JOURNAL
OF
LAW & INNOVATION

VOL. 3 JUNE 2020 NO. 1

ARTICLE

EXPERIMENTAL STRATEGIES FOR REGULATING FINTECH

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Faced with new technologies that confound existing financial regulatory structures, regulators around the world have been experimenting with new approaches to regulating fintech. The most prominent of these experiments have been innovator-focused programs that provide guidance (and in the case of regulatory sandboxes, regulatory relief) to private sector firms, in order to help them navigate a confusing thicket of financial regulation that might otherwise impede their innovation. These innovator-focused programs can improve efficiency and competition in the provision of financial services, but can—at best—only make incidental contributions to the financial regulatory goals of consumer and investor protection, and the promotion of financial stability. This Article argues that when regulatory resources are scarce, the priority should be experimentation by the regulators in order to advance the

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core financial regulatory goals of protecting investors, consumers and the financial system. This Article therefore surveys recent technological experimentation by financial regulators (known as "SupTech") and concludes that while the experimentation to date has been valuable and may improve the execution of longstanding financial regulatory functions, further experimentation is needed to address the new problems and risks created by the rise of fintech.

INTRODUCTION

Our current financial regulatory system is struggling to deal with the rise of fintech, and this Article examines the experimental governmental programs that are being trialed in response. From innovation hubs to regulatory sandboxes to specialty charters, recent efforts by governments and regulatory authorities to promote fintech innovation and competition have been in the spotlight. However, the technological advances afoot in the financial industry also impact the core regulatory goals of protecting consumers, investors and financial stability. This Article argues for financial regulators to experiment more with their own technological approaches to furthering these goals (a phenomenon known as "SupTech"). In particular, such experimentation is needed to respond to the new threats to consumers, investors and financial stability posed by fintech business models that use

technologies like machine learning and smart contracts to deliver financial services in new ways.

All regulators, not just financial regulators, struggle when confronted with new innovations.[2] Under-resourced regulators can find it challenging to keep pace with a nimbler private sector that often seeks to exploit loopholes in regulations that were drafted long before the innovation was even dreamt of. The fear of unintended consequences looms large over any steps that regulators take to regulate the innovation. Regulators must also address new innovations in accordance with their statutory mandates, which are often multiple and conflicting. This Article uses three innovative business models—marketplace lending, robo-investing, and smart contract swaps—as case studies to illustrate some of the new challenges facing four financial regulatory agencies: the Office of the Comptroller of the Currency ("OCC"), Consumer Financial Protection Bureau ("CFPB"), Securities and Exchange Commission ("SEC") and Commodity Futures Trading Commission ("CFTC").

Each of these agencies is currently experimenting with different forms of fintech regulation, but the most visible of these are designed to encourage private sector innovation.[3] Private sector fintech innovation can further regulatory goals of promoting market efficiency and competition in the interests of consumers. However, regulators cannot rely on the private sector to protect investors or consumers from predatory practices, or to ensure the ongoing stability of the financial system. This Article argues that regulators should instead prioritize *their own* technological experimentation in order to further these core regulatory goals. It therefore surveys the current (nascent) state of "SupTech" innovation, and explores many of the challenges it faces. In many respects, these are the perennial challenges—limited resources, opportunities for arbitrage, and fear of unintended consequences—that animate all debates about regulating innovation. Notwithstanding these challenges, however, this Article urges regulators to experiment with SupTech as much as possible. The SupTech innovations advocated for in this article (including circuit breakers for smart contracts and hypothetical data sets for machine learning algorithms) are things that must be "plugged in" to private sector products in order to be effective. Such regulatory strategies will have the most impact if developed while the private sector technology is still in its infancy and therefore more malleable; time is therefore of the essence for SupTech experimentation.

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[2] For an excellent discussion of the challenges regulators face in regulating new innovations, *see generally* Tim Wu, *Agency Threats*, 60 DUKE L. J. 1841 (2011).

[3] *See infra* Part III.

The rest of this Article will proceed as follows. Part II will briefly engage with the administrative law literature on regulating innovation in general, before using case studies from the financial industry to illustrate some of the particular problems facing the OCC, CFPB, SEC, and CFTC. Part III surveys the most high-profile regulatory experiments conducted by these and other financial agencies and makes clear that these high-profile programs and policies are all designed to encourage private sector innovation. Part III then explores why encouraging private sector innovation will not address the core financial regulatory mandates of consumer/investor protection and financial stability. Part IV then makes the case for SupTech innovation by the regulatory agencies themselves to advance their core mandates and considers the challenges facing SupTech innovation.

II. THE CHALLENGES OF REGULATING NEW FINANCIAL TECHNOLOGIES

Innovation is the process by which the economy is revitalized with new types of products and services, as well as new ways of providing existing products and services.[4] However, while often beneficial, innovation is not always improvement, and so regulators must remain alert to the new ways in which products and services are being provided.[5] All types of innovation pose some basic challenges for regulators. First, because innovation often allows outcomes to be achieved in ways that were previously unanticipated, existing regulatory structures often do not contemplate that innovation. As a result, desirable processes and outcomes might be unintentionally prohibited, whereas problematic processes and outcomes might be unintentionally permitted by the regulatory structures already in place.[6] Regulators can seek to update their regulations to address innovation, but the pace of innovation is typically more rapid than the slow-moving apparatus of regulatory action.[7]

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[4] *See, e.g.*, JOSEPH SCHUMPETER, CAPITALISM, SOCIALISM AND DEMOCRACY 82–83 (1975) (describing progress as the "destruction of capital values in the strata with which the new commodity or method of production competes").

[5] *See* Hilary J. Allen, *A New Philosophy for Financial Stability Regulation*, 45 LOY. U. CHI. L. J. 173, 215-22 (2013) (discussing the hazards of heralding the latest advancement as necessarily the best).

[6] *See* Eric Biber et al., *Regulating Business Innovation as Policy Disruption: From the Model T to Airbnb*, 70 VAND. L. REV. 1561, 1565 (2017) (describing a "policy disruption" as "disjunction between the structure of the regulatory system and the industry that is being regulated").

[7] *See* Wu, *supra* note 2, at 1851 (describing such speed-related issues that arise when regulating an uncertain or developing industry); *see also* Dan Awrey, *Complexity, Innovation,*

Furthermore, if rules are adopted before the innovation is properly understood, they may become sticky and hard to change, even if it ultimately becomes clear that they are poorly suited to the evolved innovation.[8] On the other hand, if regulators wait too long, the market for the innovation can become well established and regulators may then be loath to intervene for reasons of political economy.[9]

Regulators are typically under-resourced when compared with the private sector's technical expertise and funding, and often struggle to keep up with the pace of innovation.[10] As a result, regulators become increasingly reliant on the industry for information and expertise, which can breed regulatory capture (a condition in which regulators start to take on the worldview of the industry they regulate, as opposed to prioritizing the interests of the public they are charged to protect).[11] This type of capture is particularly likely to arise when there is no crisis at hand to motivate the public to call regulators to account.[12] In such circumstances, regulators face few negative consequences for neglecting the public interest, and an uphill battle in challenging the interests of the industry.

Even when regulatory measures are taken, market participants will typically adjust their behavior in light of the new standards.[13] If those adjustments involve acting in a way designed to skirt the regulation, then they are known as regulatory arbitrage—a perennial thorn in the side of any

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and the Regulation of Modern Financial Markets, 2 HARV. BUS. L. REV. 235, 239 (2012) (discussing that "the pace of innovation has left financial regulators and regulation chronically behind the curve").

[8] Wu, *supra* note 2, at 1849-50 (pointing out that the regulatory landscape may be set before any of the key players have even had a chance to weigh in).

[9] *See* Allen, *supra* note 5, at 223 (arguing that as an industry grows, regulators will be more subject to capture by certain interest groups).

[10] *See* Yueh-Ping (Alex) Yang & Cheng-Yun Tsang, *RegTech and the New Era of Financial Regulators: Envisaging More Public-Private Partnership Models of Financial Regulation* 21 U. PA. J. BUS. L. 354, 360-61 (2018) (discussing the problems associated with regulators' naturally slower speeds).

[11] *See also* Hilary J. Allen, *Putting the "Financial Stability" In Financial Stability Oversight Council*, 76 OHIO ST. L. J. 1087, 1102 (2015) (discussing the related phenomenon of cognitive capture, in which regulators take on the worldview of the industry they regulate). For a survey on the administrative law literature on informational and cultural capture, *see* Jonas Anderson, *Court Capture*, 59 B.C. L. REV. 1543, 1560-63 (2018).

[12] *See* Allen, *supra* note 11, at 1102 (discussing the increased risk of capture when the public loses interest in regulation).

[13] *See* Lawrence G. Baxter, *Adaptive Financial Regulation and RegTech: A Concept Article on Realistic Protection for Victims of Bank Failures* 66 DUKE L. J. 567, 594 (2016) ("market participants quickly and rationally adjust their behavior around the 'certainty' created by the new targets").

regulatory regime.[14] Two well-worn categories of regulatory arbitrage are jurisdictional and categorical arbitrage.[15] The first exploits differences in the laws of different jurisdictions; the latter "exploits a legal discrepancy between the treatment of two types of activity or products that are functionally similar."[16] Technological innovation increases opportunities for a process-oriented variant of categorical arbitrage: often, innovations are designed to avoid regulation by creating functional equivalents that achieve the same outcomes as regulated products and services, using processes that were not anticipated by the regulatory regime.

