Financial Services Leadership Summit

October 2019

FSLS

PREVIEW

Making the system resilient in a new age of financial services

> *We are ten years out and it's not entirely clear to me that people learned the lessons they needed to the last time. Have we really done all that we need to do to understand the risks we are taking on? Have we done enough in the non-financial risk area to understand whether we are going to be resilient going forward?* – Summit participant

These questions were posed by a participant in the 2019 Financial Services Leadership Summit; they represent some of the core matters for discussion on the 16th and 17th of October in Washington, D.C. Participants from the Bank and Insurance Governance Leadership Networks – directors, executives, regulators, and other subject matter experts – will meet to discuss how to make the financial system resilient to a range of evolving risks.

More than ten years after the global crisis, the financial services business has changed. Large institutions have shored up capital and liquidity, new rules have been implemented, and supervision has tightened. Yet, business models have also changed, and new models are emerging, as incumbents and fintechs adopt advanced technologies and large tech companies wade into financial services. New risks are moving up the agenda for the leaders and boards of financial institutions; some of these risks could have systemic implications. Operational, technological, and geopolitical risks remain challenging to measure and monitor. Firm leaders and regulators are working hard to understand and anticipate the second- and third- order effects to institutions and the system.

At the summit, participants will discuss questions including: How effectively have policymakers, regulators, and financial institutions addressed the risks that triggered the last crisis? What risks might trigger a future crisis? With the prospect of a global recession looming, we will consider the dimensions of risk that could stress the financial system and how financial institutions and their regulators are working to mitigate their impact.

This *PreView* is organized into the following sections:

- Economic and monetary policy may be exacerbating risk in the system
- Regulatory reform and response: looking back and ahead
- Could technical and operational risks trigger the next crisis?
- Disruption of traditional business models
- Climate change and other exogenous risks move up the agenda

Economic and monetary policy may be exacerbating risk in the system

At a dinner a few years ago, a bank chief executive advised a group of non-executive directors: *"Focus on the basics: the yield curve and interest rates. The yield curve itself is the biggest lever, but rate increases have almost as much impact on the financial income of your company."* As of the writing of this *PreView*, several key yield curves had inverted, and the President of the United States was exhorting the Federal Reserve to follow the European Central Bank and some other parts of Europe into negative interest rates. A number of indicators suggest that, following the single longest economic expansion in U.S. history, we may be on the verge of a slowdown and perhaps a global recession. Not since the immediate aftermath of the financial crisis have financial institutions, regulators, or policymakers had to deal with an economic downturn.

The global economy may already be in recession

"I don't think there will be a real deep recession, but it will be a global one. I am not sure what the policy response to it could be."

— Participant

An article in the *Financial Times* noted, "As any number of indicators now show — from weak purchasing managers' indices in the US, Spain, Italy, France and Germany, to rising corporate bankruptcies and a spike in US lay-offs — the global downturn has already begun."[1] An economist asserted, "US equities are at the second most expensive period in 150 years. Prices must fall." As a result, "Capital expenditure plans are being shelved. Existing home sales are dropping, despite lower mortgage rates. And perhaps most tellingly, American consumers are cutting both credit card balances and their usage of motor fuel — two things that are uncommon at any time, let alone in the middle of the vacation season."[2] A participant said, *"I don't think the system is able to extricate itself from a significant recession. I don't think there will be a real deep recession, but it will be a global one. I am not sure what the policy response to it could be."*

A global trade war initiated by the world's two largest economies – the U.S. and China – is unlikely to help: "In lieu of some big shift in US foreign policy post 2020 (one that none of the major Democratic candidates has yet articulated) the US and China are now in a multi-decade cold war that will reshape the global economy and politics."[3] This uncertainty, combined with low interest rates, and a series of other geopolitical concerns - including Brexit, political unrest in Hong Kong, and renewed conflict in the Middle East

driving up oil prices - may further hamper businesses from making investment decisions, contributing to recession fears. "People are a little less willing to make bets. Some clients are changing supply chains, while others are holding off on drawing down on their revolving lines of credit. There's enough uncertainty going on in the world that they're going to wait," according to Bank of America's Chief Operating Officer Thomas Montag.[4]

Monetary stimulus could be creating risks in the financial system

With rates already negative or close to negative in many major economies, monetary policymakers have limited room to maneuver. Worse, quantitative easing may now be contributing to concerns about financial stability. As one commentator described, "The Fed's decade-long Plan A — blanket the economy with money and hope for normalization — has failed. There is no Plan B. The Fed will undoubtedly try to paper over all this with more rate cuts."[5] But, as some analysts have pointed out, there is so much debt already in the private sector in the U.S. that lowering the cost of credit is unlikely to stimulate much additional demand.[6] A participant said, *"Central banks have exacerbated the problem by keeping interest rates low. It creates a lot of lack of productivity and corporate investments because companies are just getting by when they shouldn't by borrowing at incredibly low rates."*

> "*Companies are just getting by when they shouldn't by borrowing at incredibly low rates.*"
>
> — Participant

Huw van Steenis, senior advisor to the CEO at UBS and former advisor to the governor of the Bank of England, recently wrote in the *Financial Times*, "Quantitative easing programmes have helped the global economy and enabled banks to repair their balance sheets. Low rates have improved the affordability of their loans, reduced bad debts and lifted the value of assets." However, he continues, "With almost $17tn of negative-yielding debt already out there, I fear we have already hit the reversal rate — the point at which accommodative monetary policy 'reverses' its intended effect and becomes contractionary for the economy." The uncertainty around interest rate policy is also creating uncertainty for investors regarding their ability to spend today if they want to achieve savings objectives. Mr. Van Steenis notes, "As long as this uncertainty remains, it is hard for banks to know whether the loans they are making are economically sensible or for investors to price the securities of financial institutions with confidence."[7] And there is a very direct impact on bank profits as low rates cut into net interest margins, which could limit investment in things like cyber defense.

How might firms respond?

A recent article highlighted both the success that some of the largest US financial institutions have enjoyed since the last crisis and the challenges ahead:

> "The big American banks … have enjoyed a buoyant decade of macroeconomic context, when smaller groups, particularly those in Europe, have been through more challenging times … Scale really has been an advantage, both in absorbing the vast cost of post-crisis regulation, and in throwing off the kind of cash necessary to invest in the modernising technology that creates a virtuous circle of higher returns. Of course, success rarely lasts forever. And with so many storm clouds ahead, [the] challenge will be to maintain outperformance through the bad weather as well as the good."[8]

> *"What does change to the underlying consumer base mean for their interactions with the firms and the responses of the firms to those changes?... If things are put under economic pressure, where do they make their money?"*
>
> — Regulator

Maintaining financial performance through a downturn, especially in an industry so closely tied to the broader economy, could require additional risk-taking. A regulator posed the following: *"The central bank does resilience testing to monitor severe changes in the macroeconomic conditions that firms operate under. But I think there's less out there about what happens to conduct: what does change to the underlying consumer base mean for their interactions with the firms and the responses of the firms to those changes? Is that reasonably clear? If things are put under economic pressure, where do they make their money? How does that impact conduct within the system?"*

Regulatory reform and response: looking back and ahead

From the beginning of the global financial crisis, regulatory and policy reforms have shaped not only how the crisis was ultimately contained, but also how financial institutions operate and are supervised and how the broader financial system is monitored and governed. Looking back, supervisors and regulators lacked critical tools to respond to the emerging crisis, thereby exacerbating its scope and severity. For example, national supervisors had limited ability to coordinate across borders to wind down a failing institution in an orderly manner, which created or exacerbated the stress on other financial firms. This contributed to the need for taxpayer-funded bailouts of big financial institutions in several countries. Supervisors also lacked tools—for example, to influence compensation design and other accountability mechanisms—to rein in conduct issues and risk taking by individuals at financial institutions.

In the years since, many governments have strengthened supervisors' powers and tools. Coordination mechanisms were improved and cross-border cooperation enhanced. Regulators have also started employing innovative approaches, such as the use of advanced analytics and machine learning to identify risks and patterns. But some of the authorities and tools that regulators sought were not granted or were significantly limited. In some cases, the emergency powers were given to regulators but subsequently dialed back, possibly leaving gaps in their ability to respond to a future crisis. Geopolitical forces have altered the regulatory landscape, with rising nationalism and regionalism resulting in an emerging pushback against global coordination, perhaps at the expense of the greater good of the global economy and financial system.

Procyclicality remains an issue; the risks of shadow banking and other nonbank activities have continued to grow; some "too big to fail" institutions have gotten larger and more crucial to the system; and conduct issues have continued to diminish public trust. Furthermore, financial regulators need to consider new risks, as new technologies continue to drive digital transformation and transform the competitive environment. Some believe that these technology-related risks could cause or contribute to the next crisis. In a recent speech, Wayne Byres, chairman of the Australian Prudential Regulation Authority and former secretary of the Basel Committee on Banking

> *"The current regulatory framework is not designed for clouds, ecosystems, or partnership models. Not only do we need new skills, additional resources, and stronger partnerships, but potentially new powers."*
>
> — Wayne Byres
> Chairman, APRA

Supervision, said, "The current regulatory framework is not designed for clouds, ecosystems, or partnership models. Not only do we need new skills, additional resources, and stronger partnerships, but potentially new powers to ensure that as critical functions and data move outside the regulatory perimeter, we are able to satisfy ourselves that the requisite level of safety and control remain in place."[9]

This section of the *PreView*[10] presents context and poses questions in preparation for the opening discussion on October 16, focusing primarily on addressing policy and regulatory questions and leaving exploration of specific potential sources of systemic risk or disruption to later sections. This section will be guided by the following questions:

- How well have regulatory reforms addressed systemic risk?
- How are regulators handling new sources of systemic risk?
- How are regulators positioned to contain the next crisis?

How well have regulatory reforms addressed systemic risk?

In the decade since the financial crisis, regulators and financial institutions alike invested much of their time and energy in implementing a sweeping reform agenda. One participant said that now is a good time to reflect: *"The fact is we're 10 years out and it's not entirely clear to me that people learned the lessons they needed to learn last time. Bringing the reform agenda back out into the light and discussing it and lessons learned is important."* This section is not intended to be comprehensive, but rather to summarize the major reforms introduced in response to the crisis.

> *"Bringing the reform agenda back out into the light and discussing it and lessons learned is important."*
>
> — Participant

Among the key elements of prudential regulatory reform were changes to regulatory structures, strengthening capital and liquidity requirements, bank structural reforms, and enhanced supervisory intensity. International coordination was a cornerstone of reform efforts, as newly empowered organizations, primarily the Financial Stability Board (FSB) and the Basel Committee on Banking Supervision, took the lead in driving the agenda internationally. These efforts largely focused on those large institutions deemed to be systemically important. In 2011, the Basel Committee published its assessment methodology for identifying global systemically important banks (G-SIBs, also often called G-SIFIs); these institutions require greater scrutiny because of their size, complexity, interconnectedness, and lack of substitutes.[11]

Reshaping regulatory authorities and improving coordination

In response to perceived regulatory and supervisory failures in the run-up to the financial crisis, several countries reorganized their regulatory systems. In the United Kingdom, the Financial Services Authority was split into the Financial Conduct Authority and the Prudential Regulation Authority, while in the United States, the Office of Thrift Supervision was folded into the Office of the Comptroller of the Currency (OCC). Europe may have seen the greatest change with the creation of the European banking union for major Eurozone banks overseen by the European Central Bank. The Single Supervisory Mechanism and the Single Resolution Mechanism became the pillars of the European banking union.

