therefore interrogate their colleagues at the OFR throughout the technological development process to ensure that it remains grounded in the policy goals that inspired the technological development in the first place.²⁴²

An OFR secondment program should also be designed to prevent any one

235. Where "experimentation . . . binds parties without choice, there should be precautions taken consistent with broad principles that animate much of the regulatory state, such as notice and opportunity to be heard." *Id.* at 663.

236. *Commission Decision Laying Down Rules on the Secondment to the Commission of National Experts and National Experts in Professional Training*, EUR. COMM'N (2008) 6866 final (Nov. 12, 2008), [https://ec.europa.eu/jrc/sites/default/files/c\(2008\)6866.pdf](https://ec.europa.eu/jrc/sites/default/files/c(2008)6866.pdf) [<https://perma.cc/H86Y-DGQE>].

237. *Id.* Article 4.

238. *Id.* Article 6.

239. *Seconded National Experts*, EU SCIENCE HUB, <https://ec.europa.eu/jrc/en/working-with-us/jobs/temporary-positions/seconded-national-experts> [<https://perma.cc/Q4WG-VK54>].

240. There are also other forums, like the FSOC, that are designed to open up lines of communication. Unfortunately, the financial regulation in the United States remains significantly confined to silos, and the more interactions the better. For a discussion of the FSOC as a communication forum, see Allen, *supra* note 5, at 1151.

241. Omarova, *supra* note 146, at 101.

242. See *supra* note 174 and accompanying text (articulating a critique of the increasing importance of technologists to the regulatory state's mission).

perspective from becoming dominant within the OFR. Financial stability regulation is a multi-faceted endeavor, requiring stable markets as well as stable institutions,²⁴³ and if financial regulators with a prudential orientation (like the Federal Reserve, Office of the Comptroller of the Currency, and the Federal Deposit Insurance Corporation) become too dominant, then financial stability concerns that arise from market dynamics (as overseen by the Consumer Financial Protection Bureau, Securities and Exchange Commission, and the Commodity Futures Trading Commission) might get short shrift. Giving personnel from all of these agencies a seat at the OFR generates a better chance that the OFR's expertise will be applied to a broader cross-section of threats to financial stability and to other regulatory goals, including investor and consumer protection. For these reasons, at least five employees from each federal agency should be required to be seconded to the OFR at any given time; in some circumstances, a few more from a particular agency might be appropriate, but not so many as might create an imbalance in the influence of that agency on the OFR's functioning.

Insurance always poses particular challenges for interagency collaboration in the United States because it is primarily regulated at the state level.²⁴⁴ Professors Schwarcz & Schwarcz have advocated for bolstering the capacity of the Federal Insurance Office ("FIO"), which was established by the Dodd-Frank legislation in 2010, "to shape insurance regulation when it has credibly determined that doing so is necessary to help monitor, manage, or prevent systemic risk in insurance."²⁴⁵ The FIO has also been somewhat beleaguered in recent years,²⁴⁶ but if the FIO could be revitalized in tandem with the rebuilding of the OFR, personnel from the FIO could be seconded to the OFR. This would help ensure that the impact of climate change on the insurance industry, as well as the use of new technologies in insurance (colloquially referred to as "insurtech"), are not neglected.

An OFR secondment program should not just be about improving the performance of the OFR, though. Ideally, the secondees' experiences will also help engender a cultural shift at their home agencies. If the EU's SNE program aims to encourage the secondees, "to take back to their home administration the knowledge of Community issues which they acquire during their secondment," the analogous aim for OFR secondees should be that they take back to their home regulatory agency an appreciation of financial stability regulation that is informed by scientific and technological understanding. While the OFR (and the FSOC) were created to promote financial stability, they depend heavily on the

243. Hilary J. Allen, *The SEC as Financial Stability Regulator*, 43 J. CORP. L. 715, 721 (2018).

244. Daniel Schwarcz & Steven L. Schwarcz, *Regulating Systemic Risk in Insurance*, 81 U. CHI. L. REV. 1569, 1576–77 (2014).

245. *Id.* at 1635.

246. For example, in 2018, "Rep. Sean Duffy, R-Wisc., chairman of the House Financial Services Subcommittee on Housing and Insurance . . . sponsored a bill to eliminate FIO's role in any domestic insurance issues and confine its work to international insurance issues." Andrew G. Simpson, *Congress Could Shrink Federal Insurance Office*, INS. J. (Jun. 5, 2018), <https://www.insurancejournal.com/news/national/2018/06/05/491290.htm> [<https://perma.cc/7G6F-4WAC>].