Financial regulators contemplating new fintech innovations suffer acutely from all of these difficulties. They also have to assess new fintech innovations in the context of their competing legal mandates. The primary goals of financial regulation around the world are the protection of consumers and investors, financial stability, market efficiency, competition, and prevention of financial crime.[17] Most financial regulators need to balance more than one of these mandates, which further complicates the task of regulating new innovations. For example, the first financial regulatory agency to adopt a regulatory sandbox for fintech, the United Kingdom's Financial Conduct Authority (FCA), identified three main benefits that it hoped to achieve with the sandbox: "reduced time-to-market at potentially lower cost," "better access to finance" (for innovators), and "more innovative products reaching the market."[18] These benefits are consistent with its mandate to promote competition in the financial services markets,[19] but the FCA also has a mandate to protect consumers,[20] and to support the integrity of the U.K.'s financial system, including "its soundness, stability and resilience."[21] The case studies in this Part will demonstrate some situations in which fintech innovation, while improving competition and efficiency in the markets, may ultimately conflict with goals of consumer/investor protection and financial stability.

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[14] For a discussion of the term "regulatory arbitrage," *see* Elizabeth Pollman, *Tech, Regulatory Arbitrage, and Limits*, 20 EUR. BUS. ORG. L. REV. 567 (2019).

[15] *Id.* at 8.

[16] *Id.*

[17] JOHN ARMOUR ET AL, PRINCIPLES OF FINANCIAL REGULATION 61-69 (2016).

[18] FIN. CONDUCT AUTHORITY (FCA), REGULATORY SANDBOX 5 (Nov. 2015), https://www.fca.org.uk/publication/research/regulatory-sandbox.pdf.

[19] Financial Services Act 2012, c. 21, § 6 (U.K.) (amending Financial Services and Markets Act 2000, c. 1E).

[20] *Id.* (amending Financial Services and Markets Act 2000, c. 1C).

[21] *Id.* (amending Financial Services and Markets Act 2000, c. 1D).

Like the FCA but unlike most U.S. financial regulators, the CFPB and CFTC both have a mandate to promote competition. The CFPB was created to ensure "that all consumers have access to markets for consumer financial products and services and that markets for consumer financial products and services are fair, transparent, and competitive."[22] The CFTC has a mission "to protect market users and the public from fraud, manipulation, and abusive practices related to the sale of commodity futures and options and to foster open, competitive, and financially sound commodity futures and option markets."[23] Both agencies, then, must seek to balance their competition mandate (which militates for policies that promote innovation that would result in more firms and products in the market) with their respective consumer or investor protection mandates. The CFTC's mission to pursue financially sound markets could also be interpreted as a direction to pursue financial stability, providing yet another example of the conflict inherent in these agencies' mandates.

For the U.S. regulators who do not have statutory mandates to promote competition, policies designed to promote innovation must be tied to other parts of the missions of these agencies—most obviously, a market efficiency function. For example, the SEC has a mandate to promote efficient markets and capital formation,[24] which could be invoked as the basis for efforts to promote innovation. However, the SEC also has an investor protection mandate that could conflict with its efforts to promote fintech innovation.[25] The OCC has no statutory mandate to pursue competition or innovation; instead it is charged with "assuring the safety and soundness of, and compliance with laws and regulations, fair access to financial services, and fair treatment of customers" by national banks.[26] However, the OCC has committed to supporting "responsible innovation" by national banks, and justifies such support by recognizing that the banking system must innovate in order to "remain relevant and vibrant and to meet the evolving needs of the consumers, businesses, and communities it serves."[27] The OCC

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[22] Dodd-Frank Wall Street Reform and Consumer Protection Act, 12 U.S.C. § 5511(a) (2018).

[23] COMMODITY FUTURES TRADING COMMISSION, *About the CFTC*, https://www.cftc.gov/sites/default/files/anr/anrabout99.htm.

[24] SECURITIES AND EXCHANGE COMMISSION, *About the SEC*, https://www.sec.gov/about.shtml.

[25] The SEC arguably has a financial stability mandate as well. *See generally* Hilary J. Allen, *The SEC as Financial Stability Regulator*, 43 J. CORP. L. 715 (2018).

[26] 12 U.S.C. § 1(a) (2011).

[27] OFFICE OF THE COMPTROLLER OF THE CURRENCY (OCC), POLICY STATEMENT ON FINANCIAL TECHNOLOGY COMPANIES' ELIGIBILITY TO APPLY FOR NATIONAL BANK

recognizes, however, that it must approach such innovation with a view to protecting consumers and maintaining the stability of the banking system.[28]

Regulators contemplating new fintech innovations thus face many challenges. The remainder of this Section aims to make this discussion less abstract by discussing some concrete examples of fintech innovations that confound existing regulatory structures. I have chosen to discuss marketplace lending, robo-investment services and smart contract derivatives here, because they illustrate many of the regulatory quandaries raised by advances in big data analytics, artificial intelligence and smart contracts. However, this is in no way intended to be an exhaustive list of fintech innovations.

A. *Marketplace Lending*

In the marketplace lending business model, a borrower requests a loan using an online platform, and loan applications are assessed using a combination of big data analytics and machine learning.[29] Advances in data collection and processing technologies allow for a variety of non-traditional sources to be consulted, including "social media, public records (property transactions, births, deaths, marriage, divorce, criminal and civil legal matters, and the like), GPS and satellite tracking, and cameras."[30] Machine learning algorithms can be trained to process this voluminous data set relatively quickly, using rules learned by observing correlations between equivalent data points and default that exist for other customers.[31] If a prospective borrower meets the algorithmic criteria, then the loan will be made – initially by a bank, but the bank is soon repaid with funds provided by investors, whose interest in the loan is ultimately evidenced by a note issued by the online platform.[32] The platform also processes repayments and provides administrative services.[33]

CHARTERS (Jul. 31, 2018), https://www.occ.gov/news-issuances/news-releases/2018/pub-other-occ-policy-statement-fintech.pdf.

[28] *Id.* at 1.

[29] John L. Douglas, *New Wine into Old Bottles: Fintech Meets the Bank Regulatory World*, 20 N.C. BANKING INST. 17, 27 (2016).

[30] Jo Ann S. Barefoot, *Disrupting FinTech Law*, 18 FINTECH L. REP. 1, 5 (2015).

[31] Hilary J. Allen, *Driverless Finance*, 10 HARV. BUS. L. REV. 101, 113 (2020).

[32] Eric C. Chaffee & Geoffrey C. Rapp, *Regulating Online Peer-to-Peer Lending in the Aftermath of Dodd-Frank: In Search of an Evolving Regulatory Regime for an Evolving Industry*, 69 WASH. & LEE L. REV. 485, 491-95 (2012)

[33] For further discussion of the marketplace lending model and applicable regulations, *see id*. at 493.

The somewhat convoluted nature of the marketplace lending business model ensures that many regulators have oversight over at least some part of the process. The notes issued to the lenders are securities, and so that part of the process is regulated by the SEC.[34] The CFPB oversees the compliance of the platforms with federal financial consumer protection laws, and accepts complaints from marketplace lending customers.[35] The platforms must also comply with consumer protection regulations in each state in which they do business;[36] this has generated interest in the OCC's proposal to grant special purpose national bank charters to fintech companies that would preempt many of these state rules.[37] Although this so-called "fintech charter" is currently mired in legal challenges from state authorities, there has been speculation that large marketplace lending platforms like Prosper and LendingTree would be among the candidates for a fintech charter, if its legality is upheld. Furthermore, while marketplace loans are typically unsecured and for small amounts,[38] we should not be surprised if, in the future, regulated banks begin to adopt some of these new credit scoring innovations for mortgages and other larger loans. If this transpires, the OCC (which oversees national banks) will certainly have a significant interest in understanding how machine learning assesses creditworthiness.

Machine learning is a form of artificial intelligence, which can be distinguished from earlier generations of algorithms on the basis of its ability to function without precise instructions directing it to achieve a particular outcome. Instead, machine learning algorithms are "programmed to draw their own decision-making rules from exposure to voluminous data sets . . . ."[39] These algorithms work by detecting patterns and correlations from the data, but they cannot infer causation.[40] As a result, the decisions made by machine learning algorithms can be unpredictable, and their results may seem

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[34] Douglas, *supra* note 29, at 38.

[35] CONSUMER FINANCIAL PROTECTION BUREAU, CFPB NOW ACCEPTING COMPLAINTS ON CONSUMER LOANS FROM ONLINE MARKETPLACE LENDER (Mar. 7, 2016), available at https://www.consumerfinance.gov/about-us/newsroom/cfpb-now-accepting-complaints-on-consumer-loans-from-online-marketplace-lender/.

[36] Douglas, *supra* note 29, at 30-32.

[37] OCC, *supra* note 27.

[38] Marketplace loans are typically under $50,000 for small businesses and around $10,000 for individual consumers, *see Marketplace Lending 2.0: Bringing on the Next Stage in Lendin*g, DELOITTE, at 7 (2017), https://www2.deloitte.com/content/dam/Deloitte/us/Documents/financial-services/us-fsi-markeplace-lending2.pdf.

[39] Allen, *supra* note 31, at 105-6.

[40] *Id.* at 120.

inexplicable to humans.[41] Because these algorithms learn probabilistically, machine learning responses are most likely to diverge from human responses when assessing low-probability events.[42]

Machine learning is not central to the issuance of notes by the lending platforms, and so nothing in the marketplace lending business model seems to significantly upend the SEC's application of the securities laws that pertain to the offering and issuance of notes to investors. However, the consumer and prudential laws that have traditionally been applied to lending are likely to struggle with the machine learning aspects of this business model. A loan approval process based on new data sources and machine learning is vastly different to the more labor-intensive way that loan applications have been traditionally processed in the past. While by no means perfect, more traditional methods of borrower assessment have been honed and tested through many credit cycles, and regulators are accustomed to supervising these forms of assessments.[43] Machine learning, however, has only been applied to financial services in the decade since the last financial crisis,[44] putting "pressure on regulators to move from regulations designed to control human behavior to regulation that seeks to supervise automated processes."[45] Furthermore, these machine learning algorithms rely on a wide range of sources of granular data that will be new for regulators charged with assessing the quality of a financial institution's lending practices[46] – and most of these new data have been generated since the recovery from the financial crisis began, and so provide little indication of people's creditworthiness in a struggling economy.[47]

Machine learning therefore has the potential to upend supervision and examination strategies that have been developed over time to assess

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[41] Andrew Tutt, *An FDA for Algorithms*, 69 ADMIN. L. REV. 83, 87 (2017).