Additionally, global and regional organizations were empowered, including the FSB and the Basel Committee on Banking Supervision, and became increasingly important for promulgating international or regional standards and coordinating across geographies. In Europe, the role of the European Banking Authority has evolved as the European Central Banks's role and prominence has expanded. One regulator said, *"They were very successful in having global coordination and alignment on a lot of global banking standards at the time. Of course, the role of these organizations is different now compared to 2010, when they were critical to a lot of the improvements that were made."* Today, one participant explained, *"There is definitely more of an information-sharing focus rather than rule making."*

The U.S. system remains fragmented, with multiple federal regulators and state regulations to contend with. Some now also question whether similar international coordination will be possible in the future. The enhanced coordination and cooperation of national regulatory authorities via international bodies like the FSB, the Basel Committee, and the International Association of Insurance Supervisors (IAIS), may be difficult to replicate in a future crisis. In the current geopolitical environment in which nationalism and regionalism are increasingly resurgent, this kind of coordination is difficult to envision. A recent EY report noted, "There are signs that the consensus on post-crisis objectives is fraying. The implementation of global standards is incomplete and inconsistent across jurisdictions. In some cases, local rules are already subject to review or revision (e.g., in the US, the FDIC recently indicated that it will consider easing requirements for resolution plans)."[12] A regulator said, *"There is a lack of harmony around international standards and as regulators, we appreciate that and we're trying to respond and continue to*

push for standardization." Another regulator acknowledged, however, *"I think you can safely say the global cooperation among regulatory authorities worked pretty well, but you do wonder if that would happen again."*

More capital and liquidity, less leverage

Two important reforms were passed in the aftermath of the financial crisis:

- **Basel III.** Responding to the perceived failures of Basel II and inadequate capital at banks, in 2011 the Basel Committee on Banking Supervision created Basel III, which introduced new regulatory standards on capital requirements, leverage (leverage ratio), and liquidity (liquidity coverage ratio).
- **Solvency II.** In November 2009, the European Parliament and European Council approved the Solvency II directive, which went into effect on January 1, 2016. The goals of Solvency II were to create a harmonized, EU-wide, risk-based insurance regulatory regime that includes three pillars: quantitative capital requirements, strengthening internal risk management, and increased disclosures.[13]

> *"I think you can safely say the global cooperation among regulatory authorities worked pretty well, but you do wonder if that would happen again."*
>
> — Regulator

Final implementation of Basel III has been extended repeatedly and the current implementation date has been pushed back to January 1, 2022, but large banks are generally meeting the required capital levels today. Financial institution leaders and commentators have, however, questioned the relative costs and benefits of these requirements, including how levels were calibrated to determine the acceptable trade-offs between potentially negative effects on profitability and risk taking, and improving safety and soundness. Some see the requirements as unnecessarily high, while others have suggested the capital levels were set much too low. Still others have suggested that higher absolute capital requirements would be preferable to complex rules and attempts to more closely supervise large institutions. Broadly speaking, however, the combination of higher capital, lower leverage, and more liquidity is widely accepted as having effectively reduced the risk that an individual large, regulated institution will fail, and as limiting systemic consequences.

Structural reform

Ring-fencing, or financially separating some parts of banks from others either by business line or geography, became a hotly debated topic after the global financial crisis. In the United Kingdom, as of January 1, 2019, banks were required to ring-fence their retail operations from their riskier investment banking units.[14] Under Bank of England rules, retail and investment

businesses within the same bank must operate as separate legal entities, maintaining their own boards and subject to limits on how much capital the businesses can share. The rules, which apply to UK banks with more than £25 billion in deposits, have spurred concerns that continental European and US banks no longer face the same regulatory burden. In the European Union, the Liikanen reforms, which were similar to the UK rules, eventually stalled. In the United States, the Volcker Rule, which was part of the Dodd-Frank Act, effectively barred financial firms from engaging in speculative trading with their own capital and was seen as an alternative to ring-fencing investment banking from retail banking. These rules are now being eased by regulators, and some banks are moving back into principal investing.[15]

New tools for regulators and supervisors

As part of the enhanced regulation around SIFIs, regulators were empowered with new supervisory tools. These include:

- **Recovery and resolution plans.** A significant focus of regulatory reform has been the promulgation of recovery and resolution plans, or "living wills," that would provide road maps for institutions and their regulators as to how a firm would either wind down or recover from financial distress. Earlier this year, US regulators proposed allowing the largest US banks to produce plans every four years rather than annually.[16] The Bank of England announced over the summer that it would move forward with requirements that all UK lenders with more than £50 billion in retail deposits must publish living wills every two years.[17]
- **Stress testing.** A tool to measure a bank's capital levels under simulated adverse conditions, stress testing has proven valuable to both large firms and regulators in understanding vulnerabilities and increasing confidence in resilience to financial shocks. The US Federal Reserve recently overhauled several components of the testing process, including easing its more subjective qualitative portion.[18] One director explained how stress testing has helped institutions to prepare for a crisis: *"It's quite enlightening because you can actually see that the more capital you've shored up and the more prepared you are, the risk profile changes dramatically and you're far better equipped to react."*

Improving identification and monitoring of systemic risks

The crisis revealed that both regulators and institutions lacked the capacity to develop a clear picture of risks building up in the financial system. As a result,

central banks, which have a broad mandate to maintain financial stability, were given a more prominent role in macroprudential supervision, and new regulatory bodies created to better gather and analyze data. These include the Financial Stability Oversight Council (FSOC), established in the United States by the Dodd-Frank Act; the Bank of England's Financial Policy Committee; and the European Systemic Risk Board. The new bodies are tasked with looking at risk holistically and enhancing regulatory coordination. In an era of low interest rates, many proponents are calling for macroprudential tools to be used to help direct credit where it can help the economy and not to places that could create undue risk. Central banks can deploy macroprudential tools, including countercyclical capital and liquidity buffers and limits on loan-to-value ratios, to attempt to reduce the growth of bubbles and potential systemic risks.

> *"We're better prepared than we were last time around. Having said that, we're typically fighting the last war and not preparing for the next war."*
>
> — Participant

In preparing for discussion, participants might consider the following questions:

- How effective have regulatory reforms been in addressing systemic risks?
- What areas of regulatory reform missed the mark or have not achieved their intended purpose?
- What major risks did the regulatory reforms fail to address?

How are regulators handling new sources of systemic risk?

As a result of post-crisis reforms, banks and other large financial institutions are now better capitalized, maintain more liquidity, and are generally considered better equipped for another economic downturn. However, questions remain as to the sector's resiliency to a range of nonfinancial risks. As one participant put it, *"Most of us would agree our operational and risk management capabilities have significantly matured versus where they were at the last recession. Generally, I would say we're better prepared than we were last time around. Having said that, we're typically fighting the last war and not preparing for the next war."*

Overseeing too-big-to-fail institutions

Many of the world's largest financial institutions have continued to grow, leaving some analysts to wonder if the threat posed to the global financial system by this concentration has grown in parallel. Criticism of "too big to fail" continues in some political corners, and some calls for forced break-ups.

Other commenters suggest, however, that breaking up the largest institutions may have little or no benefit in addressing systemic risk, and in fact, could stoke new, unintended risks.[19]

> *"If you don't see a huge opportunity to get revenue growth, you are going to focus on doing that through a merger."*
>
> — Director

Until earlier this year, there had been no merger of large banks in over a decade. In February, BB&T and SunTrust struck the largest bank deal since the financial crisis when they agreed to a merger that would create the sixth-largest US retail bank.[20] Some have predicted a rapid increase in consolidation among smaller US banks following the relaxation of rules by the Trump administration, with the *Wall Street Journal* stating, "The merger of BB&T and SunTrust could be the deal that opens the spigot."[21] In Europe, Société Générale CEO Frédéric Oudéa recently said that mergers between big European lenders "make sense," adding that they are likely to start once "fundamental obstacles"—such as varying national regulations across the bloc—are removed.[22] Indeed, there have been reports of merger talks between different European banks, including between Commerzbank and Société Générale, ING, and Deutsche Bank, Unicredit, and UBS. A director said more consolidation among large European firms is likely: *"I do think it will happen. It might be a little slow, but ultimately if you don't see a huge opportunity to get revenue growth, you are going to focus on doing that through a merger."*

Determining whether insurers pose systemic risk

In 2013, the IAIS, at the request of the FSB, developed a methodology for identifying global systemically important insurers (G-SIIs) and identified nine insurers as G-SIIs.[23] Like banks, insurers designated as systemically important faced the requirement to adopt risk-mitigating measures and heightened regulatory oversight. The policy measures included higher loss absorbency requirements for nontraditional activities, enhanced group-wide supervision, and recovery and resolution planning requirements, including the establishment of a crisis management group.[24]

The FSB and IAIS updated the list annually until 2017, when they announced they were suspending G-SII designations while developing a new framework for assessing and mitigating systemic risk in the insurance sector. The new framework, which is scheduled for implementation in 2022, proposed "moving away from a binary approach in which certain additional policy measures are only applied to a relatively small group of insurers (the identified G-SIIs)," to an approach that addresses "activities and exposures that can lead to systemic risk targeted to a broader portion of the insurance sector."[25]

In the United States, the FSOC had designated three insurers as SIIs, although all had shed that designation by late 2018. In early 2019, the Council issued new guidance that would revise its process for identifying and addressing potential risks to the financial system. The updated guidance, like the IAIS framework, emphasizes an activities-based approach and suggests that the council will designate a nonbank financial entity as systemically important (and thus subject to Fed supervision) "only if a potential risk or threat cannot be addressed through an activities-based approach."[26] The guidance also alters the process for designating a nonbank financial institution to include a cost-benefit analysis and the likelihood that an institution will face material financial distress following such a designation.[27]

Updating tools to reflect a new risk environment

While participants generally see the steps and methods adopted since the crisis as effective, they worry about whether these tools will allow regulators to effectively identify and respond to new risks. For example, one participant said, *"I think a lot of people still wonder about stress testing, how the use of it and the dynamics will change as we enter another potential recession."* One industry commenter recently asked, "[Ten] years after the crisis, are stress tests focusing on the most critical risks? Risks have changed and maybe the new ones are less amenable to stress testing … What about the new risks out there—a cyber hack, an IT meltdown, reputational risks related to the new emphasis on environmental, social and governance strategies, or the risks of being accidentally used for money laundering? These risks are not easily captured by a stress test, even a redesigned one."[28]

To reflect the changing risk environment, regulators have been encouraging firms to use data analytics and machine learning to model additional risks and, in some cases, have proactively updated key aspects of stress tests and other tools. Randal Quarles, the Federal Reserve's vice chairman for supervision, wants to make the tests more transparent and serve as teaching tools. "If stress tests are to continue to be relevant and effective, I strongly believe they must continue to change. They must respond to changes in the economy, the financial system, and the risk-management capabilities of firms," he said.[29] In June, the Prudential Regulation Authority began its latest stress testing for general and life insurers, adapting it to include newer risks like climate change and cybersecurity.[30]

Remaining vigilant

> *"The greatest threat to financial stability is complacency."*
>
> — Regulator

A regulator noted, *"Complacency is creeping back into the industry; that's the biggest risk right now. As regulators, how is this experience that we've had going to affect how we manage going forward?"* An executive said, *"Both firms and the regulators have done a lot to rebuild and ensure good resilience, but you worry that things are going in the wrong direction now."* The same regulator expanded, *"The greatest threat to financial stability is complacency. We're working very hard not to be complacent because we do not want to be victims of our own success."*

The rapid adoption of new technologies across the industry and the digital transformations underway at most banks may be introducing complex risks to the financial system. Further, new competitors and partners have emerged across the sector, posing new questions about evolving business models, while other nonfinancial risks, some new but others longstanding, continue to demand supervisory scrutiny.

Keeping up with innovation

The rapid evolution of financial services, in part driven by the proliferation of new technologies and innovation, is also challenging regulators' ability to keep pace. As described in EY's *2019 Global Bank Regulatory Outlook*, "The changing digital landscape raises questions about the use and ownership of data and the boundaries of regulation, in light of differing supervisory approaches to new products and services.