There is also industry support for curtailing the FIO: the National Association of Mutual Insurance Companies "concluded the office adds little value to the U.S. insurance system, policyholders, or taxpayers. The experiment has been a failure, and the time has come to eliminate the FIO. NAMIC opposes continuing the existence of a federal office that has demonstrated it is both duplicative and unnecessary." *Our Positions: Federal Insurance Office (FIO)*, NAT'L ASS'N MUT. INS. COS., <https://www.namic.org/Issues/federal-insurance-office> [<https://perma.cc/6WG5-RJ2S>].

work of other financial regulatory agencies, none of which have financial stability mandates themselves.²⁴⁷ I have previously argued for enacting legislation creating such financial stability mandates.²⁴⁸ However, in the absence of such legislation, any program that focuses the employees of those agencies on the importance and practicalities of financial stability regulation is an improvement over the status quo.

There is a body of research that assesses the impact of the SNE program on its participants, and several studies have concluded that the secondment program results in the experts becoming more committed to supranational European integration.²⁴⁹ As one recent study concluded, “international institutions do have a socializing influence after all. One of the many roads to international norms does indeed run through Brussels.”²⁵⁰ While of course there are many variables that will impact an individual employee’s priorities, this research suggests that there is reason to hope that an agency-to-agency secondment program will succeed in expanding the perspective of the participating individuals, beyond the immediate concerns of their home agency, to include financial stability.

The implementation of such a secondment program would require minor structural changes to the relationships between the OFR and other financial regulatory agencies, but these could be made through MOUs, and would not require new legislation. If the program cannot be arranged through bilateral MOUs, the FSOC’s Deputies Committee—which “[c]oordinates and oversees the work of the interagency staff committees”²⁵¹—could spearhead it. Presumably, the other agencies would appreciate not having to invest so heavily in their own technological expertise and training, and this would act as an inducement to participate in the program. If those other agencies have concerns about paying the salary of the secondees on an ongoing basis, those concerns could be mitigated by sending relatively junior (and therefore less expensive) employees to the OFR – although minimum levels of seniority (perhaps seven years) should be imposed for participants in the program lest the secondees not have enough experience to meaningfully contribute.

As with hiring in general, ensuring high-quality secondees will be a chicken and egg problem. If participation in the secondment program were considered highly prestigious, then it would be relatively easy to attract good secondees from the other agencies. But the program needs to become prestigious before that virtuous cycle can start. This virtuous cycle could be kickstarted, perhaps, by establishing secondments with personnel from regulatory agencies abroad—ironically, it is sometimes easier to collaborate across national borders than across agency lines. Recruiting secondees will also be easier if the OFR has an appealing workplace culture.

247. Allen, *supra* note 5, at 1129.

248. *Id.* at 1149.

249. See generally Sara Connolly & Hussein Kassim, ‘Supranationalism’ *In Question: Beliefs, Values, and the Socializing Power of the European Commission Revisited*, 94 PUB. ADMIN. 717 (2016) (utilizing different definitions of ‘supranationalism’ to “capture multiple ways in which individuals may be affected by the experience of working for the organization”).

250. *Id.* at 734.

251. U.S. GOV’T ACCOUNTABILITY OFF., GAO-15-51, FIN. STABILITY OVERSIGHT COUNCIL: FURTHER ACTIONS COULD IMPROVE THE NONBANK DESIGNATION PROCESS 66 (2014), <https://www.gao.gov/assets/670/667177.txt> [<https://perma.cc/KVP7-QTRN>].

F. Culture

In order to be effective in a financial system that is facing new existential threats and being shaped by new technologies, a rebuilt OFR needs to have several cultural imperatives. First, there needs to be a guiding appreciation of the limitations that models have in assessing risks—and that appreciation must be extended to the next generation of machine learning models, as well as the future generations of models to come. Second, the OFR needs a culture that continuously questions our understanding of how financial crises occur. In particular, a new appreciation of operational risk is required, not just as a potential trigger for a more traditional financial system breakdown, but also as the potential transmission mechanism for future systemic failures.²⁵² This will require a complexity science perspective, and an acceptance that sometimes the best a regulator can do is seek to understand—solutions may not always be immediately possible.²⁵³ Where solutions are possible, however, regulators will often need to be innovative—traditional rulemaking and enforcement will sometimes be ineffective in addressing the risks of climate change and new technologies—and regulators may need to respond with new types of solutions. The third cultural imperative, therefore, is for regulators to see their potential as innovative actors within the financial system, rather than simply as passive reactors. This Part will consider the practicalities of these necessary cultural shifts.