[42] Allen, *supra* note 31, at 128-9.

[43] For a discussion of the banking supervisory process, *see* RICHARD S. CARNELL, JONATHAN R. MACEY & GEOFFREY P. MILLER, THE LAW OF FINANCIAL INSTITUTIONS 344-9 (6th ed. 2017).

[44] U.S. DEPARTMENT OF THE TREASURY, OPPORTUNITIES AND CHALLENGES IN ONLINE MARKETPLACE LENDING, 1 (2016), https://www.treasury.gov/connect/blog/Documents/Opportunities_and_Challenges_in_Online_Marketplace_Lending_white_paper.pdf.

[45] Dirk A. Zetzsche et al., *Regulating a Revolution: From Regulatory Sandboxes to Smart Regulation*, 23 FORDHAM J. CORP. & FINCORP. & FIN. L. 31, 93 (2017).

[46] Dirk A. Zetzsche ET AL., *The Future of Data-Driven Finance and RegTech* 48 (Eur. Banking Inst., Working Paper No. 2019/35), https://ssrn.com/abstract=3359399.

[47] In 2016, IBM published a report that found that "90 percent of the data in the world today has been created in the last two years alone." *See*, IBM Marketing Cloud, *10 Key Trends for 2017*, 3 (Dec. 2016).

traditional loan approval processes, which can serve as an indicia of the lender's safety and soundness.[48] Mispriced loans can also be problematic from a consumer protection perspective. While a consumer may initially be very interested in obtaining a low-interest rate loan, if the credit assessment algorithm is improperly calibrated, the consumer may ultimately find themselves unable to repay the loan, which could expose them to default, collections processes and ultimately bankruptcy.[49] The stability of the financial system as a whole would suffer if a sufficiently large group of consumers received enough mispriced credit to create a bubble in a particular asset class, and then that bubble inevitably popped – generating negative impacts for the balance sheets of banks and other financial institutions[50] (those same banks and financial institutions could also be harmed if they themselves invested heavily in the mispriced loans). Regulators like the OCC will therefore have to experiment with new ways of assessing data quality (an issue that will be explored more fully in the next Part). They should also explore the technology available to allow machine learning algorithms to contextualize and provide explanations of their decisions,[51] and consider requiring regulated firms that rely on machine learning to use a form of this technology. Such explanations will better enable the regulators to supervise a firm's credit assessment process, and then address common errors with informal guidance or rules.

Advances in machine learning will also make it more difficult for the CFPB to assess whether the Equal Credit Opportunity Act (1974) ("ECOA") has been breached. This statute prohibits discrimination in the provision of credit on the basis of an applicant's race, color, religion, national origin, sex, marital status, age or participation in public assistance programs,[52] and the prohibition extends to credit scoring policies that have a disparate impact on any one of these classes.[53] ECOA prohibits:

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[48] "To evaluate a bank's financial soundness, examiners use the Uniform Financial Institutions Rating System, commonly known as the CAMELS system." CARNELL, MACY & MILLER, *supra* note 43, at 346. As part of this assessment, "[t]hey scrutinize the bank's lending and investment standards, internal controls, and risk-identification and loan-administration practices." *Id.* at 248.

[49] Leonard J. Kennedy et al., *The Consumer Financial Protection Bureau: Financial Regulation for the Twenty-First Century*, 97 CORNELL L. REV. 1144-5 (2012).

[50] *Id.*

[51] Andrew D. Selbst & Solon Barocas, *The Intuitive Appeal of Explainable Machines*, 87 FORDHAM L. REV. 1085, 1087 (2018).

[52] 15 U.S.C.§ 1691(a).

[53] CARNELL, MACY & MILLER, *supra* note 43, at 508.

> a creditor practice that is discriminatory in effect because it has a disproportionately negative impact on a prohibited basis, even though the creditor has no intent to discriminate and the practice appears neutral on its face, unless the creditor practice meets a legitimate business need that cannot reasonably be achieved as well by means that are less disparate in their impact.[54]

Over the decades, regulators have developed ways of assessing the disparate impact of facially neutral credit scoring techniques, but different strategies will be needed to assess whether machine learning algorithms have engaged (perhaps unwittingly) in discrimination by making decisions on the basis of proxy variables for protected classes.[55] As Prince and Schwarcz observe, a machine learning algorithm:

> does not care that the link between the variable and the desired outcome is actually due to association with a protected class; it only seeks to find the link. Indeed, because a model's goal is to find the best possible predictors though correlation, it will often be difficult, if not impossible, to determine from the model alone whether proxy discrimination is occurring.[56]

In addition to technologies that allow machine learning algorithms to provide explanations and context for their decisions, other technological solutions may also be useful to the CFPB: Prince and Schwarcz have suggested the possibility of exposing machine learning algorithms to additional data sets that will train them to control for membership of a protected class when making decisions.[57]

B. *Robo-Investment*

Robo-advisory firms offer automated investing services to consumers that aim to be at least as good as (if not better than) what a human financial

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[54] 12 CFR § 1002.6(a) (Supp. I 2019).

[55] Solon Barocas & Andrew D. Selbst, *Big Data's Disparate Impact*, 104 CAL. L. REV. 671, 675 (2016).

[56] Anya Prince & Daniel Schwarcz, *Proxy Discrimination in the Age of Artificial Intelligence and Big Data*, IOWA L. REV. (forthcoming 2020) (manuscript at 65), https://ssrn.com/abstract=3347959.

[57] *Id.* at 63. ("[T]he first step…is for the statistical model under consideration to be re-estimated in a way that explicitly includes data on legally prohibited characteristics.").

advisor can provide, at a fraction of the cost.[58] While robo-advisory firms already use predictive algorithms to provide automated "customer profiling, asset allocation, portfolio selection, trade execution, portfolio rebalancing, tax-loss harvesting, portfolio analysis,"[59] there is significant interest in developing machine learning techniques that can gather information about a client's financial situation and improve portfolio selection.[60] Because robo-advisory firms typically provide investment advice to their clients as well as executing transactions for them, they will usually be regulated both by the SEC and by FINRA (a self-regulatory organization that is overseen by the SEC and focuses on broker-dealer regulation).[61]

The SEC has traditionally not viewed itself as having a mandate to promote financial stability, and this stance has perhaps been most controversial in the context of its supervision of the asset management industry, of which robo-advisors form a part.[62] The potential for the asset management industry to negatively impact the stability of the financial system will likely be exacerbated by the increasing prominence of the robo-advisory services that the SEC oversees. Currently, the approach taken by many robo-advisory firms is to assign its investor clients to one of several buckets, with identical portfolios for everyone included in the same bucket, which raises the possibility that this business model will make investment decisions more monolithic, and thus exacerbate trends towards the asset bubbles and panics that undermine financial stability.[63] New advances in machine learning may ultimately be used to create more personalized portfolios, moving away from the current industry standard of putting

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[58] Tom Baker & Benedict Dellaert, *Regulating Robo Advice Across the Financial Services Industry*, 103 IOWA L. REV. 713, 719-20 (2018).

[59] FINRA, REPORT ON DIGITAL INVESTMENT ADVICE, 2 (2016), https://www.finra.org/sites/default/files/digital-investment-advice-report.pdf.

[60] *See, e.g.*, DELOITTE, *The Next Frontier: The Future Of Automated Financial Advice In The UK*, at 22 (2017), https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/financial-services/deloitte-uk-updated-robo-advice-new-horizons-layout-mww8.pdf ("[I]t is possible that we will see automated advisers enter more sophisticated advice markets and be able to deal with issues as complex as tax and holistic financial planning . . . .")

[61] Allen, *supra* note 31, at 12 ("For example, Betterment has registered with the SEC . . . [and] . . . registered with FINRA.").

[62] Allen, *supra* note 25, at 726. ("[T]he FSOC issued a Notice Seeking Comment on Asset Management Products and Activities that stated 'the SEC's initiatives are not specifically focused on financial stability.'")

[63] Allen, *supra* note 31, at 27 ("[W]hen financial decision-making is automated and performed by a few algorithms rather than a crowd of individuals, market behavior is likely to become even more correlated.").

investors in just a few buckets,[64] but if the algorithms in question are learning from the same data set of historical market information, then they are nonetheless likely to learn to react in correlated ways.[65] Furthermore, because machine learning algorithms learn probabilistically, there is a real risk that they will consistently underemphasize low-probability but potentially high-consequence risks in choosing investment strategies.[66] If such a high-consequence tail event were to occur, the ramifications would be felt extremely quickly in a market characterized by automated portfolio rebalancing.

Stronger tendencies towards bubble-bust dynamics in the securities markets could have significant ramifications for the broader economy. I have therefore argued that "[i]n order to mitigate systemic risk, financial algorithms capable of machine learning may therefore need to be exposed to hypothetical scenarios that emphasize worst-case scenarios, and demonstrate the consequences of correlated responses to such events."[67] While by no means a perfect solution, such hypothetical scenarios would at least force machine learning algorithms to anticipate the possibility of a tail event, and then they could perhaps be trained in simulated 'war games' with other algorithms to mitigate the systemic repercussions of their decisions. The creation of hypothetical scenarios and conduct of war games would be an expensive and laborious process, with parallels to the creation of the stress testing scenarios currently devised by the Federal Reserve.[68] It is unlikely that the SEC would be eager to take the lead on such a process, but it could collaborate with the Federal Reserve using the Financial Stability Oversight Council (of which the SEC and Federal Reserve Chairs are both members) as a forum for such cooperation.[69]

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[64] FIN. STABILITY BD., ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN FINANCIAL SERVICES: MARKET DEVELOPMENTS AND FINANCIAL STABILITY IMPLICATIONS at 30 (2017), http://www.fsb.org/wp-content/uploads/P011117.pdf.