> *"The pace of change is so rapid; we've reached a point where we're learning about these things as they're already happening and having an impact."*
>
> — Regulator

Understanding the implications of new technologies is an ongoing challenge for regulators. For example, a US Treasury report last year found that bank regulations hadn't "sufficiently modernized to accommodate cloud and other innovative technologies."[31] At a recent BGLN meeting, one regulator said, *"The pace of change is so rapid; we've reached a point where we're learning about these things as they're already happening and having an impact. Trying to keep up is a constant challenge."*

Machine learning algorithms now automate tasks including credit management, insurance underwriting and claims management, fraud detection, trading, and the provision of investment advice. The use of data-driven algorithms raises important issues for regulators and supervisors. Issues like biased decision-making both in insurance and banking and the capability of robo-advisors to offer suitable investment advice to individuals have often been highlighted as common concerns in this area. From a systemic perspective, the speed at which trading algorithms operate and their tendency to move in the same direction may pose concerns of increasing

market volatility and procyclicality. Further, these algorithms can be difficult to oversee and govern, as it can be technically difficult to determine why an algorithm made a certain decision. The FSB recently noted, "The complexity and opacity of some big data analytics models makes it difficult for authorities to assess the robustness of the models or new unforeseen risks in market behavior."[32]

As regulators increase efforts to respond to innovation, two key approaches have emerged:

- **Creating sandboxes.** Regulatory sandboxes are used for the limited testing of new products and services in a controlled environment, allowing regulators to better understand the potential risks of new products and services.[33] Several regulatory bodies have launched regulatory sandboxes over the last few years, including the UK Financial Conduct Authority, the US Office of the Comptroller of the Currency, the Hong Kong Monetary Authority, the Monetary Authority of Singapore, and regulators in Australia, Indonesia, Malaysia, India, Denmark, and Canada.
- **Encouraging use of regulatory technology.** Late in 2018, US regulators—including the Federal Reserve, the Treasury's Financial Crimes Enforcement Network, and the Office of the Comptroller of the Currency—issued a joint statement encouraging banks to explore more innovative approaches to anti-money laundering compliance, noting that if the application of new technology uncovers any problems with legacy compliance programs, banks will not necessarily be penalized for those prior failures.[34] "Private sector innovation, including new ways of using existing tools or by adopting new technologies, can be an important element in safeguarding the financial system against an evolving array of threats," said Sigal Mandelker, US Treasury Department undersecretary for terrorism and financial intelligence, in reference to the joint statement.[35]

> *"The growing size and influence of the unregulated financial system has continued."*
>
> — Participant

Monitoring risks outside of large, regulated institutions

In a 2018 report, the Group of Thirty noted, "Paradoxically, the preventative steps taken to bolster big banks, while welcome, could increase the likelihood that prevention by itself will not be enough given that a corresponding effort was not made with respect to systemically important non-bank financial institutions that could play a bigger role in the financial system as a result."[36] A participant observed, *"The growing size and influence of the unregulated financial system has continued - that would include fintechs, which in most cases are still quite small – but if you throw in the large pension funds and the large asset managers, if you look at the size of*

BlackRock today, for example, just the balance in the system that has moved around and become aggregated and concentrated in certain spots, it's fascinating." According to CNBC, "Nonbank financials, which also include insurance companies, pension funds, and the like, have grown 61% to $185 trillion since the global financial crisis. Traditional bank assets have increased 35% to $148 trillion during the same period."[37]

The FSOC is responsible for addressing the systemic risk posed by nonbank financial institutions in the United States. Though it has the authority to designate nonbanks as SIFIs— and has done so in the past—currently there are no such institutions. In March, the FSOC proposed a cost-benefit analysis requirement for nonbank financial companies to be designated systemically important.[38] Notably, the proposal would require the FSOC to consider not just the impact of an institution's failure but the likelihood it will occur—a change from past guidance used for institutions like Prudential and MetLife.

Shadow banking

Participants have expressed concern that growth in bank regulation would shift more activity to the less-regulated shadow banking system and result in heightened risk. The FSB defines shadow banking as "credit intermediation involving entities and activities (fully or partially) outside the regular banking system."[39] Indeed, in the years since the crisis, global shadow banks have seen their assets grow to $52 trillion in 2017, a 75% jump from the level in 2010, the year after the crisis ended.[40] Shadow banking has now supplanted regulated banks as the leading source of credit for businesses and consumers, and some industry observers fear it contains a credit bubble that could pose risks to the financial system.[41] Regulators' ability to address these concerns is limited, and policymakers have acknowledged that progress has been relatively limited as well. One regulator said, *"If you're talking about risks and areas where regulators are concerned, you're going to talk about shadow banking. That's an area where the regulatory structure has some gaps or questions about how regulators can oversee it effectively."*

"The big banks are always going to tell you why you should be worried about the small guys, and we have to weigh out the genuine risk they pose."

— Regulator

Fintech

Participants have continually shared concerns that new financial services entrants may pose new and hitherto unaccounted risks because of an uneven regulatory playing field. However, regulators see limited systemic risks posed by these institutions, individually or collectively. One said, *"The big banks are always going to tell you why you should be worried about the small guys, and we have to weigh out the genuine risk they pose, but they also need to*

understand the disruptive benefits they provide through innovation and competition."

A recent FSB report on the potential financial stability implications of fintech noted the dual impact of increasing competition: "Greater competition and diversity in lending, payments, insurance, trading, and other areas of financial services can create a more efficient and resilient financial system. However, heightened competition could also put pressure on financial institutions' profitability, and this could lead to additional risk taking among incumbents in order to maintain margins. Moreover, there could be new implications for financial stability from BigTech in finance and greater third-party dependencies, e.g. in cloud services."[42] Indeed, as fintechs increasingly become partners with incumbents—often providing key services and technologies—their systemic importance also grows.

Considering oversight of key technology providers

With the financial ecosystem becoming increasingly connected, often crossing boundaries between regulated financial firms and unregulated vendors or partners, questions about the related risks have emerged. Unregulated providers have become crucial players in the financial system, often making possible many of the products and services that customers now take for granted. The increasing importance of technology providers for the financial services sector could lead to what the European Banking Authority recently described as "systemically important unregulated technology suppliers."[43] One executive said, *"We don't know the technological harms of some of these providers if they fail. It's a new systemic concentration, and we need to establish a new framework for understanding it and preparing for a systemic risk resulting from it."*

Growing concerns about concentration risk

The rising use of cloud technology represents a prominent example of industry reliance on a relatively small number of key providers, particularly as many financial institutions undergo legacy system upgrades and employ third-party cloud providers to provide infrastructure. The relationship between SIFIs and the handful of dominant cloud providers has recently drawn scrutiny from regulators concerned about concentration risk and the threats it could pose to the system. In 2018, the top five infrastructure-as-a-service providers accounted for nearly 77% of the global market.[44] Amazon Web Services represented approximately half of the market, followed by Microsoft, Alibaba, Google, and IBM. A regulator said, *"I used to look at these banks as large and*

powerful institutions; now I look at their cloud providers and think maybe the banks are not the powerful ones."

> *"I look at their cloud providers and think maybe the banks are not the powerful ones."*
>
> — Regulator

At a macroprudential level, concentration risk can arise if many firms rely on the same cloud service provider's infrastructure, and security breaches present huge operational and reputational consequences. When Capital One reported a major theft of data that was being stored on a cloud provided by Amazon Web Services, it immediately raised new questions about governance of the cloud and the potential role for regulators in monitoring the ever-growing relationships between SIFIs and a few key providers.[45] *"Critical infrastructure providers to banks and what regulators are doing—that's the topic du jour right now among supervisors. The Capital One breach gave it another push, too,"* said one regulator.

Potential for regulatory oversight

A senior regulator recently said in a speech, "Formally reviewing the capabilities of unregulated service providers would have once been rejected as regulatory over-reach—now such service providers may be so fundamental to the operations of a bank that bank supervision cannot properly be done without it."[46] Yet most regulators lack the authority to directly supervise these providers. *"We don't currently have plans to provide direct supervision to providers. We are trying to figure it out. Outsourcing guidelines were written in an analog era. If that model isn't completely broken, it will be soon enough,"* said a regulator.

> *"Outsourcing guidelines were written in an analog era. If that model isn't completely broken, it will be soon enough."*
>
> — Regulator

Regulators from the Federal Reserve conducted a formal examination at the Amazon headquarters in April, reviewing key documents in "the first of what is expected to be ongoing oversight of giant cloud providers that have become repositories of sensitive banking information," the *Wall Street Journal* reported.[47] However, questions remain as to whether any systemic risks arise from these relationships. A recent FSB report stated, "Reliance by financial institutions on third-party data providers (e.g. data provision, cloud storage and analytics, and physical connectivity) for core operations is currently estimated to be low. However, … if high reliance were to emerge, along with a high degree of concentration among service providers, then an operational failure, cyber incident, or insolvency could disrupt the activities on multiple financial institutions."[48] The FSB Financial Innovation Network will continue to monitor third-party dependencies in cloud service and single-point-of-failure risks.

In the United States, some industry observers have argued that the FSOC should designate cloud providers as systemically important financial market

utilities and subject them to enhanced supervision by the Federal Reserve.[49] Currently, no financial regulatory agency has supervisory authority over cloud providers in the United States.[50] A regulator outlined the practical challenges: *"The ability to do inspections on key providers is not a panacea. What power or influence would we really have? The most we can do is say, 'You can't use this provider,' but you pull the plug on the cloud provider and you're pulling the plug on the entire bank in some cases"*

In preparing for discussion, participants might consider the following questions:

- Does the growing importance of key third-party providers represent a systemic risk?
- How resilient will new entrants and new models be to major dislocation? Which, if any, are most vulnerable?
- Are there other emerging areas that may pose systemic risks that are not being addressed by regulation?

> *"The ability to do inspections on key providers is not a panacea. What power or influence would we really have?"*
>
> — Regulator

How are regulators positioned to contain the next crisis?

As regulators continue to monitor traditional sources of risk and new areas that may pose systemic risk, it is important to consider the tools they have for managing new and potentially unprecedented systemic events.

Taking stock of emergency powers

In a joint essay published in April 2019, Ben Bernanke, Tim Geithner, and Henry Paulson wrote, "A decade later, the vital question to ask is whether the United States is better prepared today. We believe the answer is: yes and no. There are better safeguards in place to avoid a panic in the first place … But the emergency authorities for government officials to respond when an intense crisis does happen are in many ways even weaker than they were in 2007."[51] The previously mentioned Group of Thirty report came to a similar conclusion, summarizing, "Of greatest concern, some of the tools available to fight extreme crises, when and if they occur, have been weakened, especially in the United States."[52] A regulator said the impact varies by country, depending on the country's experience of the last crisis: *"Those experiences made a big difference in setting the current stage. For example, in the US prior to the financial crisis, it was permitted by law to bail out the banks. In Canada, there was no law and no precedent. In the US now, law seeks to prohibit it; in Canada, the law has been amended to permit it."*

Though the introduction of Dodd-Frank reforms contributed to a more robust crisis defense, it also ushered in changes that could leave authorities less well equipped in an emergency. Partially in response to public outrage about the Troubled Asset Relief Program (TARP), the Dodd-Frank reforms took away the ability of the FDIC to guarantee liabilities of banks and bank holding companies other than insured deposits and they significantly truncated the Fed's ability to use its emergency lending authority to provide the kinds of short-term funding that can be crucial for fulfilling the economy's credit needs. The expiration of TARP means there is no standing ability to inject capital into nonbank firms to avert a systemic crisis. According to former US Comptroller of the Currency Eugene Ludwig, limiting these emergency powers represents a "serious mistake. The best bulwark against a severe economic downturn spinning out of control is the combined power of the Fed, FDIC, and the Treasury department. They need to be able to take action to contain the financial and economic effects of systemic financial shocks."[53]

Two other key factors are at play when it comes to the ability of policymakers and regulators to respond to a future crisis. One is that political backlash to the last crisis may affect what is possible in the next one. Several participants shared skepticism that governments and regulators would be able to respond to a future crisis of a similar magnitude to the last one, particularly because of the public and political backlash to the bailouts a decade ago. Lender-of-last-resort tools have come under scrutiny after being deployed at an unprecedented level during the prior crisis, when banks, nonfinancial firms, and entire markets received assistance. In the United States, regulators like the Federal Reserve may be hamstrung by a lack of political and financial support. In the United Kingdom, ongoing Brexit negotiations and related political crises have taken center stage, potentially leaving a lack of political cover for regulatory bodies to act during a crisis.

Considering available tools

Among the tools available to regulators is the authority to raise capital or liquidity buffers for more troubling economic periods. The Fed has spent the past year debating whether to exercise its power to impose the countercyclical capital buffer, a tool intended to reduce the risk of a credit crunch in an economic downturn.[54] The tool has been employed in other parts of the world, including Sweden and Hong Kong. Some regulators have also shown a willingness to boost liquidity in response to expected challenging economic and geopolitical situations, such as in late 2018 when the UK Prudential Regulation Authority introduced new liquidity requirements for some lenders in advance of the run-up to Brexit, requiring them to hold

enough liquid assets to withstand a severe stress, such as a halt in lending among bank, of as many as 100 days rather than the previous 30.[55]

In summarizing the current state of regulatory powers, the Group of Thirty said, "Overall, this shift in powers has improved the ability to deal with failures of individual institutions and modest shocks to the financial system, but has reduced flexibility to deal with a systemic crisis."[56] In response, the group recommends that new preventive frameworks and resolution and restructuring plans should be accompanied by discretionary tools available to central banks and resolution authorities to use in response to extreme crises.