i. Addressing Modelling Limitations and Automation Bias

Some of the early criticisms of the OFR (most notably Nassim Taleb's) argued that the OFR relied too heavily on the same types of quant-generated models that the private sector uses to manage its financial risks.²⁵⁴ It is hard to say whether that criticism was then or is now justified—an actor can use models and still appreciate their deficiencies—but it is clear that a revitalized OFR will need to maintain a healthy degree of skepticism with respect to risk models. The OFR needs to apply this skepticism not only to its own models, but also when it considers the models that are used by financial institutions to calculate their own risks.

Take value at risk (“VaR”) models, for example, which are widely used by financial institutions to manage their risks internally. These models generate a number that is supposed to represent the most that a financial institution could be expected to lose within a specific time period.²⁵⁵ The “worst case scenario” generated by a VaR model is expressed at a specified confidence level, usually 95% or 99%.²⁵⁶ This means that in 5% or 1% of possible scenarios, the financial institution could lose more—perhaps even much more—than that worst case outcome generated by the VaR model. Because financial system failures have a low probability of occurring, these models have inherent

252. Allen, *supra* note 98, at 463.

253. For an argument in favor of observing glitches purely to understand, rather than to fix problems, see SAMUEL ARBESMAN, *OVERCOMPLICATED: TECHNOLOGY AT THE LIMITS OF COMPREHENSION* 123 (2016).

254. See *supra* notes 52–55 and accompanying text (explaining that the OFR's analytical models could lead to overconfidence in the ability to predict financial crises).

255. Erik F. Gerding, *Code, Crash, and Open Source: The Outsourcing of Financial Regulation to Risk Models and the Global Financial Crisis*, 84 WASH. L. REV. 127, 140 (2009) (detailing risk-modeling tools, including value-at-risk which is “used to determine potential losses from a given form of risk”).

256. *Id.*

and severe limitations when it comes to managing exposures during financial system failures. Attempts to model climate-related financial system failures will introduce even more difficulties, as models will also have to engage with uncertainties about the occurrence of extreme weather events and how those events will impact the existing uncertainties about financial system behavior.²⁵⁷ These inherent limitations of VaR models are then magnified by financial institutions' incentive structures. Financial institutions often have strong incentives to understate the risks in their investment portfolios. Most notably, regulatory capital requirements require institutions to fund themselves with more expensive equity if their investment portfolios are riskier, so models that downplay risk allow for cheaper funding.²⁵⁸

The next generation of machine learning modeling technologies do not provide a silver bullet solution to any of these problems. Currently, machine learning is primarily used to test and validate VaR and other types of risk management models.²⁵⁹ However, many in the financial industry expect that financial institutions will increasingly use machine learning technology in their primary risk management models.²⁶⁰ Such a trend should be of significant interest to a revitalized OFR. As explored in Section III.B, machine learning algorithms draw decision-making rules from large data sets, and they do so by assessing probabilities and other statistical relationships in the data set. Because the decision-making rules are entirely statistically driven, it should come as no surprise that machine learning algorithms are not very good at catering for or responding to tail events²⁶¹—even when they are trained with high-quality data, which isn't always the case.²⁶² Different types of machine learning algorithms exhibit this problem to greater and lesser degrees, and the collection and selection of data used to train and test an algorithm, as well as tinkering by programmers and data scientists with the training and testing processes, will also influence how likely a machine learning algorithm will be to underestimate tail risk.²⁶³ Again, financial institutions will have incentives to construct their machine learning algorithms to understate the risks they face.

Regulators, therefore, cannot afford to take the output of the private sector's

257. FIN. STABILITY BD., *supra* note 2, at 10–11.

258. Gerding, *supra* note 255, at 157.

259. FIN. STABILITY BD., ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN FINANCIAL SERVICES: MARKET DEVELOPMENTS AND FINANCIAL STABILITY IMPLICATIONS 16 (2017), <https://www.fsb.org/wp-content/uploads/P011117.pdf> [<https://perma.cc/PE2W-EJF4>].

260. Louie Woodall, *Model Risk Managers Eye Benefits of Machine Learning*, RISK.NET (Apr. 11, 2017), <https://www.risk.net/risk-management/4646956/model-risk-managers-eye-benefits-of-machine-learning> [<https://perma.cc/EW5L-FTZV>].