[65] Allen, *supra* note 31, at 29.

[66] *Id.*

[67] *Id.* at 45.

[68] The Federal Reserve creates "hypothetical macroeconomic scenarios that incorporate an assumed sharp deterioration in economic and financial conditions." Daniel K. Tarullo, Governor, Fed. Reserve, *Speech at the Federal Reserve Third Annual Stress Test Modeling Symposium*: *Stress Testing after Five Years* (Jun. 25, 2014), https://www.federalreserve.gov/newsevents/speech/tarullo20140625a.htm; Allen, *supra* note 31, at 45 ("The difficulty and cost of developing such scenarios should not be understated.").

[69] The FSOC recently committed to an "activities-based approach" to protecting financial stability. U.S. DEP'T OF TREASURY, FINANCIAL STABILITY OVERSIGHT COUNCIL PROPOSES CHANGES TO NONBANK DESIGNATIONS GUIDANCE (Mar. 6, 2019), https://home.treasury.gov/news/press-releases/sm621 ("The proposed guidance [regarding

The SEC's more traditional investor protection function will also face challenges as robo-advisory business models become more prominent. The Investment Advisers Act of 1940 seeks to protect investors from their advisers' conflicts of interest by requiring disclosures from advisers and prohibiting certain types of transactions:[70] while many have argued that such conflicts are less likely when investment decisions are being made by machines rather than fallible human beings, it is quite possible that machine learning algorithms might *learn* predatory behavior from data sets that include examples of conflicted transactions.[71] As with discrimination in the provision of credit (discussed in the previous Part), such undesirable behavior may be harder to detect when it is performed by a facially neutral algorithm. The SEC's approach of regulating conflicts through disclosure will be ineffective in this context unless the algorithm is designed to provide explanations and context for its decisions.

C. *Swaps as Smart Contracts*

At the most basic level, a derivative is simply a contract that derives its value from some kind of financial variable. A swap is a particular type of derivative contract that involves two counterparties swapping promises to exchange payments (which are calculated as a percentage of a specified notional amount).[72] The percentage is often derived from some kind of economic variable, such as an interest rate.[73] Perhaps the most notorious type of swap is the credit default swap ("CDS"), which played a pivotal role in the last financial crisis. A credit default swap involves one party swapping a premium (calculated as a percentage of a notional amount) for a promise from the other party to make a payment if a "credit event" occurs with respect to a referenced debt instrument (depending on the contract, credit events might

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nonbank financial company designations] would implement an activities-based approach to . . . financial stability."). Though some have questioned how genuine this push for activities-based regulation is, *see, e.g.*, Jeremy C. Kress et al., *Regulating Entities and Activities: Complementary Approaches to Nonbank Systemic Risk*, 92. S. CAL. L. REV. 1455, 1505 (2019), if the FSOC is truly committed to activities-based regulation, creating hypothetical data sets for robo-advisory firms would help address the threats to financial stability posed by this activity.

[70] COX ET AL., SECURITIES REGULATION: CASES AND MATERIALS 1019 (9th Ed.2020).

[71] Rory Van Loo, *Rise of the Digital Regulator*, 66 DUKE L. J. 1267, 1277, 1290 (2017).

[72] MARK JICKLING & RENA S. MILLER, CONG. RESEARCH SERV., DERIVATIVES REGULATION IN THE 111TH CONGRESS 27 (2011).

[73] *Id.*

include a ratings downgrade, a default, or a bankruptcy).[74] The contract itself is usually based on a form contract promulgated by the International Swaps and Derivatives Association, and referred to colloquially as an "ISDA."[75]

In the lead up to the last financial crisis, AIG alone had issued $1.8 trillion of credit default swaps that insured the holders of mortgage-backed securities against the occurrence of a credit event.[76] AIG did not have sufficient funds to actually pay all of the holders of those credit default swaps if a credit event occurred, but it had assumed that the underlying mortgage-backed securities would never default and that it would therefore never be required to make any payments.[77] AIG had grossly underestimated the risks associated with those mortgage-backed securities, however, and ultimately required a bailout from the federal government once systemic problems with mortgage-backed securities became apparent.[78] In response to the financial crisis, Title VII of Dodd-Frank was enacted, which was designed to manage the risks inherent in swap contracts by requiring most swaps to be cleared through a regulated central clearinghouse, and by requiring swap counterparties to post deposits (referred to as margin) with the clearinghouse to cover any losses.[79] The size of the deposit required is adjusted daily (marked-to-market) to reflect fluctuating risks associated with the underlying variable for the contract.[80] Title VII also requires most swap transactions to be reported.[81] This regulatory regime is primarily overseen by the CFTC, although the SEC has jurisdiction over security-based swaps.[82]

Dodd-Frank was enacted in 2010, before the current wave of fintech innovation. There is now significant interest in representing swaps as smart contracts, though,[83] so it is important to consider whether Title VII is equipped to deal with any new problems that smart contracts might create. "Smart contracts" are computer algorithms that govern the functionality of a

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[74] *Id.* at 31.

[75] STEPHEN J. LUBBEN, CORPORATE FINANCE 316 (2014).

[76] RENA S. MILLER & KATHLEEN ANN RUANE, CONGRESSIONAL RESEARCH SERVICE, THE DODD-FRANK WALL STREET REFORM AND CONSUMER PROTECTION ACT: TITLE VII, DERIVATIVES 5 (2012).

[77] *Id*; *see also* THE FIN. CRISIS INQUIRY COMM'N, THE FINANCIAL CRISIS INQUIRY REPORT, 266. (2011) [hereinafter FCIC Report].

[78] *Id.*

[79] *Id.*

[80] *Id.* at 3.

[81] *Id.* at 3.

[82] *Id.* at 5.

[83] *See, e.g.*, ISDA & King & Wood Mallesons, *Smart Derivatives Contracts: From Concept to Construction*, 27 (Oct. 2018) (available at https://www.isda.org/a/cHvEE/Smart-Derivatives-Contracts-From-Concept-to-Construction-Oct-2018.pdf).

contractual relationship (in this instance, a swap) and that are intended to be self-executing and self-enforcing.[84] Smart contracts are recorded and transferred on a "distributed ledger," "an electronic record that is updated in real-time and intended to be maintained on geographically disperse servers or nodes."[85] If a credit default swap were memorialized as a smart contract, the smart contract would automatically calculate and deduct the premium from one counterparty, and regularly check in with designated external sources (known as "oracles") to see if a credit event has occurred that would automatically initiate a transfer from the other counterparty.[86] The CFTC takes the view that swaps memorialized as smart contracts should be regulated like any other swap covered by Title VII.[87] Such an approach certainly has benefits – a credit default swap memorialized as a smart contract will still pose the risks posed by credit default swaps memorialized in paper contracts, and so Title VII's clearing and margin requirements remain appropriate. However, there are additional risks raised by smart contracts that are not contemplated by Title VII (particularly new kinds of operational risks relating to the distributed ledger on which the smart contracts will be hosted).[88]

Furthermore, many have expressed skepticism that Title VII's margin and collateral requirements are large enough to protect swap counterparties during a systemic event that affects more than one institution – in such circumstances, the solvency of the clearinghouses themselves could even be threatened, with major systemic implications.[89] It is quite possible that extraordinary measures would need to be taken during a future systemic crisis to prevent catastrophic failures, including the suspension of contractual terms that relate to the posting of margin.[90] Smart contracts–even when working as intended without any technological glitches or misinformed oracles–could create new problems in such a context.

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[84] Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 DUKE L. J. 313, 333 (2017); Carla L. Reyes, *If Rockefeller Were a Coder*, 87 GEO. WASH. L. REV. 374, 383–84 (2018).

[85] LabCFTC, *A Primer on Smart Contracts*, 7 (Nov. 27, 2018), available at https://www.cftc.gov/sites/default/files/2018-11/LabCFTC_PrimerSmartContracts112718.pdf.

[86] *Id.* at 15.

[87] *Id.* at 25.

[88] *Id.* at 27-29.

[89] *See, e.g.*, Adam J. Levitin, *The Tenuous Case for Derivatives Clearinghouses*, 101 GEO. L. J. 445, 462-463 (2013).

[90] Katharina Pistor, *A Legal Theory of Finance*, 41 J. COMPARATIVE ECON. 315, 320-321 (2013).

To illustrate, we can imagine how the CDS agreements that AIG entered into with Goldman Sachs and others in the lead up to the last financial crisis might have performed had they been smart contracts. In July 2007, Goldman Sachs sought to enforce provisions in its ISDAs with AIG that authorized Goldman Sachs to determine whether and how much collateral AIG should post in connection with those ISDAs.[91] At the time it had entered into these ISDAs, AIG had not developed its own models for assessing the amount of collateral requested by a counterparty – or even really recognized that a collateral call might be made at all.[92] Because AIG failed to negotiate over the possibility of a collateral call, if this right had been recorded in a smart contract, Goldman Sachs would simply have had to type the dollar amount of desired margin into a computer, and the smart contract would have withdrawn that dollar amount from AIG's account on the distributed ledger. This could have been a fatal blow for AIG, as early as the summer of 2007 – but smart contracts had not yet been developed, which gave AIG an opportunity to negotiate with Goldman Sachs over the amount of collateral to be provided. This is what transpired: Goldman Sachs agreed to negotiate, and they ultimately agreed that AIG could post much less collateral than Goldman Sachs had initially demanded.[93]

Of course, AIG had issued so many credit default swaps referencing ailing mortgage-backed securities that other counterparties were soon clamoring for collateral,[94] and AIG reached the brink of failure in September 2008 as a result of these margin calls.[95] AIG's insolvency was averted by the federal government, however, in order to prevent the domino effect of insolvencies that likely would have occurred if AIG had defaulted on all of its contracts with other financial institutions.[96] The federal government achieved this by pledging to provide AIG with funds to cover the margin calls.[97] If AIG's CDSs had been automated smart contracts, however, AIG's accounts might have been automatically debited for the collateral, rendering AIG insolvent before government funds could arrive. Unless a smart contract were programed in advance to delay execution following the announcement of a government bailout of a counterparty (an unlikely event that would probably not have been contemplated at the time the smart contract was formed), the

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[91] FCIC Report, *supra* note 77, at 266.
[92] *Id.* at 266.
[93] *Id.* at 268.
[94] *Id.* at 268-69.
[95] FCIC Report, *supra* note 77, at 344-345.
[96] MILLER & RUANE, *supra* note 76, at 5.
[97] *Id.*

government's ability to stave off a crisis by announcing relief would be circumscribed, making financial instability far more likely.