> *"I think people forget that one of the lessons from the crisis was that nobody imagined where we were and how bad it could get… the imagination needs to kick in… because it's going to be worse than anything we've imagined."*
>
> — Regulator

In preparing for discussion, participants might consider the following questions:

- ? Are regulators and central banks well positioned for the next crisis?
- ? How has the weakening of emergency powers affected the sector's resilience?
- ? Should policymakers and regulators enable more oversight authority of nonbank financial institutions?

****

Efforts by policymakers and regulators toward preventing and handling another potential crisis have been substantial, but not comprehensive. Predicting a financial crisis is a difficult task that is unlikely to be accurate in its results, putting policy or regulatory efforts at risk of falling short. As one regulator said, *"If we are going to have another crisis, it's going to be something that we missed. There will be a surprising element to it. The last looks entirely predictable now in retrospect, but it didn't then."* For this reason, an executive highlighted the necessity for policymakers, regulators, and firms to prepare for the worst, perhaps by thinking outside the box: *"I think people forget that one of the lessons from the crisis was that nobody imagined where we were and how bad it could get. We've tackled some things and have good levels of capital and liquidity, but the imagination needs to kick in and expand beyond that, because it's going to be worse than anything we've imagined."*

Could technical and operational risks trigger the next crisis?

> *"Now the question is operational. How do we ensure we're thinking of that in an idiosyncratic, firm-by-firm basis, but also as an industry?"*
>
> — Executive

Operational resilience is the ability of an organization to prevent, respond to, recover, and learn from operational disruptions without harm to customers and the wider market. It has become a primary focus of regulators and financial institutions. In July 2018, the Bank of England, the Prudential Regulation Authority, and the Financial Conduct Authority published a joint discussion paper titled "Building the UK Financial Sector's Operational Resilience,"[57] combining the three regulators' perspectives on operational and technology risk into a single framework. The Office of the Comptroller of the Currency (OCC) subsequently included operational resiliency as one of its priority objectives for 2019 and specified an "emphasis on maintaining information technology systems and remediating identified concerns."[58]

This focus on operational resilience is partly driven by concerns about protecting customers from harm, but its primary objective is to ensure the continued functioning of the financial system. The discussion paper from the UK authorities noted the connection between resilience and financial stability: "Operational disruptions to the products and services that firms and FMIs [Financial Market Infrastructures] provide have the potential to cause harm to consumers and market participants, threaten the viability of firms and FMIs, and cause instability in the financial system."[59]

As financial institutions continue down the path of digitization, the risks to the system could be greater than ever. Steve Durbin, managing director of the Information Security Forum, notes, "This new hyperconnected digital era will create an impression of stability, security and reliability. However, it will prove to be an illusion that is shattered by new vulnerabilities, relentless attacks and disruptive cyberthreats."[60]

An executive observed, *"You could argue the resiliency of the financial industry is in a much better place than pre-crisis. But now the question is operational. How do we ensure we're thinking of that in an idiosyncratic, firm-by-firm basis, but also as an industry?"*

Operational and technical risks that could trigger systemic issues

Summarizing the range of resiliency issues that financial institutions and regulators confront, an executive commented: *"It's cyber, it's continuity of*

business, it's third- and fourth-party risk management. Everybody is focused on the ability of firms and the infrastructure of the financial industry being able to provide their services in a stress situation."

Ever-expanding cyber risk

Since the earliest discussions about cyber risk in the BGLN and IGLN, subject matter experts have warned about the potentially systemic consequences of an attack on a major institution, the payments system, or other critical infrastructure. A 2018 report from the Brookings Institution on "The Future of Financial Stability and Cyber Risk" highlighted concerns about financial stability:

> *"It's cyber, it's continuity of business, it's third- and fourth-party risk management."*
>
> — Executive

> "In contrast to the financial and policy shocks that have triggered past financial panics, cyber attacks are generally designed and initiated by sentient adversaries in aggressive pursuit of specific malicious goals. If one of those goals is broad financial system instability, a cyber attack may pose unique challenges. Unfortunately, the interactions between the financial contagion channels and the technological and operational risk channels of cyber attacks have not been examined carefully. For example, a sustained attack on a large global financial institution could be contagious across both dimensions, but where and how the contagion channels might feed on each other and accelerate risk is an important area for future work."[61]

The report further notes the complexity of cyberspace, which is "highly interconnected and tightly coupled," meaning that "disruptions in one area can cascade easily and in unexpected ways." The report notes the parallels to risk in financial services: "Of course, the financial sector is also complex and capable of black-swan behavior, but at least in finance this complexity is the object of intense study by risk specialists using advanced and mature models. These simply do not exist to the same degree for cyber risk."[62]

A participant noted the challenges for individual institutions in trying to mitigate the potentially systemic implications of a major cyberattack on the financial system: *"If someone took down State Street or BlackRock from being able to transact, that's going to affect everyone. First order is you look at shared critical infrastructure, e.g., central clearing parties ... Firms are trying to think about it, but I think we have to realize and be humble about the challenges like the lack of transparency and the inability of us to transform the system because we're just participants."*

> *"If someone has an outage that they don't get out of for 24 hours, what's the impact?...There is a lot of real estate between a temporary disruption and a disruption where the firm doesn't know when it will be out of it."*
>
> — EY expert

Prolonged service outages

An EY expert said, *"I worry about an extended. What would be the market reaction? Given the reliance on third-party vendors, what would be the participation required by the interested parties to settle it? If someone has an outage that they don't get out of for 24 hours, what's the impact? What's the behavior? It is not just a black swan event or a cyber event, it's recognizing there is a lot of real estate between a temporary disruption and a disruption where the firm doesn't know when it will be out of it."* A director shared a similar concern, noting, *"The timeline is third-party dependent, vendor dependent. There is so much information you just don't have immediately."*

Some participants worry about regulatory and public overreaction to short-term outages. A regulator said, *"Believe me, the last thing I want to do is call you 20 minutes into a mobile banking failure. It's not helpful for anyone. I would rather hear something, anything, from you as early as possible that you're aware and working on it."* But participants also acknowledged that ensuring these kinds of outages don't cause an institution to go into stress, or create a systemic problem, will likely require collaboration among regulators and among financial institutions to identify solutions and manage public expectations.

Loss of data integrity

> *"The real worry is data corruption. That is the nightmare scenario we should all be thinking about."*
>
> — Director

A network participant described the power of data today: *"People say data is the new oil, but I like to say data is the new uranium. It's extremely powerful, but it can be very dangerous because it can be used in ways we don't intend."* A director said, *"The real worry is data corruption. That is the nightmare scenario we should all be thinking about. It's miles above any other concern we have. It's an unconscionable position to find yourself in as a financial institution."* Trust in institutions and the information they use and share is essential to the functioning of the financial system. A director highlighted the potentially systemic consequences of losing that trust, perhaps due to a cyberattack: *"If the data set at a very large bank is compromised, that could spell the end of the country's financial system."*

Others are less convinced that operational failure represents an existential risk to an individual institution, let alone the financial system. One director noted, *"We have seen recently a lot of data being compromised. Of course, that's a major worry, but would it make a bank go bust? I don't think so."*

New sources of concentration risk

In 2014, the University of Cambridge Judge Business School Centre for Risk Studies coined the term "Systemically Important Technology Enterprises." Writing in the *Financial Times*, the Centre's executive director, Michelle Tuveson, said, "But what is worrying is the potential for a global system-wide IT failure occurring simultaneously across many organisations—a 'correlated loss' event that affects a vast number of companies, or an entire sector … A number of technology companies has become so deeply embedded in business productivity that they are systemically important to the overall economy … technology enterprises vital to international corporate productivity."[63] Cloud computing providers offer an obvious example, since a tiny number of giant providers service most large corporations and financial institutions. An executive observed, *"Cloud providers or companies who are providing security software infrastructure, etc.—that's actually where some of the real concentrations are. It's not necessarily that we have concentration with a central counterparty or big bank in the system. Those risks still remain, but it's more us not knowing the technological harms of some of these providers if they fail. It's a new systemic concentration and we need to establish a new framework for understanding it and preparing for a systemic risk resulting from it."* As the Brookings report notes, the risks from the concentration of these providers are not yet well known: "There is little understanding of the ways in which the failure, whether by accident or adversary design, of an IT company 'too big to fail' (such as a major cloud service provider) might cascade."[64]

> *"The power of social media today is exponentially greater than even two or three years ago…It can create a false truth at scale very quickly."*
>
> — Chairman of a financial institution

The power of social media to spread (mis)information

In a discussion earlier this year, the chairman of a financial institution said, *"The power of social media today is exponentially greater than even two or three years ago. It's like a snowball going down a hill. It keeps getting bigger. It changes behaviors. It can create a false truth at scale very quickly. Most institutions probably haven't thought defensively about just how pervasive it is today."* Recent studies suggest that around 3.5 billion people, some 45% of the world's population, actively use social media.[65] Another director noted the broader impact on society: *"Social media is also changing traditional media. Newspapers react as fast as they possibly can with no regard for standards."*

The risk from this rapid spread of potentially inaccurate information extends beyond traditional reputation concerns. As a *Financial Times* article highlighted, there could be dire consequences:

> "There is a physical element to the archetypal bank run. First of all, you have to get to the bank. Then you have to queue. Then you need to carry or wheelbarrow your money out of the building. So what happens to bank runs when banks, like everything else, become websites? … Third parties may be highly motivated to move money away (or encourage their deposit clients to do so) from a potentially troubled institution at the first hint of any problems, no matter how strong the deposit insurance scheme or the resolution toolkit. Why? Because no intermediary wants to risk its reputation by having to explain to its depositor clients why their money is on deposit with a troubled institution even if the risk of actual loss is virtually nil. What is newer … is the role of third party businesses as part of the growing integration of social media and the financial system. In the search for the next crisis, this trend is much less heavily scrutinised than the familiar features of the last one, like house prices or the cost of credit. Once, you closed down the bank. Now, it's the internet you'd have to close."[66]

Bad actors can also take advantage of the widespread use of social media and new technologies to intentionally spread misinformation. Andrew Grotto from the Center for International Security at Stanford University recently said, "Where things get especially scary is the prospect of malicious actors combining different forms of fake content into a seamless platform. Researchers can already produce convincing fake videos, generate persuasively realistic text, and deploy chatbots to interact with people. Imagine the potential persuasive impact on vulnerable people that integrating these technologies could have."[67] When asked what might trigger a future crisis, one participant predicted, *"The loss of confidence of our customers and depositors in the world of social media. That's really about confidence in the system. People talk about cyber being a trigger. How quickly will we lose confidence in an organization to figure out what the problem is and be trustworthy again?"*

- ? Which operational or technology risks are of greatest concern to individual institutions? Which could represent risks to the financial system?
- ? How are boards keeping up with the rapid evolution of these risks?

Efforts to mitigate potentially systemic operational risks

"I think we've gotten better at capturing the risk and having the right capital, but not managing the risk."

— Participant

At an event a few years ago, a bank official asked: "Why should a bank be worried about systemic risk? Its own risk should be its only focus."[68] In fact, financial institutions have to consider the potential impact of a range of operational risks that could crystalize outside of their firm in order to prepare accordingly. A participant observed, *"There is probably more that has been done to transfer nonfinancial risks into capital charges, for example through the [Comprehensive Capital Analysis and Review] exercises, but I'm not sure there has been the same effort and energy towards actually managing the risks better. I think we've gotten better at capturing the risk and having the right capital, but not managing the risk … The capital and liquidity and just general financial risks are fairly well understood. Both the regulators and the firms have done a lot to rebuild and ensure good resilience there, but I'm not sure the same lessons have been translated to the nonfinancial risks."*

Integrating systemic resilience into risk management and oversight

"The hard part is imagining and seeing around the corners to all the nonobvious ways these risks can bulge out and impact you in a second- or third-order way."