261. Allen, *supra* note 1, at 174 (defining tail risks as “the very risks that are most likely to cause financial crises”).

262. In 2017, Rama Cont, the chair of mathematical finance at Imperial College London, said that there were insufficient data available to use machine learning to model most financial risks. He said:

We are not in a big data situation really. The only situation where we are really strong with data is consumer loans, credit cards and so on. We only have one market history, so is the pattern which led to Lehman the same which leads to the fall of bank X the next time?

Nazneen Sherif, *Academics Warn Against Overuse of Machine Learning*, RISK.NET (Mar. 15, 2017), <https://www.risk.net/risk-management/4120236/academics-warn-against-overuse-of-machine-learning> [<https://perma.cc/TY3T-XZBR>].

263. See *supra* notes 118–120 and accompanying text (noting the influence of human inputs used to train machine learning systems in variable risk assessment outcomes).

machine learning algorithms at face value. Unfortunately, humans (including financial regulators) have a tendency to defer to the output of technological models. This tendency has been referred to as “automation bias,”²⁶⁴ and it can exacerbate the issue of capture that we already discussed, encouraging regulators to acquiesce in financial institutions’ automated risk management processes. Because the limitations of machine learning technologies have yet to be highlighted by any crisis, automation biases may be particularly acute and regulators may exhibit too much deference to these models. The same may be true of new types of models that are developed to gauge the likely impact of climate-related physical and transition risks on financial institutions.

In some respects, the OFR’s own models will be superior to the models developed by financial institutions as financial institutions can only populate their models with publicly available information and their own proprietary information, but regulators can access proprietary information about the current risk profiles of multiple private sector firms—regulators also lack the private sector’s incentives to downplay risks. However, the OFR should remain mindful that even with the highest quality information and technology, tail risk remains difficult to model. It will therefore be important for the OFR to take steps as an institution to push back against automation bias. Once it has hired people with the necessary expertise, the OFR should encourage them to take new modeling technologies with a grain of salt, recognize what those technologies are likely to be good at (like seeing patterns amongst variables that humans might miss, and providing real-time alerts that allow for earlier intervention to address the development of outsized risks),²⁶⁵ and supplement their deficiencies with human skills like imagination, critical thinking, and intuition (all of which have so far defied recreation in artificial intelligence).²⁶⁶

In a fascinating essay on the success of human-machine partnerships against machine opponents in games of chess, Nicky Case emphasizes that the key to getting the best results from collaborations amongst humans and artificial intelligence (like machine learning) is not the choice of human or artificial intelligence, but the process through which they interact.²⁶⁷ Case suggests that the optimal division of labor amounts to humans thinking creatively about the questions that need to be answered, and the artificial intelligence being harnessed to answer the selected questions, within constraints identified by the human.²⁶⁸ The process should be iterative, with a collaborative group of humans taking the answers provided by artificial intelligence, discarding some of them and using others as the basis for more detailed questions, and so on.²⁶⁹ One professor of management and information technology has suggested that persistently asking the following questions of model outcomes will facilitate the exercise of human critical thinking and intuition on their results:

264. Linda J. Skitka et al., *Accountability and Automation Bias*, 52 INT. J. HUMAN-COMPUT. STUD. 701, 704, 715 (2000) (discussing accountability generally, including the psychology of how automation errors lead to poor decision-making).

265. FIN. STABILITY BD., *supra* note 259.

266. See Nicky Case, *How to Become a Centaur*, J. DESIGN SCI. (Jan. 8, 2018), <https://jods.mitpress.mit.edu/pub/issue3-case/release/6?version=c847d892-97dc-40a7-a412-315d255b9b2d> [<https://perma.cc/4WSD-RZVA>] (discussing the story of AI and intelligence augmentation).