Title VII does nothing to address the new fragilities that are being introduced into the financial system by using smart contracts to automate (and therefore speed up and preclude the exercise of human judgment with respect to) the execution of swap contracts. The CFTC therefore needs to experiment with new types of regulatory measures that could pause and potentially undo these transactions when the circumstances warrant. Such measures might include requiring that all smart contract swaps be programmed to respond to an oracle maintained by the CFTC that could function as a circuit-breaker, allowing the CFTC to pause smart contract execution in extraordinary circumstances.[98] In order to detect the extraordinary circumstances that warrant the use of the circuit-breaker, the CFTC would need to invest in data analysis tools (such as risk indicator dashboards) that would provide it with early warning signals.[99] The CFTC could also consider requiring that all such smart contracts be hosted on a distributed ledger maintained by identifiable nodes with the power to undo erroneous transactions when necessary.[100] However, no such steps have yet been taken. The following two Sections will instead survey the regulatory experimentation that *has* been conducted to date by financial regulatory agencies with respect to fintech.

III. EXPERIMENTS WITH REGULATORY SANDBOXES AND OTHER INNOVATOR-FOCUSED REGULATORY APPROACHES

A. *Regulatory Models*

Technology entrepreneurs seeking to enter the market for financial services often find it hard to understand and comply with the regulations that apply to the financial industry – indeed, even established financial institutions can find it complicated to understand the regulations that would apply to a new financial product.[101] Jurisdictions seeking to encourage fintech innovation have therefore adopted a variety of measures to help innovators navigate the applicable financial regulations. The most prominent of these

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[98] Allen, *supra* note 31, at 141.

[99] Dirk Broeders and Jermy Prenio, *Innovative Technology in Financial Supervision (Suptech) – The Experience of Early Users*, BANK FOR INT'L SETTLEMENTS FIN. STABILITY INST. INSIGHTS ON POL'Y IMPLEMENTATION NO. 9, 3 (Jul. 2018).

[100] Allen, *supra* note 31, at 142.

[101] Hilary J. Allen, *Regulatory Sandboxes* 87 GEO. WASH. L. REV. 579, 588-592 (2019).

is the "regulatory sandbox" designed to allow innovators to conduct a limited test of fintech products and services in a lenient regulatory environment,[102] but there are many other ways in which financial regulators can and do support fintech innovation. This Section will discuss a sample of the measures that have been adopted, with a focus on the United States and the United Kingdom. This is admittedly a very limited sample–sandboxes and other measures to promote innovation have been prolific in many other jurisdictions (particularly in Asia)[103] –but this Article is focused primarily on the United States. The United Kingdom is discussed in this Article, however, because it pioneered the regulatory sandbox concept and as such has significant precedential value. Also, as a common law jurisdiction with a vibrant financial sector, the United Kingdom shares many similarities with the United States – analyzing the United Kingdom's approach therefore sheds light on the United States' situation.

The United Kingdom's FCA was the first to implement a fintech regulatory sandbox in 2016: the FCA describes this sandbox as "a 'safe space' in which businesses can test innovative products, services, business models and delivery mechanisms while ensuring that consumers are appropriately protected."[104] Applicants who are selected by the FCA receive six months of regulatory relief, after which (if the business model is sufficiently successful) they are expected to transition to the fully regulated environment.[105] The regulatory relief provided takes the form of a restricted authorization, which the firms can rely upon in order to test their financial products and services with a limited pool of customers – this alleviates the cost and delay associated with applying for a full authorization.[106] The FCA also provides individual guidance to sandbox firms as to how it will interpret the application of existing regulatory requirements (typically developed prior to the smartphone era) to new technologies.[107] Importantly, a restricted authorization still entails some regulation – sandbox firms must develop

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[102] *Id.* at 580.

[103] For a more global discussion of these efforts, see Ross P. Buckley et al., *Building Fintech Ecosystems: Regulatory Sandboxes, Innovation Hubs and Beyond*, 4 (Euro. Banking Inst., Working Paper Series no. 53, 2019), https://ssrn.com/abstract=3455872.

[104] Press Release, FIN. CONDUCT AUTHORITY, *Financial Conduct Authority's Regulatory Sandbox Opens to Applications* (May 9, 2016), https://www.fca.org.uk/news/press-releases/financial-con- duct-authority's-regulatory-sandbox-opens-applications.

[105] Allen, *supra* note 100, at 596.

[106] *Id.*

[107] *Id.*

policies in conjunction with the FCA to ensure some protections for the participating consumers.[108]

The FCA's sandbox has a very high profile, but it is only one part of the FCA's Project Innovate, which was started in 2014.[109] Through this project, the FCA also provides advice and other support to fintech innovators who are not participating in any sandbox cohort.[110] Buckley et al. observe that far more firms have benefited from this support than have benefitted from the FCA's regulatory sandbox.[111] Similar support programs for fintech have also been established in the United States, where they are arguably more necessary because of the limited opportunities for fintech innovators to participate in regulatory sandboxes. True sandboxes, offering waivers of regulatory requirements as well as guidance for innovators, have only been adopted by the states of Arizona, Utah and Wyoming and by the federal Consumer Financial Protection Bureau,[112] and each of these sandboxes faces significant limitations that undermine its appeal to innovators seeking to trial their products and services.

The appeal of the state-based sandboxes is limited by the fact that these sandboxes only allow innovators to test their products and services with customers residing in the relevant state.[113] There has been some discussion of "passporting," which would allow innovators to access consumers in all states that have established reciprocal sandbox arrangements and thus make state-administered regulatory sandboxes more useful for innovators, but such an arrangement would only be valuable if a large number of states adopted sandboxes with similar passporting arrangements.[114] Furthermore, federal laws will continue to apply to innovators participating in a state-administered sandbox. The CFPB's "Compliance Assistance Sandbox," which was launched in September of 2019,[115] is administered at the federal level and therefore provides access to a much larger market than state-administered

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[108] *Id.* at 597.

[109] Buckley et al., *supra* note 103, at 7.

[110] *Id.*

[111] *Id.* at 4.

[112] Anthony C. Kaye, *Utah's New Regulatory Sandbox,* CONSUMER FIN. MONITOR (Jun. 11, 2019), https://www.consumerfinancemonitor.com/2019/06/11/utahs-new-regulatory-sandbox/.

[113] Hilary J. Allen, *Sandbox Boundaries,* 22 VAND. J. ENT. & TECH. L. 299, 314 (2020)

[114] Wendy Kearns & Andrew J. Lorentz, *Fintech Sandboxes – Update on State Approaches*, DAVIS WRIGHT TREMAINE LLP BLOG (Apr. 16, 2018), https://www.dwt.com/blogs/payment-law-advisor/2018/04/fintech-sandboxes—update-on-state-approaches.

[115] BUREAU OF CONSUMER FINANCIAL PROTECTION, POLICY ON THE COMPLIANCE ASSISTANCE SANDBOX, 84 Fed. Reg.FR 48246 (Sept. 13, 2019).

sandboxes. However, the CFPB only claims the legal authority to preempt three enumerated federal consumer protection statutes[116] – and even that authority has been questioned by state attorneys-general.[117] Given the fragmented nature of financial regulatory authority in the United States, no regulatory sandbox is likely to give innovators any real certainty that they will be exempt from regulatory enforcement unless it is coordinated amongst all of the federal regulators, and designed to preempt all state regulation.[118]

In the absence of any compelling regulatory sandbox, many regulators in the United States have offered other types of support for fintech innovation. The main differentiating factor between regulatory sandboxes and these other forms of innovation support seems to be the "signaling" feature that regulatory sandboxes have, communicating that a jurisdiction is committed to fostering fintech innovation (although that signal may depreciate in value as more and more jurisdictions adopt sandboxes).[119] These other forms of regulatory support can nonetheless be very successful in promoting innovation. For example, many financial regulators have pre-existing powers to grant waivers and no action letters that can facilitate testing and piloting of innovative products and services, where appropriate, even in the absence of a sandbox.[120] Regulators have also pursued programs that do not provide any regulatory relief, but provide guidance to innovators in navigating regulatory regimes that were often adopted long before the technologies in question were designed, and as such are often difficult to reconcile. This support typically takes the form of providing opportunities for innovators to consult with the regulators – for example, the CFTC's LabCFTC, FinCEN's Innovation Hours and the P2P meetings hosted by the SEC's FinHub are all designed to allow for innovators to meet and receive guidance and feedback from regulatory personnel at an early stage of the innovation. As the CFTC puts it, "[s]uch feedback may include information that, particularly at an early stage, could help innovators/entities save time and money by helping them understand relevant regulations and the CFTC's approach to oversight."[121]

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[116] *Id.* at 48249.

[117] Kate Berry, *State AGs Assail CFPB Plan to Build Fintech Sandbox*, AM. BANKER (Feb. 12, 2019), https://www.americanbanker.com/news/state-ags-assail-cfpb-plan-to-build-fintech-sandbox.).