— Participant

One participant outlined the ways their institution takes systemic concerns into account: *"[The firm] is underwriting with resilience to potential stressful scenarios in mind, to ensure they're resilient enough to be profitable under stress. I am sure most firms are doing this. And then in the risk appetite framework, one can think about concentrations. So, we're going to keep participating in an area where we may see growing risk, but not let it get unduly large … The hard part is imagining and seeing around the corners to all the nonobvious ways these risks can bulge out and impact you in a second- or third-order way."*

The UK authorities' discussion paper on operational resilience introduced the concept of "impact tolerance." In a discussion earlier this year, a participant noted, *"Customer behavior is clearly changing, and changing fast. Have we put ourselves in a position where customers live real-time?"* Yet, as a director stated, *"If you are requiring me to have perfect service all the time, you will never get it. So, what is the definition of tolerable harm where all of us stand up for each other and say, 'Sometimes this happens'? The industry needs an engagement that defines tolerable harm in a technologically frail world where expectations are rising. It goes wrong sometimes."* Importantly, for this discussion, the related questions are: What is the impact tolerance of the financial system for a major technical or operating failure at a large financial

institution? What might the second-, third-, and fourth-order effects be, and how can institutions and regulators prepare for those scenarios?

> *"The problem with the operation side is that we don't have examples. We don't know how severe it could be."*
>
> — Participant

Regulators use stress tests; institutions develop their own stress scenarios. Many groups also perform reverse stress tests to examine what could bring the institution down. A director said, *"A few years ago, the scenario was another major counterparty going bust, so the Lehman situation is the example. But the more you increase your capital and risk assessment, the better equipped you are. Through reverse stress testing, we found the only way we could go bust is through several things happening simultaneously: a major macroeconomic or geopolitical issue, plus a major cyberattack, or a major counterparty going bust, etc."* The challenge, however, is that there is limited information available to identify which operational risks could ultimately create systemic stress. *"What are the things that could happen that could be really severe? Things that we are more familiar with—capital erosion, loss of liquidity—we understand. The problem with the operation side is that we don't have examples. We don't know how severe it could be. When I look at cyber, loss of data, we've yet to accumulate the data to tell us what the severity will be,"* reported another summit participant.

Industry collaboration

> *"The crown jewel is customer confidence and trust in the system."*
>
> — Participant

Many experts promote prioritizing protection of "the crown jewels" when considering cybersecurity investments. In a discussion on emerging risks, a network participant asserted, *"The crown jewel is customer confidence and trust in the system … It is not competitive by institution; it is competitive by country."* Beyond individual efforts to address these risks, industry participants recognize their vulnerability to risks that could become systemic, and the responsibility to collaborate to improve mitigate efforts. For example, financial institutions, often working with governments, have created the following collaborative or consortium groups:

- **FS-ISAC.** The Financial Services Information Sharing and Analysis Center (FS-ISAC) was created in 1999 "to help assure the resilience and continuity of the global financial services infrastructure and individual firms against acts that could significantly impact the sector's ability to provide services critical to the orderly functioning of the global economy."[69] In 2017, FS-ISAC expanded by setting up regional hubs in London and Singapore. Network participants have been complimentary of the organization's role in improving information sharing.
- **FSARC.** The Financial Systemic Analysis & Resilience Center was established in 2016 by a consortium of large financial services firms. Its

mission is to "proactively identify, analyze, assess, and coordinate activities to mitigate systemic risk to the U.S. financial system from current and emerging cyber security threats."[70] Among other activities, the FSARC develops scenarios and a risk registry to prioritize systemic risks and take steps to promote the resiliency of the financial sector against these threats.

- **Sheltered Harbor.** Sheltered Harbor, a nonprofit subsidiary of FS-ISAC, was created "to protect customers, financial institutions, and public confidence in the financial system if a catastrophic event like a cyberattack causes critical systems—including backups—to fail," allowing "institutions to provide customers timely access to balances and funds in such a worst-case scenario."[71] Often, when asked about these kinds of worst-case scenarios, executives and directors point to the many redundancies and backups used by their institutions. But Dan Geer, former chief information security officer for In-Q-Tel, the US Central Intelligence Agency's venture investment vehicle, describes the risk inherent in many traditional approaches: "Where failures come from intentional actions by sentient opponents, redundancy adds to risk rather than subtracting from it because redundancy replicates vulnerability to sentient action but not to random events … diversity of mechanism is required."[72] The frequency with which many backups are created, often at least every hour, could be part of the problem if the backups themselves become corrupted.
- **UK National Cyber Security Centre.** Launched in October 2016, The NCSC "provides a single point of contact for SMEs, larger organisations, government agencies, the general public and departments. We also work collaboratively with other law enforcement, defence, the UK's intelligence and security agencies and international partners."[73]

  ? How effectively are individual firms managing cyber and other operational risks relative to more traditional market and financial risks?

  ? What additional efforts should regulators or institutions be taking, individually, or collectively, to better mitigate the systemic consequences of operational and technology risks?

***

A participant asserted, *"If there's going to be another crisis, what's going to cause it? Credit. Credit is going to kill banks. Yes, we spend more time on cyber, yes, we spend more time on operations, but credit is what kills banks."* Yet, cyber and other operational risks are evolving so rapidly that few are

> *"To create truly secure-by-design systems would probably take a generation to implement, but the conversation needs to start now."*
>
> — Expert

comfortable that the implications of a major failure and the impact on the system are well understood and managed. Financial institutions continue to invest hundreds of millions of dollars in improving cybersecurity and systems resiliency. However, one subject-matter expert said, *"To create truly secure-by-design systems would probably take a generation to implement, but the conversation needs to start now."* As Mr. Geer notes, financial institutions and governments face a fundamental set of decisions: "So, if our 'critical infrastructures are those physical and cyber-based systems essential to the minimum operations of the economy and government' and if aggregate risk is growing steadily (as leading cybersecurity operational managers confirm), then do we put more of our collective power behind forcing security improvements that can only be increasingly diseconomic or do we preserve fallbacks of various sorts in anticipation of events more likely to happen as time passes? ... We will never have a more analog world than we have now. We will never live under thinner-tailed distributions than we have now."[74]

Disruption of traditional business models

For years, industry leaders have been concerned about the potential for new business and operating models to disrupt their business. At the 2018 Financial Services Leadership Summit on "Reinventing financial services," participants explored the role of fintechs and Big Tech in helping to redefine the nature of the industry. Even with the increasing emergence of fintech and insurtech unicorns, and even with investment in the space running well into the billions, one participant observed that we were only in the first half of what could be a 20-year *"golden era of fintech."*

Truly systemic disruption has come to be referred to as the "Uber or Netflix moment," i.e. when a new entrant or entrants, enabled by emerging technologies, completely upends traditional business models in an industry, changing the economics and the competitive dynamics. That has yet to happen in banking or insurance at the same scale as it has in other industries like car services and media. In part, this is because many fintechs and insurtechs target specific products or provide complementary offerings to large incumbents. Even with the technology to quickly roll out products to customers, would-be disrupters are finding that acquiring those customers and getting the economics right takes time.

In contrast to fintechs, large tech companies such as Google and Facebook have the potential to create a different kind of disruption. At the London Summit, participants debated the role that large technology companies could play within financial services. One participant observed, *"In the last five years there has been a major change in attitudes about Big Tech as a competitor. It has become clear that they demand our attention as a real competitive threat."* Not everyone expected a direct assault.; another participant asserted, *"Big Tech does not want to be a bank. You might hear them say they want to be a bank, they want a charter, but they don't. They don't want to deal with the stuff incumbents deal with."*

It is not just individual fintechs or large tech companies that could fundamentally disrupt traditional models: there is the very real potential that fundamental advances in the underlying technologies will rapidly change the roles of traditional intermediaries, and even governments and central banks. A participant explained how broad and foundational shifts in technology could enable new models: *"Think about a pyramid. At the top are the use-cases we see in our everyday lives: order a ride through Uber, or Skype our*

> *"The fundamental improvements in computing power in the hands of virtually anyone, at relatively low cost. That can unleash all kinds of possibilities."*
>
> — Participant

grandchildren. In the middle is the tech enabling those use-cases: things like mobile technology and video capabilities. But at the base is the fundamental improvements in computing power in the hands of virtually anyone, at relatively low cost. That can unleash all kinds of possibilities."

Since last year's Summit, a series of events have highlighted the potential for system-wide disruption of traditional financial services. Earlier this year, for example, key regulators commented publicly on the potentially disruptive impact of Big Tech in financial services. Facebook then captured the attention of the financial services industry and general public with its proposed launch of Libra and Calibra, a new digital currency and wallet, respectively. Perhaps in direct response, Bank of England Governor Mark Carney called for central banks to establish a global digital currency to challenge the dollar's role as the global reserve currency. China, meanwhile, is developing its own digital currency.

The FSB and IMF highlight systemic risks posed by disruptive business models

In February, the Financial Stability Board (FSB) issued a report entitled "FinTech and market structure in financial services: Market developments and potential financial stability Implications," which explores how fintech, Big Tech and emerging technologies could alter the competitive dynamic in financial services. It starts by acknowledging the positive potential: "Technological innovation holds great promise for the provision of financial services, with the potential to increase market access, the range of product offerings, and convenience while also lowering costs to clients."[75] The report adds that "Greater competition and diversity in lending, payments, insurance, trading, and other areas of financial services can create a more efficient and resilient financial system."[76]

> *"There could be new implications for financial stability from Big Tech in finance and greater third-party dependencies."*
>
> — FSB report

The FSB also highlighted risks that disruptors present to firms and the system, noting that "heightened competition could also put pressure on financial institutions' profitability. This could lead to additional risk taking among incumbents in order to maintain margins. Moreover, there could be new implications for financial stability from Big Tech in finance and greater third-party dependencies."[77] The FSB saw no potential threat to stability coming from fintech. In fact, its report states that "the relationship between incumbent financial institutions and FinTech firms appears to be largely complementary and cooperative in nature."[78] Rather, the report warns, it is Big Tech "with these firms' existing wide customer base, trusted customer relationships, strong capital positions and easy access to external funding, and potentially

different business focus (for instance to exploit data rather than rely directly on fees)" that could truly disrupt the status quo with "financial stability implications."[79]

Others have also raised concerns about the potential systemic implications of a Big Tech move into financial services. In comments around the June G20 Summit in Osaka, Christine Lagarde, Managing Director of the International Monetary Fund, explained, "A significant disruption to the financial landscape is likely to come from the big tech firms, who will use their enormous customer bases and deep pockets to offer financial products based on big data and artificial intelligence."[80]For Ms. Lagarde, Big Tech could bring significant benefits to the financial system in terms of extending access to products and services and modernizing markets. Industry participants, however, cannot discount the potential risks to financial systems from putting payment and settlement systems into the hands of a select group of tech giants. This presents "a unique systemic challenge to systemic stability and efficiency,"[81] she said.

Big Tech has thus far had the greatest impact in emerging markets. In China in particular, large tech providers dominate in payments—Alibaba via Ali Pay and its subsidiary Ant Financial, and Tencent via WeChat. They have ushered in a new era of financial services with significant benefits, expanded access, and new risks to the system. In her comments around the G20, Ms. Lagarde explained, "Over the last five years, technology growth in China has been extremely successful and allowed millions of new entrants to benefit from access to financial products and the creation of high-quality jobs. But it has also led to two firms controlling more than 90% of the mobile payments market."[82] To put this 90% into perspective: in 2018, China processed $41.5 trillion in mobile transaction volume[83], so it is safe to infer that Alibaba/Ant Financial and Tencent together managed $40.5 trillion. Total spending processed by US-issued Mastercard and Visa cards that year was $6.021 trillion.[84] Ant Financial now also oversees the largest money market fund in the world.[85]

Digital currencies and Big Tech could upend the financial and monetary system

Much attention has focused on the competitive threat to existing institutions posed by fintechs and big technology companies. Now, however, proposed new digital currencies from the private sector, and the reaction from central banks and policymakers, could drive a more fundamental disruption of

financial services and monetary policy. A prominent fintech investor asked, *"I wonder if those that lived through the rise of Bretton Woods, the end of the dollar/gold peg, the rise of the foreign exchange rates, the free floating system, realized at the time these were historical moments that ushered in new global financial systems? We are certainly living in such a moment presently."*

> *"I wonder if those that lived through the rise of Bretton Woods...realized at the time these were historical moments that ushered in new global financial systems? We are certainly living in such a moment presently."*
>
> — Fintech investor

Libra is the boldest foray into financial services by a Western Big Tech

Commenting on the growth of digital payments driven by large technology companies in China, Darren Buckley, the head of Citi's consumer bank there, recently said, "If you're a banker in the United States, trying to envision what consumer banking could be like, this is pretty close to the end state. The level of convenience, 24/7, is well beyond what you can deliver through a traditional banking model."[86] While Big Tech in China has unquestionably captured a massive share of Chinese consumer financial services, especially in payments, many industry experts have questioned whether a similar shift could take place in developed Western markets.