267. *Id.*

268. *Id.*

269. *Id.*

1. What was the source of your data?
2. How well do the sample data represent the population?
3. Does your data distribution include outliers? How did they affect the results?
4. What assumptions are behind your analysis? Might certain conditions render your assumptions and your model invalid?
5. Why did you decide on that particular analytical approach? What alternatives did you consider?
6. How likely is it that the independent variables are actually causing the changes in the dependent variable? Might other analyses establish causality more clearly?²⁷⁰

Adoption of this type of iterative, questioning process is something that the OFR can try to influence through its culture, as is the relationship between OFR employees and technology more generally. Psychological researchers documenting automation biases have found that these biases can be checked (meaning human decision-makers will be more critical, and consider a wider range of alternative approaches and alternative data sources) if humans are held accountable for their overall performance.²⁷¹ In a rebuilt OFR, responsibility for analysis, conclusions and recommendations must ultimately fall on human employees—they shouldn't be permitted to blame the models for such analysis, conclusions and recommendations. With that said, we shouldn't expect perfection from humans any more than we should expect it from machines. Regulators dealing with new technologies must be extended some grace—a topic we will return to shortly.

ii. Questioning Financial Stability Orthodoxy

At the same time as the OFR strives to create a culture of good-natured suspicion of the latest risk-management models, it should also try to broaden its perspective beyond financial stability orthodoxy. In other words, while the OFR should not ignore the hard-won knowledge we have about how financial crises have propagated in the past, it should appreciate that future crises may unfold in new and unexpected ways. Our prevailing understanding of financial crises (supported by hundreds of years of experience) is that while the shocks that set off an individual crisis may vary, the transmission mechanisms that move those shocks through the financial system to the broader economy remain familiar. First, a shock causes panic that restricts the availability of credit extended *to* financial intermediaries, as in a bank run. Then the people and businesses that usually rely on credit *from* those intermediaries are unable to continue getting it. Without such credit, the economy cannot grow, and the crisis jumps from Wall Street to Main Street.²⁷² Although we understand how these credit channels can transmit crises (and they remain an important focus of financial stability regulation), we have no historical experience of climate change to draw upon, and transmission mechanisms may operate differently

270. Davenport, *supra* note 171 (emphasis added).

271. Skitka, *supra* note 264.

272. See Bernanke, *supra* note 96, at 256 (articulating two theories that try to account for why the Great Recession was so severe, moving with such swiftness from the financial sector to the broader economy).

when the shock is a climate-related event that is causing problems outside of the financial system as well. More generally, credit channels may not always be the primary mechanism by which shocks are transmitted through the financial system to the broader economy.

As the provision of financial services becomes increasingly technologically complex and its infrastructure becomes increasingly vulnerable to extreme weather events, operational problems could cascade through the plumbing of the financial system, preventing the system from providing the capital intermediation and payment services on which the broader economy relies. Right now, there is considerable enthusiasm for using distributed ledger technology to replace the often clunky financial infrastructure that is currently used for processing payments and clearing and settling financial trades.²⁷³ While this technology will likely make processing more efficient and its distributed nature might avoid some of the impacts of extreme weather events, increased processing speed could also inflame panics in the financial markets, and increased technological complexity could make it harder to put the brakes on such processing.

The OFR was founded in part to address a lack of understanding about how the actions that individual financial institutions take to preserve their own solvency (for example, engaging in fire sales of financial assets) might weaken the financial system as a whole.²⁷⁴ It is similarly possible that the steps that individual financial institutions take in the future to manage their own operational risks could overload financial infrastructure in ways that prevent other financial institutions from discharging *their* functions.²⁷⁵ I recently argued that a new type of “macro-operational” competency needs to be added to financial stability regulators’ toolkit, which would examine potential systemic interactions of technological operational risks.²⁷⁶ While the OFR has not traditionally had a strong focus on operational risks (with the notable exception of a consistent focus on the financial stability threats posed by cyberattacks),²⁷⁷ a resurrected OFR with significant interdisciplinary expertise could serve as the birthplace of a macro-operational approach to regulation.

Some of the critiques of the OFR during the Obama Administration expressed concerns that the OFR felt it could manage uncertainty, and that this lack of humility would set it up for a fall.²⁷⁸ Whether or not these critiques were justified, pioneering macro-operational regulation—as well as other new approaches to managing systemic risks and promoting financial stability—will require a certain level of humility and comfort with uncertainty. Uncertainty is inevitable in a system as complex as our financial system,²⁷⁹ and the discipline of complexity science may sometimes suggest

273. For a discussion of the potential payments and trading applications of distributed ledger technology, see DE FILIPPI & WRIGHT, *supra* note 113, at 61, 89.

274. See Reed, *supra* note 19 and accompanying text (championing the legislation that created the OFR).

275. Allen, *supra* note 98, at 469.

276. *Id.* at 456.