[118] Allen, *supra* note 101, at 619-20.

[119] Buckley et al., *supra* note 103, at 7, 18.

[120] *Id.* at 25.

[121] Commodity Futures Trading Commission, *LabCFTC Overview*, https://www.cftc.gov/LabCFTC/Overview/index.htm.

The Office of the Comptroller of the Currency has taken a slightly different approach, offering tailored regulatory regimes coupled with ongoing guidance in order to encourage innovation. It has proposed an "Innovation Pilot Program" that is intended to assist regulated banks experimenting with new technologies to navigate the regulatory requirements that apply to those technologies.[122] It also offers a so-called "Fintech Charter" that is available to non-banks[123] – although recipients of this charter would be subject to significant regulation by the OCC, it may nonetheless be appealing because it purports to preempt the application of state laws to the fintech firm.[124] However, because neither of the OCC's programs offers relief from federal regulations, they would not typically be considered sandboxes.

Efforts to support fintech innovation at the transnational level have also begun. The UK's FCA spearheaded the creation of the Global Financial Innovation Network in January 2019.[125] The CFPB was a founding member of the GFIN; the CFTC, SEC, FDIC and OCC joined in October of 2019 (the New York State Department of Financial Services and the Office of the Arizona Attorney General have also joined). It is not yet clear precisely what support the GFIN will give to individual innovators, but one of the GFIN's stated goals is to "provide accessible regulatory contact information for firms," and the GFIN also intends "to provide firms with an environment in which to trial cross-border solutions."[126] While the FCA had initially envisaged the GFIN as offering "a full multilateral sandbox that allows concurrent testing and launch across multiple jurisdictions," the level of regulatory coordination necessary for a project has been conceded as too ambitious for now.[127] Even bilateral regulatory coordination on sandbox trials is likely to involve a significant commitment of regulatory resources.

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[122] OFFICE OF THE COMPTROLLER OF THE CURRENCY, OCC INNOVATION PILOT PROGRAM 2 (Apr. 2019), https://www.occ.treas.gov/topics/supervision-and-examination/responsible-innovation/occ-innovation-pilot-program.pdf.

[123] OCC, *supra* note 27, at 2.

[124] The OCC's fintech charter would be a specialized national banking charter. *Id.* National banking charters preempt the application of state law in circumstances where the state law would "prevent or significantly interfere with the national bank's exercise of its powers." Barnett Bank of Marion County v. Nelson, 517 U.S. 25, 18 (1996).

[125] Gina Conheady, *Is Fintech Ready for a Global Regulatory Sandbox?*, A&L GOODBODY (Nov. 27, 2018), https://www.algoodbody.com/insights-publications/is-fintech-ready-for-a-global-regulatory-sandbox.

[126] *Terms of Reference for Membership and Governance of the Global Financial Innovation Network (GFIN)*, FIN. CONDUCT AUTHORITY (Feb. 27, 2020), 1https://www.fca.org.uk/publication/mou/gfin-terms-of-reference.pdf.

[127] Conheady, *supra* note 125.

B. *Limitations*

These experimental innovator-supporting programs have primarily been adopted to further the regulatory goals of efficiency, and to promote competition.[128] Fostering efficiency and competition can help ensure that consumers have better and cheaper access to financial services, but these regulatory goals must also be balanced against the goals of financial stability and investor/consumer protection. Given the far-reaching societal costs of financial crises, financial stability should be the apex goal of financial regulation.[129] The protection of consumers and investors (in order to ensure that they have sufficient confidence to participate in a financial system characterized by information asymmetries) is also a key purpose of financial regulatory regimes around the world – widespread harm to investors and consumers was the genesis of the SEC and CFPB respectively.[130] Financial stability and consumer/investor protection are the core functions of financial regulators.

This Article therefore argues that when designing financial regulatory experiments, the core goals of financial stability and consumer/investor protection should not be neglected in favor of innovation-driven efficiency and competition. In practice, however, these latter goals have been the preeminent drivers of regulatory experimentation to date. This is likely part of a larger phenomenon: as Professor Coffee has explained, the attitudes of regulators and the public towards the necessity of protective financial regulation tend to move in a "regulatory sine curve," waxing immediately following a crisis and waning as time passes and memories fade.[131] It is therefore not particularly surprising that more than a decade after the last crisis, regulatory focus has shifted towards promoting innovation and competition, potentially at the expense of consumers, investors and the

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[128] Zetzsche et al., *supra* note 45 at 69-70; *Global Financial Innovation Network (GFIN) Consultation Document*, FIN. CONDUCT AUTHORITY, 17 (Aug. 2018), https://files.consumerfinance.gov/f/documents/bcfp_global-financial-innovation-network_consultation-document.pdf.

[129] Allen, *supra* note 11, at 1088. *See also* Jeffrey N. Gordon, *'Dynamic Precaution' in Maintaining Financial Stability: The Importance of FSOC* (Colum. L. and Econ., Working Paper No. 587, 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3229518.

[130] MICHAEL S. BARR ET AL., FINANCIAL REGULATION: LAW AND POLICY. 49, 63 (2nd ed., 2016).

[131] John C. Coffee Jr., *The Political Economy of Dodd-Frank: Why Financial Reform Tends to be Frustrated and Systemic Risk Perpetuated*, 97 CORNELL L. REV. 1019, 1029 (2012).

stability of the financial system as a whole. The fact that it is unsurprising does not make it good policy, however.

Most of the methods of innovation support discussed in the previous Part are very resource intensive, as a result of the one-on-one support provided to innovators by the regulators (it has been observed that programs that fail to invest significant regulatory resources are unlikely to be as successful in promoting innovation).[132] Such support can certainly help innovators bring their products and services to market, but if the innovation process primarily benefits the innovator and does not generate broader benefits for society, then it is not good public policy to dedicate scarce public resources to facilitating the innovation process.[133] Ideally, such support will result in innovations that are both profitable *and* beneficial for consumers/investors (particularly in previously underserved markets) by providing financial services more cheaply and efficiently.[134] However, if "financial inclusion" turns out to be a euphemism for unscrupulous fintech providers preying upon unsophisticated consumers and investors, then it will be particularly important for financial regulators to continue to exercise their more traditional consumer/investor protection functions. Furthermore, it is unrealistic to expect private sector innovation to further the regulatory goal of financial stability, except inadvertently (private sector innovators almost always lack the incentives – not to mention the ability to coordinate their competitors – necessary to promote the stability of the financial system as a whole).[135] Regulatory sandboxes could prove to be a particularly problematic form of regulatory experimentation if they dispense with regulations that are designed to protect consumers, investors or financial stability – in such circumstances, they could operate as a form of deregulation that results in real harm.

Unfortunately, the limitations of innovator-supporting regulatory programs often receive less attention than they deserve, perhaps because of an unwarranted presumption that innovation is inherently good.[136] That presumption should not be left unexamined, however. Supporting fintech innovation should not result in financial regulators neglecting their core objectives of consumer/investor protection and financial stability.

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[132] Buckley et al., *supra* note 103, at 6.

[133] Allen, *supra* note 101, at 606.

[134] FIN. CONDUCT AUTHORITY, REGULATORY SANDBOXES LESSONS LEARNED REPORT 9 (Oct. 2017), https://www.fca.org.uk/publication/research-and-data/regulatory-sandbox-lessons-learned-report.pdf.

[135] Allen, *supra* note 11, at 1103.

[136] For a critique of this assumption, see Allen, *supra* note 101, at 605 *et seq*.

Experimentation with innovator-supporting regulatory programs can *incidentally* benefit these regulatory goals, by allowing regulators to influence the development of new innovations, and to learn about nascent technologies (as such, the value of these programs should be assessed by reference to the level of collaboration, influence and information-sharing involved).[137] However, the regulatory experiments discussed in the previous Part were not adopted for the *primary* purpose of helping financial regulators to execute their core regulatory goals.

Furthermore, all of the regulatory experiments discussed in the previous Part require an affirmative decision by a private firm to participate. They do not provide any tools for financial regulators to pursue their core mandates of consumer/investor protection and financial stability against firms that do not opt in to collaborating with the regulator. The next Section will therefore explore other types of experimentation that regulators should consider engaging in – experimentation that uses technology in an attempt to address the problems for investors, consumers and financial stability raised by fintech's new processes for delivering financial products and services, irrespective of whether a fintech firm has chosen to work with the regulator.

IV. EXPERIMENTATION WITH SUPTECH

A. *The State of Regulatory Innovation*

The previous Section demonstrated that the most high-profile experimentation with fintech regulatory strategies has been outward facing, designed to support private-sector innovators. In the last year, however, regulators around the world have increased their own experimentation behind the scenes, exploring the use of technologies to address their own core mandates.[138] This Article uses the term "SupTech" to refer to innovation by financial regulators that is informed by technological advances in big data analytics, machine learning, and distributed ledger technology.[139] Readers may be more familiar with the term "RegTech," but this Article prefers "SupTech" because of the confusion inherent in the former term. "RegTech" is used to describe technologies that are used by industry participants to

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[137] Allen, *supra* note 101, at 636.

[138] "Suptech solutions have emerged only recently, with a marked take-off in 2019." Simone de Castri et al., *The Suptech Generations*, BANK FOR INT'L SETTLEMENTS FIN. STABILITY INST. INSIGHTS ON POL'Y IMPLEMENTATION NO. 1, 14 (Oct. 2019).

[139] *Id.* at 1; Yang & Tsang, *supra* note 10, at 366. (stating that Suptech is when financial authorities use innovative technology).

facilitate their own regulatory compliance, as well as innovations that are used by the regulators themselves to improve their regulatory functions.[140] This Article focuses primarily on the latter, and so the narrower term "SupTech" provides more precision.