In Western markets, although some large tech companies have dabbled in aspects of financial services, the same direct threat has not yet surfaced. That may be changing. In June, Facebook announced the planned launch of Libra, a stable-coin digital currency supported by government-backed securities. Its mission is bold: "to enable a simple global currency and financial infrastructure that empowers billions of people."[87] Included in those "billions of people" would presumably be the 2 billion users Facebook currently counts on its various platforms. This would make Libra a potentially systemic proposition from day one.[88]

Facebook is not alone in this venture. To help oversee Libra, the tech giant announced the formation of a Geneva-based nonprofit, The Libra Association. It consists initially of more than two dozen Founding Members, including payment companies Visa, Mastercard, PayPal, and Stripe, tech disruptors Uber, Lyft, and Spotify, as well as Mercado Libre, Vodafone, and a host of blockchain companies, venture capital firms, nonprofits, and academic institutions.[89] Interestingly enough, there are no banks among the Founding Members. Through the nonprofit, "Facebook will not have any special privilege or special voting rights at the association level," according to David Marcus, the head of the Facebook blockchain team leading the project. "We will have competitors and other players on top of this platform that will build competing wallets and services."[90]

In parallel with Libra, Facebook is creating a new subsidiary called Calibra, which will offer a digital wallet for storing and sending the digital currency. Calibra will house transaction data separately from data gleaned from users' social media profiles. According to Mr. Marcus, "There's a clear distinction between Calibra and what Calibra has access to, and what Facebook Inc. has access to. It's very clear that people don't want their financial data from an account to be comingled with social data or to be used for other purposes."[91]

> *"It's very clear that people don't want their financial data from an account to be comingled with social data or to be used for other purposes."*
>
> — David Marcus
> Facebook

Could Libra represent a "watershed moment"?

Thus far Libra is just a proposal in a white paper, but it has already elicited strong reactions and predictions. Cryptocurrency proponents lauded the initiative. Barry Silbert, the founder and CEO of Digital Currency Group, tweeted, "The launch of Facebook's cryptocurrency will go down in history as THE catalyst that propelled digital assets (including bitcoin) to mass global consumer adoption. Will be remembered as just as important -- and transformative -- as the launch of the Netscape browser. Buckle up."[92] Mark Mahaney, an analyst at RBC Capital Markets who covers Facebook, said, "We view Facebook's introduction of the Libra currency as a potential watershed moment for the company and global adoption of crypto … In terms of scale and importance, we believe this new financial infrastructure could be viewed similar to Apple's introduction of iOS to developers over a decade ago."[93]

Regulators and policymakers express concern

Not surprisingly, the response from key regulators has been far more muted and, in some instances, even hostile. Bank of England Governor Mark Carney initially stated that any initiative of this type would "have to be subject to the highest standards of regulations." He later added: "It's got to be rock solid right from the start, or it's not going to start."[94] Federal Reserve Chairman Jerome Powell said, "Libra raises serious concerns regarding privacy, money laundering, consumer protection, financial stability." French Finance Minister Bruno Le Maire was very clear on his approach to Libra: "My determination to make sure that Facebook's … Libra project does not become a sovereign currency that could compete with the currency of states is … absolute. Because I will never accept that corporations could become private states."[95] Led by chair Maxine Waters, the US House of Representatives Financial Services Committee sent a letter to Facebook's leaders calling for a moratorium on Libra, saying, "It appears that these products may lend themselves to an entirely new global financial system that is based out of Switzerland and intended to rival U.S. monetary policy and the dollar … This raises serious privacy, trading, national security, and monetary policy

concerns for not only Facebook's over 2 billion users, but also for investors, consumers, and the broader global economy."[96]

The broader potential for disruption

> *"Trust in the financial system can erode very, very quickly if unregulated firms are allowed to do things in areas where regulated firms currently operate."*
>
> — Participant

There is little doubt that Libra faces a long and arduous task in gaining approval to launch. Mr. Marcus has already appeared before the US Senate and House of Representatives, pledging that Libra will not move forward until it has "fully addressed regulatory concerns and received appropriate approvals."[97] Yet, as several participants noted during our preparatory calls, Libra represents a clear signal of intent and raises a number of questions about the potential for disruptive threats to the system. One participant said, *"It's incredibly important to talk about how these things might evolve. The future will look different from what it looks like today. I do think the legal/statutory apparatus needs to pay careful attention. Trust in the financial system can erode very, very quickly if unregulated firms are allowed to do things in areas where regulated firms currently operate. I'm worried about the legal apparatus being anticipatory and knowledgeable enough to know when something could introduce risk without the proper controls around it."* A director noted the complicated relationships that incumbents and Big Tech companies maintain. *"It is complicated because, in certain respects, you are partnering and cooperating with these guys, but in other respects, they are competitive threats. Do they really understand what it means to be in this business and all the responsibilities that come with it? Do they enjoy the trust of all their customers that would create a platform for success? I think that's a big remaining question. Their ambitions are large—endless, it would seem."*

> *"Apple Pay really didn't take off the way they hoped it would. Now you look at them pivoting to doing stuff with Goldman. It feels like they're realizing it's not as easy as it looks."*
>
> — Director

One industry observer commented, "Maybe the Libra won't work, but even if so, currencies and commerce will be more attractively situated for better future effectiveness thanks to Facebook's efforts to meet the needs of people now."[98] A director predicted, *"My gut feeling would be that Facebook is going to land on a WeChat payment platform in the end. It will ultimately look more like a traditional banking thing."*

Whether or not Libra takes hold, the potential for large tech companies to influence the direction of financial services is top of mind for many financial institution leaders. A director pondered the role Apple could play in financial services: *"You do wonder. Look at some of Apple's forays. Apple Pay really didn't take off the way they hoped it would. Now you look at them pivoting to doing stuff with Goldman. It feels like they're realizing it's not as easy as it looks."* Nonetheless, in assessing why Apple's intentions matter, Oprah

Winfrey recently reminded everyone, "They're in a billion pockets, y'all. A billion pockets."[99]

Central banks exploring government-issued digital currencies

The dominant role of the US dollar in the international financial system has long been a subject of concern. The United States, for instance, represents only 10% of global trade and 15% of global GDP, but half of trade invoices and two-thirds of global securities are denominated in dollars.[100] Dollar dominance can create global imbalances that are particularly challenging for emerging-market countries, and may not even be beneficial to the United States if the dollar becomes overvalued.[101]

In his recent comments at the annual US Federal Reserve gathering in Jackson Hole, Bank of England Governor Mark Carney openly contemplated the creation of a "Synthetic Hegemonic Currency (SHC)" which, similar to Libra, could be issued by the private sector or "perhaps through a network of central bank digital currencies."[102] Mr. Carney explained his beliefs: "An SHC could dampen the domineering influence of the US dollar on global trade. If the share of trade invoiced in SHC were to rise, shocks in the US would have less potent spillovers through exchange rates, and trade would become less synchronized across countries. By the same token, global trade would become more sensitive to changes in conditions in the countries of the other currencies in the basket backing the SHC." Mr. Carney concluded his remarks with a call to action: "Let's end the malign neglect of the IMFS [international monetary and financial system] and build a system worthy of the diverse, multipolar global economy that is emerging."[103]

The Bank of England is not the only central bank contemplating a state-backed digital currency. The People's Bank of China (PBOC) has announced plans to issue its own digital currency.[104] While it is unclear if the PBOC's initiative aims to provide an alternative to the dollar, doing so could allow Beijing to further tighten control of the financial system, allowing the PBOC to better identify risks, combat money laundering, and gain greater insight into personal transactions. It would also protect China from having to operate on a third-party tech platform like Bitcoin.[105]

A challenge to the dollar, whether from the public or private sectors, would obviously be highly disruptive and would likely be met with stiff resistance from President Donald Trump's administration. Following the proposed launch of Libra, Mr. Trump tweeted, "We have only one real currency in the USA, and it is stronger than ever, both dependable and reliable. It is by far the

most dominant currency anywhere in the World, and it will always stay that way. It is called the United States Dollar!"[106] At least one director sees the reluctance of the US policy and regulatory community to engage more deeply in digital currency discussions as a potential risk itself: *"The fact the US is taking such a hard approach to regulating and accommodating crypto is pushing the problem overseas. If the US keeps continuing to ignore it, I honestly don't think it will get better."*

In assessing the potential for systemic risk from disruptive innovation, participants might think about the following questions:

- ? What new business models have the greatest potential to disrupt the financial system? What would be the benefits and risks associated with these models?
- ? What should leaders of financial institutions do to prepare for these threats? What questions should boards be asking management about disruptive business and operating models that could create system-wide risk?
- ? How should regulators be thinking about these issues?
- ? The Libra Association has attracted a number of leading firms as founding members and yet, no banks. If Libra succeeds, what would that mean for incumbent financial institutions?
- ? If the alternative to Libra were a government-backed digital currency, how might that change the debate?

Climate change and other exogenous risks

The global financial system is embedded in the broader economic, political, and environmental context, and nonfinancial risks can readily generate shocks to the system. Conversations with FSLS participants identified two categories of exogenous risks as increasingly important today: climate change and geopolitical instability.

> *"Climate risk is the ultimate systemic risk."*
>
> — Executive

Climate change

Climate change as a source of business risk, including financial risk, has risen steadily on the risk agenda in recent years. In 2019, for instance, climate-related risks topped the World Economic Forum's annual risk report.[107] The impact of climate change could be widespread and significant in terms of both the direct impact of rising temperatures and the economic impact of measures taken to mitigate climate change. *"Climate risk is the ultimate systemic risk,"* one executive stated.

The nature of climate risk

There are two primary channels by which the impact of climate change can be transmitted to the financial system: physical risk and transition risk. Physical risk refers to the direct impact of a warming climate, including damage from more frequent and more severe catastrophic weather-related events, and more gradual changes such as rising sea levels, floods, wildfires, and droughts. Transition risk stems from efforts to mitigate climate change and transition to a low-carbon economy, spurred by policy, technological development, or public opinion. In a 2019 report, the Network for Greening the Financial System - a coalition formed in 2017 by 34 central banks and supervisors - concluded, "There is a high degree of certainty that some combination of physical and transition risks will materialize in the future."[108] In addition, as public opinion shifts, and consumers put greater pressure on companies to act responsibly, reputational risk is a concern for financial institutions.

Physical risk

Physical risks arise from increased destruction of property, loss of asset value, loss of economic activity, and declining global incomes. Some studies suggest that climate change could reduce average global incomes by up to a

quarter by the end of the century.[109] Effects felt in the wider economy are translated to the financial system in a variety of ways.

Insurance

The insurance sector faces direct effects: losses will be felt by insurers in higher claims, and by policyholders in higher premiums. FSLS participants have noted that the impact of increased losses on insurers can be mitigated by general insurers updating their models and repricing their policies annually. One participant said, *"We're working very diligently to improve the quality of our model that both looks back and forward on predicting the risks associated with volatility in the climate."* However, there are limits to insurers' ability to do so. One participant said, *"Yes, you can reprice annually, but the ability to do that is still constrained by regulators and your ability to forecast."*

"Yes, you can reprice annually, but the ability to do that is still constrained by regulators and your ability to forecast."

— Participant

Moreover, some areas may be so risk prone that they become uninsurable. The CRO Forum warned that, in an extreme warming scenario, "severe damage and disruption could become so frequent later in the century that many risks may be uninsurable, with a profound impact on the economy and on society."[110] One participant said, *"I am convinced that Wales and Florida will become archipelagos. We will not write insurance there. In finite time, there will become a point where insurance companies stop writing primary insurance."* This is already beginning to happen. For example, insurers have begun withdrawing from wildfire-prone areas in the Western United States, or significantly increasing premiums.[111] In August 2019, the Bank of Montreal announced it would exit its reinsurance business because of the effects of climate change. One bank official said, "We are expecting, and we have continued concerns, that with climate change we're going to see more frequent and higher claims. So we didn't feel there was a good symmetry with risk and reward."[112]

Insurers' retreat from risk-prone areas, raises the specter of further government intervention. One director said, *"We are running into a situation where cost is becoming so high that the private industry cannot underwrite it; then it becomes a socialized cost of the state or a nation. It's a serious question for the industry. How do you participate and offer reasonable protection at an affordable price?"*

"We are running into a situation where cost is becoming so high that the private industry cannot underwrite it."