277. In its 2015 Strategic Plan, the OFR described the risks it assessed: “We assess a full spectrum of risks in the financial system—macroeconomic, market, credit, funding/liquidity, and contagion—complementing the assessment of risks associated with particular markets or institutions.” OFF. FIN. RSCH., STRATEGIC PLAN: FISCAL YEARS 2015–2019 5 (2015), <https://www.financialresearch.gov/strategy-budget/files/Office-of-Financial-Research-Strategic-Plan-2015-2019.pdf> [<https://perma.cc/C2ZT-47WG>].

278. *Supra* notes 52–55 and accompanying text.

279. “Uncertainty” is used here in the Knightian sense of situations that are so uncertain that the risks are unknowable. FRANK H. KNIGHT, RISK, UNCERTAINTY, AND PROFIT 19–20 (1921).

approaches that are a better fit for financial stability regulation than academic disciplines that prioritize elegant calculations and clean answers. The complexity science approach recognizes that while regulatory interventions are sometimes warranted, such interventions inevitably make a system more complicated and therefore more fragile and unpredictable.²⁸⁰ Sometimes, the best approach is to behave like a biologist and simply “examine the anomalies and malfunctions to gain insights, even if we don’t fully understand the system as a whole.”²⁸¹ A revitalized OFR seems uniquely suited to perform such forensic examinations, and could help satisfy the need for a “holistic” financial regulator recently identified by Judge and Awrey that would “seek to monitor and evaluate ongoing structural changes to the financial system, assess the impact and effectiveness of new regulation, and better understand the role and perceptions of finance within wider society.”²⁸² The OFR’s research activity could then serve as the basis for the other financial regulatory agencies to revise existing and implement new regulatory approaches in light of the OFR’s assessments, as jurisdictionally appropriate.

iii. Encouraging Innovation

We do not typically think of regulators as innovators. This is partly due to decades of framing regulation as something that exists only to solve market failures.²⁸³ If we follow this line of thinking through to its logical conclusion, regulators should be reactive and limit their encroachment on private sector activity until the private sector is demonstrably unable to come up with its own solution; under this conception of regulation, regulators are precluded from acting as proactive innovators. However, this characterization of financial regulation is increasingly being questioned, both in terms of its accuracy and its normative desirability. In many instances, financial regulators already make important, proactive decisions, such as dictating the type of infrastructure within which private markets will operate.²⁸⁴ From a normative perspective, Professor Cristie Ford has observed “the capacity to be innovative . . . is a form of power,”²⁸⁵ and if financial stability regulators take a permanently passive approach to their missions, they will cede much of their ability to curtail the harmful elements of financial activities.

I have previously highlighted that financial stability regulation is an inherently

280. David L. Alderson & John C. Doyle, *Contrasting Views of Complexity and Their Implications for Network-Centric Infrastructures*, 40 IEEE TRANSACTIONS ON SYS., MAN, AND CYBERNETICS—PART A: SYS. & HUMANS, 839, 839 (2010).

Historically, we have done a poor job in managing the fragilities created by our complex networks, from global warming to ecosystem destruction, global financial crises, etc. In many cases, past failures are due to fragilities that were direct side effects of mechanisms that promised to provide great benefits, including robustness.

281. ARBESMAN, *supra* note 253, at 110.

282. Dan Awrey & Kathryn Judge, *Why Financial Regulation Keeps Falling Short*, 61 B.C. L. REV. 2295, 2352 (2020).

283. “Most normative scholarship about regulation uses a ‘market failure’ framework: regulation is justified only if certain failures of a free market occur, with externalities, public goods, monopolies, and imperfect information seen as the paradigmatic failures.” Matthew D. Adler, *Regulatory Theory in A COMPANION TO PHILOSOPHY OF LAW AND LEGAL THEORY* 595 (Dennis Patterson ed., 2nd ed. 2010).

284. For a discussion of financial infrastructure as regulatory architecture, see generally David A. Wishnick, *Reengineering Financial Market Infrastructure*, 105 MINN. L. REV. 2379 (2021).