While few SupTech applications are operational,[141] regulators around the world are becoming increasingly interested in trialing or developing such applications, with the Financial Stability Institute of the Bank for International Settlements reporting in October 2019 that approximately twenty financial regulatory bodies were engaging in some type of SupTech experimentation.[142] To date, SupTech has focused primarily on improving the collection and analysis of voluminous amounts of data relating to reporting requirements, fraud detection, and AML compliance.[143] The focus on reporting requirements makes sense in light of the increased volume of data that must be disclosed post-Crisis[144] and the private sector's increasing use of RegTech solutions to automate their compliance with those regulations[145] (as Baxter has noted, "[m]anual surveillance of automated activities . . . is entirely unrealistic, and the automation of many of the regulatory tasks traditionally performed manually seems imperative").[146] Regulators are also realizing that SupTech has the potential to be more than a defensive necessity; market surveillance for fraud and money-laundering may increasingly allow for real-time detection and intervention[147] and the hope is that "risk and compliance monitoring [will turn] from a backward-looking into a predictive and proactive process."[148]

Looking more specifically at the US financial regulators discussed in this Article, there is little information available (at least publicly) regarding any

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[140] For a discussion of the different meanings of the word "RegTech", *see* Luca Enriques, *Financial Supervisors and RegTech: Four Roles and Four Challenges* (Revue Trimestrielle de Droit Financier 53, 2017), https://ssrn.com/abstract=3087292.

[141] De Castri et al., *supra* note 138, at 2 (stating most Suptech solutions are experimental in nature).

[142] *Id.* at 8.

[143] *Id.* at 10.

[144] Broeders & Prenio, *supra* note 999, at 3. ("Post-crisis regulatory reforms have led to an upsurge in reporting requirements. This increases the need for efficient and effective monitoring to benefit from the resulting boost in data availability").

[145] De Castri et al., *supra* note 138, at 14. (stating Suptech solutions began to arise because of the burden on complying with regulations).

[146] Baxter, *supra* note 13 at 597.

[147] De Castri et al., *supra* note 138, at 11-12 (stating AI tools are well equipped to handled time-sensitive and unstructured data).

[148] Broeders & Prenio, *supra* note 99, at 1.

SupTech experimentation by the CFPB or OCC,[149] while the SEC and CFTC have engaged in more highly publicized experimentation. The SEC has focused its attentions on XBRL (machine readable data) reporting requirements, the MIDAS system to analyze big data generated by the equity markets, the ARTEMIS big data enforcement tool, and the Consolidated Audit Trail for tracking and recording trading activity across the securities exchanges.[150] These SEC programs are primarily focused on improving disclosure and surveillance processes, and the CFTC has similarly emphasized disclosure and surveillance in its "CFTC 2.0" initiative, noting that:

> [n]ew technologies hold the promise to change the way the CFTC fulfills its mission. For example, FinTech innovation could reshape the way the CFTC conducts market oversight to enhance market and risk surveillance vital to market integrity. FinTech innovation may also provide new ways for the CFTC to gather and disseminate market data to improve transparency. Through CFTC 2.0, CFTC staff can explore promising ideas and have the opportunity to develop greater in-house capability and knowledge.[151]

Experimentation with these types of SupTech is laudable. However, such experimentation has thus far sought to streamline *existing* regulatory functions. This Article (particularly Section II) has made the case that *new* regulatory functions are needed to respond to the qualitative changes that fintech is making to the processes by which financial services are being delivered. This type of SupTech experimentation is sorely lacking. Furthermore, there has only been very limited exploration of using SupTech

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[149] An argument could be made that the CFPB engaged in SupTech experimentation from its inception, as it sought to be a data-driven, technologically-savvy agency. Kennedy et al., *supra* note 49 at 1143. However, under its current leadership, the CFPB's Office of Innovation appears very innovator focused, with little apparent emphasis on developing new regulatory solutions in-house. CFPB, *Bureau of Consumer Financial Protection Announces Director for the Office of Innovation* (Jul. 18, 2018), https://www.consumerfinance.gov/about-us/newsroom/bureau-consumer-financial-protection-announces-director-office-innovation/. Similarly, materials available on the OCC's Office of Innovation make no reference to SupTech or to RegTech more generally. See, for example, OCC, *Office of Innovation*, https://www.occ.gov/topics/supervision-and-examination/responsible-innovation/occ-innovation-general-brochure.PDF.

[150] Michael S. Piwowar, *Old Fields, New Corn: Innovation in Technology and Law*, REMARKS AT THE 2018 REGTECH DATA SUMMIT (Mar. 7, 2018), https://www.sec.gov/news/speech/piwowar-old-fields-new-corn-innovation-technology-law.

[151] COMMODITY FUTURES TRADING COMMISSION, *CFTC 2.0*, https://www.cftc.gov/LabCFTC/CFTC2_0/index.htm.

to improve the performance of existing *prudential* regulatory functions,[152] which will become crucial as private firms increasingly use machine learning algorithms for risk management.[153] Yang and Tsang have observed that "[s]ome financial regulators have applied Al in model validation to detect anomalous projections generated by its models of stress tests, while others have applied it to model the capital market business for bank stress testings",[154] and the Bank of Italy is using machine learning to "analyse real estate ads in a popular online portal to forecast housing prices and inflation."[155] Overall, however, the BIS has found that very few financial regulators are dedicating their SupTech resources to prudential oversight responsibilities[156] – notwithstanding the potential for aggregating new data sources and machine learning analysis techniques to detect threats to individual institutions and the financial system as whole.[157] More experimentation with SupTech is therefore necessary, although such experimentation raises a host of challenges that are discussed in the next Section.

B. *Challenges for SupTech Innovation*

U.S. financial regulators have been comparatively slow to experiment with innovator-supporting regulatory approaches to fintech, so it would not be particularly surprising if they were not early movers in experimenting with SupTech either. However, while caution is justified when considering regulatory sandboxes and other innovator-supporting approaches (because of the resource-intensive nature of such policies and uncertainties about their ability to further core regulatory goals),[158] experimentation with SupTech should be pursued as a matter of priority. The application of machine learning and smart contracts to financial services is only just beginning, and so there is still significant scope for regulators to require that SupTech technologies be incorporated into privately-developed financial products.[159] Inserting SupTech technologies into such products once they have become operational will be far more difficult, and more likely to result in unexpected (and potentially negative) side effects.[160] Time is therefore of the essence in

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[152] De Castri et al., *supra* note 138, at 10.
[153] Yang & Tsang, *supra* note 10, at 363; 367.
[154] *Id.* at 367.
[155] De Castri et al., *supra* note 138, at 14.
[156] *Id.* at 10.
[157] Broeders & Prenio, *supra* note 99, at 12-13.
[158] Allen, *supra* note 101, at 581.
[159] Allen, *supra* note 31, at 109.
[160] *See e.g.* Hilary J. Allen, *Payments Failure* (manuscript on file with author).

SupTech experimentation – unfortunately, SupTech experimentation is very resource intensive, and faces other challenges as well. This Part will consider these challenges.

Many of the problems highlighted in Section II regarding the difficulty of regulating innovation generally pertain to the development of SupTech tools. Limited resources and expertise are an unavoidable constraint. Some form of regulatory arbitrage is inevitable, and regulators must also be careful to balance their commitments to preserving financial stability and protecting consumers/investors with any mandates to promote competition and market efficiency (the latter of which are often facilitated by new innovation). The enormity of these challenges may help explain regulators' limited embrace of SupTech so far. The BIS has made similar observations with regards to regulators' hesitancy to experiment with SupTech, noting "(i) concerns among financial authorities about the uncertain value and risks of suptech [particularly operational risks]; (ii) resource constraints; and (iii) a limited product offering for suptech solutions from a small pool of specialised technology vendors. The inertia inherent in legacy IT systems is another factor." [161]

The most obvious and pressing concern is a lack of resources and expertise. If technology is to be harnessed to achieve the regulatory goals of consumer/investor protection and financial stability, regulators will either have to develop that technology in-house or enlist someone to develop it for them. The approach chosen will depend in large part upon the resources available internally – often, regulators will lack the necessary personnel and expertise for in-house development.[162] However, regulators can only outsource if there is someone they can outsource to, and there are few vendors specializing in SupTech tools.[163] If regulators can find a suitable third party vendor, the efficacy of the technology they receive from that vendor will be necessarily constrained by their budget, and by the ability of regulators to monitor the vendor.[164] Input into the process of technological development is vital to shaping it, and so ongoing dialogue between the regulator and the vendor is vital to ensuring that the technology will properly execute regulatory priorities.[165] In order to be able to achieve this, regulators need

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[161] De Castri et al., *supra* note 138, at 14.

[162] Enriques, *supra* note 140, at 5. (A supervisor can act as a developer of RegTech if the supervisor has people with the required skillset).

[163] De Castri et al., *supra* note 138, at 15. (Only a quarter of suptech initiatives are developed by external vendors).

[164] For a discussion of private firms' analogous difficulties in overseeing outsourced technology development, *see* Veerle Colaert, *RegTech as a Response to Regulatory Expansion in the Financial Sector* 14 (Working Paper, 2018), https://ssrn.com/abstract=2677116.