— Director

This dynamic is already beginning to play out in some areas. As insurers reduce their exposure to wildfires, the insurance commissioner of California has asked the legislature for power to compel insurers to write insurance in those locales: "We want lawmakers to give us the authority to say that you have to, as an insurance company, write in these communities, because

people have done what we've asked them to do: harden their homes, get that defensible space."[113]

Broader effects to the financial system

The impact of climate change will be felt beyond the insurance sector. It increases the likelihood of asset devaluation in areas sensitive to climate risk, resulting in loss of collateral and asset values for a range of financial institutions.[114] Material and large-scale devaluation of assets could have a significant impact on the balance sheets of financial institutions, with broader implications for the financial system. The above-mentioned Network for Greening the Financial System report noted, "There is a strong risk that climate-related financial risks are not fully reflected in asset valuations."[115] Looking forward, senior officials from the central banks of England, France, and the Netherlands recently warned of "a climate-driven 'Minsky moment'—the term we use to refer to a sudden collapse in asset prices."[116]

> *"There is a strong risk that climate-related financial risks are not fully reflected in asset valuations."*
>
> — Network for Greening the Financial System

Climate change could impact the ability of borrowers to repay loans and drive declines in collateral values, increasing credit risk for banks. Falling asset values would have obvious impact on investors and asset owners, including large financial institutions.[117] Scenario testing by ClimateWise determined that a temperature increase of two degrees Celsius could result in a doubling of mortgage losses in the United Kingdom; the group concluded, "Financial institutions with long-term investments, including banks and building societies providing new 35-year mortgages today, will have exposures to risks in this time period."[118]

Transition risk

The transition to a low-carbon economy will also have a significant economic impact and could dramatically affect asset values. According to the UN Intergovernmental Panel on Climate Change, keeping global temperatures from rising more than 1.5 degrees Celsius above pre-industrial levels would require emissions to fall 45% below 2010 levels and reach "net zero"—meaning that emissions would be balanced by removing carbon from the environment—by 2050.[119] The signatories of the 2015 Paris climate accord committed to such a result, even though it would require dramatic changes in the economy and could lead to stranded assets across a range of sectors. Studies have estimated the losses associated with the devaluation of these assets to be up to $20 trillion.[120] Moreover, as time passes without meaningful progress on emissions reductions, the risk of an abrupt or disorderly transition to a carbon-neutral economy increases, which would impose significantly higher costs than a gradual, orderly transition.

> *"When a bank is publishing its intention to stop funding coal-based industries, it's not because they hate coal and they are worried about global warming—it's about public scrutiny and reaction."*
>
> — Participant

Reputational risk

Financial institutions also face reputational risks and could become targets of climate activists or face public ire for failing to take action on climate change. One bank director said, *"We have investments and other things with companies that may be contributing to climate change, and that's something we discuss as it relates to reputational risk."* Another participant said, *"For the time being, the banks are mostly defining their policy in reaction to public opinion. What I mean is, when a bank is publishing its intention to stop funding coal-based industries, it's not because they hate coal and they are worried about global warming—it's about public scrutiny and reaction."*

The challenge of the distant horizon

In 2015, Bank of England governor Mark Carney referred to climate change as "the tragedy of the horizon." The impact of climate change, he said, will be felt beyond the scope the of business or credit cycle, the political cycle, or the mandates of regulatory authorities; thus, "once climate change becomes a defining issue for financial stability, it may be too late."[121]

FSLS participants agreed. One director acknowledged that more immediate concerns squeeze out attention to climate change: *"It's hard to get enough attention on it. The way it's characterized is it's not a tomorrow issue. Today they are paying attention to the yield curve."* One regulator said, *"We struggle to see how a bank whose book rolls over every three years is exposed to some of these climate change risks, because from one year to the next it's pretty incremental. When you look at the 50-year horizon, it's more material, but we don't see a case for pushing banks to make decisions on a 50-year horizon when their assets and liabilities are on a much shorter life span than that."*

> *"Once climate change becomes a defining issue for financial stability, it may be too late."*
>
> — Mark Carney
> Bank of England
> Governor

There are, however, aspects of financial services that will feel the impact more immediately. One participant noted, *"The effects of climate change will be slower to take hold across the financial services world, but this is all over the asset management world now, with investment strategies and efforts to get asset managers not to invest in coal and fossil fuels. It will be more rapidly apparent on the investment management side but less apparent on the lending side."*

Indeed, evidence of increased economic losses from climate change has already emerged. Costs of natural disasters have exceeded the 30-year average for seven of the last 10 years, and the number of extreme weather events has tripled since the 1980s.[122] In particular, property and casualty insurers and reinsurers are beginning to feel the impact in the form of

increased losses from extreme weather events, floods, and wildfires. Insurance losses from climate-related weather events have increased fivefold over the last few decades.[123] Lloyd's of London estimated that rising sea levels increased the losses from Superstorm Sandy by 30% in 2012,[124] and 2017 and 2018 were record years for losses from natural disasters.

> *"We don't see a case for pushing banks to make decisions on a 50-year horizon when their assets and liabilities are on a much shorter life span than that."*
>
> — Regulator

Toward resilience

Central banks and supervisors increasingly assert that it is within their remit to ensure that the financial system is resilient to the risks related to climate change. They have begun exploring ways to use their supervisory authority to encourage climate resilience among financial institutions and the system as a whole.

For instance, Wayne Byres, chairman of the Australian Prudential Regulation Authority said, "We are now in a world where climate-related financial risks need to be assessed and addressed alongside more traditional balance sheet and operational risks. We are working with our colleagues on the Council of Financial Regulators to ensure we, and the industries we regulate, have an appropriate awareness of the risks, and how they are being managed."[125]

Supervisory authorities are beginning to build climate change into their supervisory activities in a number of ways:

- **Increasing climate-related disclosures.** In 2015, the Financial Stability Board established the Task Force for Climate-Related Disclosures, which released its initial recommendation in 2017. It identified four areas of disclosure of climate-related risks: governance, strategy, risk management, and metrics and targets.[126] By 2019, 785 organizations had become supporters of the task force, including many of the world's largest banks, asset managers, and pension funds, managing assets of $118 trillion.[127]
- **Including climate in risk management frameworks and capital regimes.** Several supervisory authorities have proposed integrating climate risk into institutions' risk assessment frameworks. The European Commission is exploring the feasibility of including climate-related risks in banks' capital requirements.[128] The European Insurance and Occupational Pensions Authority (EIOPA), recognizing that few insurers currently take account of climate change in calculating liabilities, recently urged insurers to embed long-range climate scenarios in their risk management and own risk and solvency assessment processes.[129]

  While there has yet been little support for incentivizing environmentally friendly investments by lowering capital requirements for institutions that

invest in green projects, some prudential regulators are considering taking into account the increased market or credit risk imposed by "brown" investments. For instance, Mark Carney recently noted, "We would be more open to a 'brown'-penalizing factor, if you will, because something that is quite damaging, quite polluting, one would expect at some point that there would potentially be some adjustment of regulation for that. And a consequence of that would potentially be higher risk."[130]

- **Stress-testing.** Several supervisory authorities, including the Bank of England, the Banque de France, and EIOPA, have begun—or announced their intentions to begin—to integrate climate change scenarios into their stress tests for financial institutions.

"I've never seen a higher point where you could see a trigger in the near term for the next financial crisis."

— Chief Risk Officer

International institutions and industry groups are also beginning to emphasize climate sustainability. For example, the United Nations Environmental Program's Finance Initiative has launched Principles for Sustainable Insurance (2012) and Principles for Responsible Banking (2019). Within a broader framework of sustainability, both sets of principles aim to position the insurance and banking industries to contribute to climate change mitigation and adaptation.[131] To date, over 70 insurers have signed on to the insurance principles, while 130 banks representing $47 trillion in assets have signed on to the banking principles.[132]

Ultimately, the financial system's resilience may depend on how the world acts to mitigate and adapt to climate change. The Network for Greening the Financial System concluded in 2019, "The lesson drawn from the first sixteen months of NGFS activity is that climate change presents significant financial risks that are best mitigated through an early and orderly transition."[133]

Geopolitical instability

Financial institutions face a range of potential shocks to the financial system from continued upheaval in the geopolitical order. One chief risk officer said, *"I am critically concerned about scenarios with a fundamental impact on financial markets,"* including *"rising populism, decreasing globalization, trade wars, and the fraying constitution of Europe—Brexit and the potential for Frexit or even Dexit [France or Germany leaving the EU]. I've never seen a higher point where you could see a trigger in the near term for the next financial crisis."*

Another executive noted, *"The biggest risk right now is that the geopolitical system has changed quite fundamentally in the last decade. The political interactions and rules-based operations have been ripped up. It's a systemic*

risk because you can get the sense that the entire game is potentially changing."

> *"The biggest risk right now is that the geopolitical system has changed quite fundamentally... It's a systemic risk because you can get the sense that the entire game is potentially changing."*
>
> — Executive

Several related developments are altering the playing field for financial institutions in ways that are potentially destabilizing for the financial system.

From globalism to economic nationalism

One member noted, *"A few years ago, globalization was flattening the world, but now there are more borders in place."* Opposition to economic globalism and large-scale immigration has fueled populist and nationalist political movements across the world. While movements in the United States, the United Kingdom, Italy, Poland, Hungary, Turkey, India, the Philippines, and Brazil all differ in material respects, they share a commitment to reasserting national identity in the face of globalization.

Political nationalism goes hand in hand with economic nationalism. Economic relations, long seen as a means of limiting geopolitical tensions by drawing nation-states into mutually beneficial relationships, have instead become an aspect of international competition. The US Commerce Department's current strategic plan, for instance, states that "economic security is national security."[134] Geopolitical competition is straining multilateral institutions and the rules-based economic order that has been integral to the financial system. FSLS participants noted two primary aspects of this trend:

> *"If we continue to make a mess of the trade situation, there will be no growth."*
>
> — Participant

- **Trade.** *"If we continue to make a mess of the trade situation, there will be no growth. The trade thing itself is nasty because it is dismantling the last half century's worth of trade expansion. I don't think anyone understands how expensive that can be and how much unrest that will cause,"* said one participant. In addition to the ongoing trade dispute with China, for instance, the United States has imposed or threatened a wide range of tariffs on the EU, which has in turn proposed countermeasures totaling nearly $300 billion.[135] Ongoing trade disputes have hindered economic growth and pushed some economies closer to a recession. The International Monetary Fund reported that growing concerns about global trade could reduce global economic growth by 0.75 percentage points in 2019.[136]
- **Flows of capital and data.** In addition to barriers on physical goods, recent years have seen the emergence of additional restrictions on the movement of data and capital. Limitations on the free flow of digital information, including rules that require data to be stored in the country where it was collected, have increased in recent years.[137] Critics argue that

such "data protectionism" imposes significant costs on businesses and restricts the growth of the global economy.[138] Similarly, a number of jurisdictions—including the United States, the EU, Germany, France, the United Kingdom, India, and Australia—have imposed or proposed restrictions on foreign direct investment in recent years.[139]

Other sources of instability

FSLS participants identified several specific areas that are generating instability and uncertainty in the global economy and are sources of risk to the financial system:

> *"There is a real possibility, more than 50-50, that we slide into an economic cold war."*
>
> — Participant

- **US-China tensions.** Ongoing friction between the United States and China has clearly been a drag on the global economy, and observers worry that the conflict could expand into a more fundamental reordering of the global economy. *"We are moving toward economic decoupling between the US and China. Not 100% separation, obviously, but decoupling will continue, and it will get worse,"* said one participant. Another suggested, *"There is a real possibility, more than 50-50, that we slide into an economic cold war where companies and technologies have to decide which side of the fence they want to sit on."* Another speculated that the trade dispute *"isn't about trade at all—it's really about an economic rebalancing of the world that needs to happen in order to contain China both economically and militarily."* The participant added, *"The people who talk about it essentially as a generational economic war, they make a lot of sense. So you worry the consequences here aren't a modest rebalancing of trade through a renegotiation of the two countries' economic relationship, if it's about a rolling back of China's power."*
- **Brexit.** Although most financial institutions have made their plans for adapting to the United Kingdom's exit from the EU, uncertainty about the timing and conditions for that exit continue to create operational challenges. Political turmoil in the United Kingdom exacerbates uncertainty about regional stability, and some observers fear that other European states may follow suit, threatening the constitution of the EU.
- **Hong Kong.** Several participants pointed to ongoing protests occurring in Hong Kong and the potential geopolitical ramifications as a significant concern and source of risk. One participant, said, *"I think Hong Kong is going to be on everyone's agenda because lots of things could happen. It's a bit like Brexit in a different environment. Brexit, nobody believed in it*

for a long time and then all of a sudden it was happening." An expansion of the protests or a crackdown by Beijing could destabilize Hong Kong as a major financial center, with repercussions for global financial markets. One participant linked the protests in Hong Kong to tensions between China and the West: *"The potential for public repression in Hong Kong might be the final nail in the coffin that divides the globe into two different camps for technology and web-based companies and in terms of trade flows."*

> *"The potential for public repression in Hong Kong might be the final nail in the coffin that divides the globe into two different camps."*
>
> — Participant

- **The Middle East.** Conflict in the Persian Gulf recently rattled markets when Houthi rebels, locked in a civil war with Saudi-backed forces in Yemen, attacked a crucial oil facility in Saudi Arabia. Oil prices surged by nearly 20% in the days immediately after the attack on fears that Saudi oil production could be disrupted for weeks.[140] Moreover, the attack, which the US and the Saudis accused Iran of backing, threatened to expand the conflict between Iran and Saudi Arabia, the region's two dominant powers, into a full-scale war. It also heightened tensions between Iran and the US, coming as Trump administration was escalating its pressure on Iran in an attempt to force it to renegotiate its nuclear agreement and reduce its support for militant groups across the region.[141]

***

One FSLS participant noted, *"Financial institutions operate in a macroeconomic and geopolitical system. Everyone accepts the economic side, but forgets the other side, because it has experienced such relative stability that we've forgotten that it's part of the system in which we all operate."* For now, leaders of financial institutions and their regulators must manage through uncertainty as to what near-term and long-term political and economic structures will ultimately look like.