285. CRISTIE FORD, *INNOVATION AND THE STATE: FINANCE, REGULATION, AND JUSTICE* 220 (2017).

precautionary exercise that is most successful if applied preemptively; past experience has shown us that measures taken to contain a crisis after it has occurred are limited in their efficacy.²⁸⁶ As finance becomes more technologically complex, rule changes may not always be adequate to address new threats to financial stability. In some instances, reform may need to take the form of technological interventions *by the regulators*—the type of suptech referred to in Section III.B. The resurrected OFR proposed in this Article would be uniquely situated to help develop such interventions. During the Obama Administration, the OFR already displayed an interest in both understanding and utilizing new technologies.²⁸⁷ With a refreshed workforce, the OFR could renew its commitment to its own technological innovation. Reorganization often spurs innovation, so the very act of restructuring the OFR could spur more creative thinking about financial stability solutions.²⁸⁸

If many of the OFR's new hires come from the tech world, they may already be predisposed to an innovation mindset. While some tech personnel are very aggressive about breaking the rules and might therefore be a poor fit for the OFR, the most "cowboy" amongst them are unlikely to be attracted to working for a government agency in the first place. Perhaps the bigger concern is that the integration of tech workers into the (traditionally more staid) financial regulatory apparatus might completely dampen their innovative spark. Even in the private sector, trying to reconcile the cultures of the finance and tech industries has sometimes been challenging, with employees who are used to the tech world's freedom and casual collaboration (particularly on open-source projects) sometimes finding it challenging to work within the many rules that govern the financial industry.²⁸⁹ Some financial institutions have responded by creating spin-off research labs that have a more tech-oriented, innovative culture,²⁹⁰ and the OFR could potentially emulate this move by creating an "OFRLab" to creatively explore suptech innovations.

This OFRLab could be structured based on the concept of "agile workflow" which would be familiar to recruits from the tech industry. An agile workflow involves "breaking complex projects into smaller ones and bringing together multi-disciplinary teams to do rapid building of solutions. It contrasts with the traditional 'waterfall' processes that dominate finance and regulation, in which initiatives travel through a linear process and sequential reviews."²⁹¹ If executed well, this OFRLab could become a prestigious locus for cutting-edge public-minded research, which would attract more skilled employees in a virtuous cycle. The best-case scenario would be for the OFRLab to

286. Allen, *supra* note 5, at 1103.

287. See, e.g., OFF. FIN. RSCH., STRATEGIC PLAN, *supra* note 46, at 13 (In the OFR's 2015 Strategic Plan, the OFR expressed an interest in "data visualization for revealing key patterns and connections in complex financial data; and agent-based models for understanding the dynamics of risk transmission arising from wholesale funding, run risks, and fire sales during crises.").

288. "One of the surest ways to get a job done more innovatively is, quite simply, to reorganize frequently. When you put people into a new structure, it stimulates them to rethink what they're doing on a day-to-day basis." *Inspiring Innovation*, HARV. BUS. REV., Aug. 2002, <https://hbr.org/2002/08/inspiring-innovation> [<https://perma.cc/KB8F-W4D9>].

289. Ari Levy, *Goldman is Going Head-to-Head with Silicon Valley Giants for Tech Talent, Says Exec*, CNBC (Feb. 12, 2020, 1:03 PM), <https://www.cnbc.com/2020/02/12/goldman-sachs-cio-george-lee-says-bank-is-competing-for-developers.html> [<https://perma.cc/QN37-6535>].

290. CAMBRIDGE CTR. FOR ALT. FIN. & WORLD ECON. F., *supra* note 130, at 67.

291. BAREFOOT, *supra* note 151, at 63.

evolve as a mecca for the best and brightest public servants, in the vein of FDR’s “Brain Trust.”

The leaders charged with rebuilding the OFR should also take affirmative steps to encourage innovation in their agency more broadly, and they can start this process by tapping into the robust organizational management literature on how to encourage innovation within a private sector firm.²⁹² One suggestion from that literature is that OFR management should make clear that innovation is a normal part of the agency’s output, to be approached in a systematic way.²⁹³ In particular, OFR management can stress collaboration with personnel from other financial regulatory agencies who don’t necessarily have technological expertise but can identify problems that need solving. Such a systematic approach can mitigate unrealistic expectations that innovation will be fueled purely by “eureka” moments. Another cultural predisposition for innovation is passion.²⁹⁴ If the OFR hires employees that are truly committed to the agency’s mission of financial stability, then that could spur innovation (and also serve as a partial antidote to regulatory capture).