[165] *Id.*

personnel who are able to communicate with the technical specialists at the vendor. As such, if regulators do not have the resources necessary to execute SupTech solutions in-house, they at least need to prioritize hiring or cultivating 'interpreters', who have one foot in the regulatory world and one foot in the technical world. These interpreters may not be as technologically sophisticated as the people actually creating the SupTech solutions, but they should be able to communicate at a sufficient level that they can relay the regulator's demands, and check at all intermediate steps that the technical solutions are responsive to those demands. Unfortunately for the regulatory agencies, such a skill set will be very valuable, and they may have difficulty retaining these 'interpreters.'[166]

Retention efforts must be made, however, because interpreters will remain vital after the initial solution has been built. Regulators must remain humble about their technological solutions, and admit when they have failed or require substantial revision – otherwise, the product will entrench and institutionalize flawed regulatory approaches.[167] The interpreters will be needed to determine if the technology is performing as needed, and the technology should be designed in a way that is sufficiently transparent to allow interpreters to either make any necessary changes themselves, or at least detect the parts of the system that require revision and contract technological experts to make the necessary changes.[168] SupTech solutions are therefore not costless to maintain, although they may increase regulatory efficiency and thus conserve resources that would otherwise need to be devoted to supervision.[169]

Luca Enriques has noted that where regulators have limited funds available to pay vendors for SupTech solutions, the same vendors may wish to leverage their work by providing related compliance solutions to private firms who can pay more – this may result in a very sophisticated form of regulatory arbitrage where the vendors skew the SupTech software in favor of their more lucrative private clients.[170] One possible way to avoid such an

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[166] Broeders & Prenio, *supra* note 99, at 18-19 ("Because of the scarcity of staff with the right background, each suptech solution may be dependent on just one or two key persons. . . . retaining qualified staff for the long term is likely to become increasingly difficult.").

[167] Colaert, *supra* note 164, at 13.

[168] *Id.* at 18 ("Internal transparency should further guarantee that changes can be made to complex systems at a later stage, even when the original developers of the system are no longer available for support.").

[169] *Id.* at 8 (". . . RegTech has been claimed to offer massive cost savings.").

[170] Enriques, *supra* note 140, at 5 (". . . when in a position to exploit information asymmetries vis-à-vis supervisors as customers, rather cater to the interests of market players [the larger and higher-margin clientele] than to those of supervisors.").

outcome is for regulators to partner with quasi-public sector entities with significant research capacity, such as universities with strong data science or software engineering departments[171] – this may be the most fruitful approach for developing the cutting edge regulatory tools advocated for in this Article.[172] Even when arbitrage is not baked into the SupTech technology itself, other forms of regulatory arbitrage remain possible – through interviews with financial regulators around the world, the BIS found that "a few supervisory agencies recognize the risk that their use of suptech might lead to market participants adjusting their behavior in order to "game" the technology."[173]

Regulatory bodies adopting SupTech solutions must therefore remain alert to forms of arbitrage, and they must also devote more resources to managing their own internal operational risks.[174] Technology-driven regulatory tools may become a target for cyberattacks, and the more complex they are, the more susceptible they are to unanticipated glitches that can cascade and compound as they move through the regulatory apparatus.[175] Such operational failures may not be confined within the agency – they may ultimately cause problems for regulated entities as well, particularly if RegTech and SupTech software are designed to be interoperable.[176] Such a possibility creates reputational and legal risks for regulatory agencies that must also be managed. Ultimately, some SupTech failures should be expected (particularly when new technologies are being layered over legacy technology systems); trial and error will be necessary.[177] While fear of the fallout from the errors might understandably deter regulators from embracing SupTech solutions, waiting too long to address the new fintech processes being adopted by the private sector is ill-advised for both political economy and technological reasons. Regulators often find it difficult to upset market expectations about the regulatory treatment of an established product

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[171] Yang & Tsang, *supra* note 10, at 400.

[172] De Castri *et al.*, *supra* note 138, at 15 ("Academic partnerships, meanwhile, can be fruitful for exploratory projects on the cutting edge of suptech research.").

[173] Broeders & Prenio, *supra* note 99, at 2.

[174] *Id.*

[175] *See e.g.* Hilary J. Allen, *Payments Failure* (manuscript on file with author).

[176] Interoperability is an identified goal of SupTech experimentation: "The key to effective OversightTech, or the use of RegTech by supervisors for oversight purposes, will be for the software to be interoperable (that is, able to dialogue) with ComplianceTech products and possibly even with Operations RegTech products." Enriques, *supra* note 140, at 4.

[177] Yang & Tsang, *supra* note 10, at 361.

or service,[178] and it is also much easier to shape a technology (for example, by inserting a circuit breaker into a smart contract) during its development than it is to alter an operational technology – and the latter is much more likely to result in unanticipated negative consequences.[179]

Even when financial regulators accept that proactively engaging in SupTech innovation is in their long-term best interests, it can be challenging to identify and prioritize opportunities for SupTech applications. Some regulatory agencies are directing their researchers to develop technological responses to questions posed by policymakers and academics; at other agencies, the regulators themselves are identifying technologies that would assist them in discharging their functions.[180] In either instance, the technological solutions adopted may have to straddle a number of different regulatory objectives. In some situations, there may not be any cause for conflict – the financial industry, regulatory agencies and financial intelligence units like FinCEN tend to be aligned in seeking more efficient ways to investigate and prevent financial crime (this win-win mentality is perhaps part of the explanation for why so much SupTech innovation has occurred in the field of AML/KYC technology, including biometrics and big data analytics).[181] More efficient and targeted approaches to reporting and fraud detection could also be considered a win-win, but some SupTech solutions may have negative consequences for other financial regulatory mandates.

For example, algorithms work more quickly with fewer lines of code, and so adding technological requirements like circuit breakers to smart contracts could make the product marginally less efficient. It may also be hard to determine upfront whether a SupTech innovation will have unintended consequences that could ultimately undermine a regulatory goal. For example, if multiple machine learning algorithms are trained with the same regulator-developed hypothetical scenarios in order to expose them to the possibility of tail events, then the result may be greater correlation in the behavior of the algorithms – which could ultimately create financial instability.[182] In developing such scenarios, regulators should therefore try to anticipate the reflexivity of algorithmic interactions,[183] but it is still possible that regulatory efforts could create what Whitehead has termed

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[178] Wu, *supra* note 7, at 1850; Kenneth C. Kettering, *Securitization and its Discontents: The Dynamics of Financial Product Development*, 29 CARDOZO L. REV. 1553, 1651 (2008).

[179] Allen, *supra* note 31, at 109.

[180] Broeders & Prenio, *supra* note 99, at 13-14.

[181] Yang & Tsang, *supra* note 10, at 368-710.

[182] Allen, *supra* note 31, at 145.

[183] *Id.*

"destructive coordination."[184] The possibility of such an outcome will be heightened if there is international regulatory collaboration on developing SupTech tools – and such collaboration is to be expected, because it can help scale many of the other benefits of SupTech.[185]

Regulators therefore need to constantly interrogate their SupTech innovations in light of their broader understanding of the financial system and their regulatory goals.[186] This can be challenging even for experienced regulators – it can be tempting to instead defer to a technological solution without interrogating its underlying process (a heuristic known as "automation bias").[187] Indeed, many tech tools seem designed to encourage automation bias, offering "intuitive, user-friendly interfaces with advanced graphics and interactive tools, which empower end users with non-technology backgrounds . . . to tap into the benefits of these advanced technologies."[188] However, automation is not a neutral process, but a reflection of the policy views of the regulators implementing the solution, perhaps tempered by the beliefs and understandings of the third-party vendor actually constructing the solution.[189] Regulators must therefore maintain some degree of skepticism and humility regarding their SupTech solutions. For more junior personnel who join regulatory agencies in the era of SupTech, it will be even more important that they be trained in developing nuanced regulatory expertise and temper their use of SupTech with human judgment.[190] Otherwise, the skillsets of regulatory expertise and judgment may be lost as regulators increasingly defer to technological solutions.[191]

CONCLUSION

SupTech is not a panacea, and we should remain mindful of Haldane and Madouros' admonition that it can be counterproductive for regulators to meet

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[184] Charles K. Whitehead, *Destructive Coordination*, 96 CORNELL L. REV. 323 (2011).

[185] There are a number of international fora already working to coordinate SupTech experimentation, including the BIS' Innovation Hub. De Castri et al., *supra* note 138, at 2.

[186] Baxter, *supra* note 13, at 603.

[187] Kenneth A. Bamberger, *Technologies of Compliance: Risk and Regulation in a Digital Age*, 88 TEX. L. REV. 669, 676 (2010).

[188] FINRA, TECHNOLOGY BASED INNOVATIONS FOR REGULATORY COMPLIANCE ("REGTECH") IN THE SECURITIES INDUSTRY 7 (Sept. 2018), available at https://www.finra.org/sites/default/files/2018_RegTech_Report.pdf.

[189] Baxter, *supra* note 13, at 603.

[190] Colaert, *supra* note 164, at 16.

[191] Colaert has cautioned against a similar outcome for private firms relying on RegTech tools. *Id.* at 26.

industry complexity with regulatory complexity.[192] However, when the industry is using complex technologies like smart contracts and machine learning, it is difficult to see how regulators can develop simple strategies for engaging with them – other than banning them, or requiring a preapproval process that would significantly slow their development. A preapproval process for new financial technologies would have many benefits, but seems politically infeasible at present (as well as ripe for jurisdictional arbitrage).[193] And bans, although they may be warranted in some circumstances, are an extreme response that could restrict the development of products and services that might ultimately benefit individual consumers and investors.[194] Financial regulators therefore need to experiment with technological responses to the technologies they regulate, and they need to do so as a matter of priority. Experimentation will take time, and if regulators miss their window, the financial system will be shaped entirely by the experimentation of a private sector with little motivation to protect consumers, investors, or the stability of the financial system.

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[192] Andrew G. Haldane, Exec. Dir., Fin. Stability, Member, Fin. Policy Comm. & Vasileios Madouros, Economist, Bank of Eng., *Speech at Federal Reserve Bank of Kansas City's 36th Economic Policy Symposium: The Dog and the Frisbee* (Aug. 31, 2012), available at http://www.kansascityfed.org/publicat/sympos/2012/ah.pdf.

[193] Allen, *supra* note 5, at 209 *et seq*.

[194] Rory Van Loo, *Making Innovation More Competitive: The Case of Fintech*, 65 UCLA L. REV. 232, 232 (2018).