Perhaps the most important aspect of a pro-innovation culture is that it permits failure.²⁹⁵ We expect failures from private sector innovators—venture capital firms expect most of the startups they invest in to fail, and “failing fast” is part of Silicon Valley culture.²⁹⁶ Regulators are typically not extended the same grace for their failures, though. While regulators should of course be held accountable for misfeasance and dereliction of their mission, they should be allowed some leeway in experimenting with the best ways to advance their mission—even if this results in some wasted funds. If the OFR fails to innovate now, then that will entail its own risks of obsolescence—taking a wait-and-see approach has been described as “accelerating backward” in the current environment of rapid technological change.²⁹⁷

The OFR cannot generate public tolerance of such failures on its own; a broader societal shift is needed to make the public more accepting of trial and error from regulatory agencies.²⁹⁸ Unless and until that occurs, though, the OFR can be somewhat insulated from criticism of inevitable failures by structural measures and funding that give it more independence from the political process (as discussed in Parts IVA and B). The OFR can also use a public relations strategy to help manage expectations about what it is trying to achieve with its innovation and the timelines involved. Managing those expectations will be crucial to the OFR’s success; as one former OFR insider observed, “dwelling on unrealistic expectations plays into the hands of those who never wanted an

292. For a short summary of the findings of this literature, see FORD, *supra* note 285, at 138.

293. *Inspiring Innovation*, *supra* note 288.

294. *Id.*

295. *Id.*; BAREFOOT, *supra* note 151, at 72.

296. Elizabeth Pollman, *Startup Governance*, 168 U. PA. L. REV. 155, 166 n. 42 (2019) (listing statistics that suggest the majority of startups fail, even after having raised millions of dollars).

297. BAREFOOT, *supra* note 151, at 87.

298. MARIANA MAZZUCATO, *THE ENTREPRENEURIAL STATE: DEBUNKING PUBLIC VS. PRIVATE SECTOR MYTHS* 10 (2015).

[T]he uncertainty inherent in the innovation process means that [the State] will often fail. But it needs to learn from failed investments and continuously improve its structures and practices. As the economist Albert Hirschman emphasized, the policymaking *process* is by its nature messy, so it is important for public institutions to welcome the process of trial and error.

OFR in the first place.”²⁹⁹ But if the OFR is rebranded as a kind of financial DARPA, the expectations surrounding the immediacy of its output will be different (DARPA, or the Defense Advanced Research Projects Agency, developed the technology that ultimately gave birth to the internet. It was created for the express purpose of pursuing “ideas that went beyond the horizon in that they may not produce results for ten or twenty years.”).³⁰⁰

V. CONCLUSION

New financial technologies and climate-related threats have the potential to overwhelm our already strained financial regulatory system. Without the relevant expertise, financial regulators are essentially left bringing a knife to a gunfight. The best way to build up the necessary regulatory expertise is to resurrect the OFR as a bastion of science and technology, as well as economic and legal, expertise. This Article’s call for a revitalized OFR is but a first step in dealing with the next generation of threats to financial stability, but it is an important one. Proposals for more far-reaching reform, such as calls for preapproval of financial algorithms³⁰¹ or federal bank purchases of “green” assets as part of quantitative easing programs,³⁰² cannot be implemented unless regulators have the underlying expertise necessary to assess the assets or technology involved.

If politically feasible, legislative reforms should be implemented to give the OFR the independence needed to pursue long-term and sometimes unpopular financial stability-related research. These legislative reforms should remove the OFR from the Treasury department; give the OFR Director a voting seat on the FSOC; authorize the OFR to adopt its own funding rules; and compel other financial regulatory agencies to share data with the OFR. If legislation is not possible, this Article’s recommended priorities can still be advanced by a Treasury Secretary who is supportive of a robust, interdisciplinary, and independent OFR, and by implementing other policies to create a more collaborative relationship between the OFR and the other financial regulatory agencies. Many such policies can be implemented without legislative reform; interagency task forces, joint research programs, and secondment programs can all be established through interagency Memoranda of Understanding. If the agencies fail to engage in these ventures themselves, then the FSOC’s Deputies Committee can play a coordinating role.

The most important step, however, will be to hire the right people. Personnel is policy, as they say, and in selecting the next Director of the OFR, the administration should prioritize selecting someone with a history of interdisciplinary collaboration. Once the next Director has been hired, that Director should aggressively seek to attract an interdisciplinary workforce, offering salaries that are as close to the market rate as possible. To ensure sufficient funding for these new personnel, any steps taken under the Trump Administration to give Congress oversight over OFR’s funding structure should be undone.

299. FELDBERG, *supra* note 69.

300. MAZZUCATO, *supra* note 298, at 82.

301. *See* Tutt, *supra* note 166 (advocating that complex, dangerous algorithms undergo an approval process to prevent misuse).

302. *See* Skinner, *supra* note 97, at 67 (noting the uncertain impact climate change will have on financial stability).