Appendix

Select Activities of Big Tech in Financial Services[142]

	Alibaba	Tencent	Baidu	Google	Amazon	Facebook	Apple	Samsung	Microsoft	Vodafone	Mercado Libre
Payments	AliPay (largest mobile paymensts platform in China)	Tenpay (#2 mobile payments platform in China)	Baidu Wallet – cooperation with PayPal	Google Pay – layers over existing card network	Amazon Pay – layers over existing card network	Messenger Pay – layers over existing card network	Apple Pay – layers over existing card network	Samsung Pay – layers over existing card network	Microsoft Pay – layers over existing card network	M-Pesa (32 million active users in East Africa and India)	Mercado Pago (offered in 8 markets in Latin America)
Lending and short-term credit	MYBank (SME lending for rural areas and online merchants)	WeBank (Personal micro-loans)	Baixin Bank (financial products and small loans)	Collaboration with Lending Club	Temporary financing in Amazon Lending; direct lending to merchants	Pilot in collaboration with Clearbanc	n/a	n/a	n/a	Offered through M-Shwari mobile banking service	Mercado Crédito (small loans to retail and SME clients)
Current accounts	Offered through MYBank	Offered through WeBank	Offered through Baixin Bank	n/a	Reports of talks with banks	n/a	n/a	n/a	n/a	Offered through M-Shwari	n/a
Asset management	Yu'e Bao (world's largest MMF)	License to offer mutual funds	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Pilots ongoing in 2018
Insurance	60% stake in Cathay Insurance China, founding stake in Zhong An Insurance	Online insurance service in life and property insurance	Joint venture with Allianz, and Hillhouse Capital announced	Insurance on Google Compare (discontinued)	Partnership with JPMorgan Chase and Berkshire Hathaway on health insurance	n/a	Cooperation with Allianz on cyber insurance discounts	n/a	n/a	n/a	Pilots ongoing in 2018

Endnotes

[1] Rana Foroohar, "Braced for the global downturn." *Financial Times,* August 11, 2019.

[2] ibid.

[3] ibid.

[4] David Benoit, "JPMorgan CEO Dimon raises specter of Zero rates," *Wall Street Journal,* September 10, 2019.

[5] Rana Foroohar, "Braced for the global downturn." *Financial Times,* August 11, 2019.

[6] Ibid.

[7] Huw van Steenis, "Why central bankers may be hurting rather than helping lenders," *Financial Times,* September 2, 2019

[8] Patrick Jenkins, "Can Jamie Dimon's magic touch weather the bad times ahead?," *Financial Times*, September 16, 2019

[9] Wayne Byres, "Reflections on a Changing Landscape" (speech, Risk Management Association Australia CRO Board Dinner, Sydney, August 26, 2019).

[10] *PreView* reflects the network's use of a modified version of the Chatham House Rule whereby comments are not attributed to individuals or corporations. Quotations in italics are drawn directly from conversations with network members and guests in connection with the meeting.

[11] Basel Committee on Banking Supervision, *Global Systemically Important Banks: Assessment Methodology and the Additional Loss Absorbency Requirement; Rules Text* (Basel: Bank for International Settlements, 2011), 10.

[12] EY, *2019 Global Bank Regulatory Outlook,* 3.

[13] "What is Solvency II?" Lloyd's, accessed September 10, 2019.

[14] Caroline Binham, "Ringfencing rules could leave British banks at a disadvantage," *Financial Times,* January 1, 2019

[15] Lalita Clozel, "Banks Get Some Relief in Volcker-Rule Changes," *Wall Street Journal*, August 20, 2019.

[16] Lalita Clozel and Liz Hoffman, "Fed Moves to Ease Living Wills, Allowing Large Banks to File Wind-Down Plans Less Frequently," *Wall Street Journal,* April 8, 2019.

[17] Caroline Binham, "UK's big banks told to publish 'living wills' from 2021," *Financial Times,* July 30, 2019.

[18] Latitia Clozel, "Big Banks Face Less Stress in This Year's Fed Tests," *Wall Street Journal,* June 20, 2019.

[19] Greg Ip, "'Too Big to Fail' Critics Go Too Far on Banks," *Wall Street Journal,* March 2, 2016.

[20] Rachel Louise Ensign and Allison Prang, "BB&T to Buy SunTrust in Largest Bank Deal Since the Financial Crisis," *Wall Street Journal*, February 7, 2019.

[21] Ensign and Prang, "BB&T to Buy SunTrust in Largest Bank Deal Since the Financial Crisis."

[22] Harriet Agnew, "Société Générale Chief Says Banking Mergers Make Sense in Europe," *Financial Times*, May 7, 2019.

[23] The list included Allianz, AIG, Aviva, Axa, Generali, MetLife, Ping An, Prudential Financial, and Prudential plc. The FSB revised the list over the next few years, dropping Generali and adding Aegon.

[24] Financial Stability Board, *Global Systemically Important Insurers (G-SIIs) and the Policy Measures That Will Apply to Them* (Financial Stability Board, 2013), 1-2.

[25] International Association of Insurance Supervisors, *Holistic Framework for Systemic Risk in the Insurance Sector* (IAIS, 2018), 5.

[26] Financial Stability Oversight Council, Authority To Require Supervision and Regulation of Certain Nonbank Financial Companies, 84 Fed. Reg. 49 (March 13, 2019).

[27] Financial Stability Oversight Council, Authority To Require Supervision and Regulation of Certain Nonbank Financial Companies.

[28] Brian Caplen, "Are Stress Tests Fit for Purpose?" *Banker*, March 12, 2019.

[29] Lalita Clozel, "Fed Wants to Teach Banks Through Stress Tests, Not Fail Them, Quarles Says," *Wall Street Journal,* July 9, 2019.

[30] Nathaniel Bullard, "Climate Change Puts Insurers to the Test," Bloomberg, June 28, 2019.

[31] Liz Hoffman, Dana Mattioli and Ryan Tracy, "Fed Examined Amazon's Cloud in New Scrutiny for Tech," *Wall Street Journal,* August 1, 2019.

[32] Financial Stability Board, *Financial Stability Implications from FinTech* (Basel: Financial Stability Board, 2017), 2.

[33] See EY, "How Regulatory Sandboxes Work," in *As FinTech Evolves, Can Financial Services Innovation Be Compliant?* (Ernst & Young Advisory Services, 2017), 10–12.

[34] Samuel Rubenfeld, "U.S. Encourages Banks to Innovate in Anti-Money Laundering Compliance," *Wall Street Journal*, December 3, 2018.

[35] US Department of the Treasury, "Under Secretary Sigal Mandelker Remarks ABA/ABA Financial Crimes Enforcement Conference December 3, 2018," news release, December 3, 2018.

[36] Group of Thirty, *Managing the Next Financial Crisis* (Washington: Group of Thirty, 2018), 8.

[37] Jeff Cox, "Shadow Banking Is Now a $52 Trillion Industry, Posing a Big Risk to the Financial System," *CNBC*, April 11, 2019.

[38] Elizabeth Festa, "FSOC Proposes Changes to Nonbank SIFI Designation," *ThinkAdvisor*, March 7, 2019.

[39] Financial Stability Board, *Strengthening Oversight and Regulation of Shadow Banking: A Policy Framework for Strengthening Oversight and Regulation of Shadow Banking Entities* (Basel: Financial Stability Board, 2012), ii.

[40] Cox, "Shadow Banking Is Now a $52 Trillion Industry, Posing a Big Risk to the Financial System."

[41] Steven Pearlstein, "The Shadow Banks Are Back with Another Big Bad Credit Bubble," Washington Post, May 31, 2019.

[42] Financial Stability Board, *FinTech and Market Structure in Financial Services: Market Developments and Potential Financial Stability Implications* (Financial Stability Board, 2019), 1.

[43] European Banking Authority, *EBA Report on the Prudential Risks and Opportunities Arising for Institutions from FinTech* (London: EBA, 2018), 21.

[44] Gartner, "Gartner Says Worldwide IaaS Public Cloud Services Market Grew 31.3% in 2018," news release, July 29, 2019.

[45] AnnaMaria Andriotis and Rachel Louise Ensign, "Capital One Cyber Staff Raised Concerns Before Hack," *Wall Street Journal,* August 15, 2019.

[46] Byres, "Reflections on a Changing Landscape."

[47] Hoffman, Mattioli and Tracy, "Fed Examined Amazon's Cloud in New Scrutiny for Tech."

[48] Financial Stability Board, *Strengthening Oversight and Regulation of Shadow Banking: A Policy Framework for Strengthening Oversight and Regulation of Shadow Banking Entities,* 2.

[49] David Fratto and Lee Reiners, "A New Source of Systemic Risk: Cloud Service Providers," *FinReg Blog*, August 8, 2019.

[50] Fratto and Reiners, "A New Source of Systemic Risk: Cloud Service Providers."

[51] Ben S. Bernanke , Timothy F. Geithner and Henry M. Paulson Jr. "Will We Survive the Next Financial Crisis?" *Politico*, April 16, 2019.

[52] Group of Thirty, *Managing the Next Financial Crisis,* 15.

[53] Eugene Ludwig, "US regulators ill prepared for next downturn," *Financial Times,* June 11, 2019.

[54] Lalita Clozel, "Fed Considers New Tool for a Downturn," *Wall Street Journal*, August 12, 2019.

[55] Caroline Binham, "BoE tightens bank liquidity buffers before Brexit," *Financial Times,* March 10, 2019.

[56] Group of Thirty, *Managing the Next Financial Crisis,* 22.

[57] Bank of England, Prudential Regulation Authority, and Financial Conduct Authority, *Building the UK Financial Sector's Operational Resilience* (London: Bank of England and Financial Conduct Authority, 2018).

[58] Office of the Comptroller of the Currency, *Fiscal Year 2019 Bank Supervision Operating Plan* (Washington, D.C.: Office of the Comptroller of the Currency, 2018).

[59] Bank of England, Prudential Regulation Authority, and Financial Conduct Authority, *Building the UK Financial Sector's Operational Resilience*.

[60] Alison DeNisco Rayome, "3 Security Threats Businesses Need to Prepare for by 2021," *Tech Republic,* March 27, 2019.

[61] Jason Healey, Patricia Mosser, Katheryn Rosen, and Adriana Tache, "The Future of Financial Stability and Cyber Risk," *Brookings,* October 10, 2018.

[62] Healey, Mosser, Rosen and Tache, "The Future of Financial Stability and Cyber Risk."

[63] Dr Michelle Tuveson and Simon Ruffle, "Diversity is the Way to Avoid Cyber Collapse," *Financial Times*. April 26, 2014.

[64] Healey, Mosser, Rosen and Tache, "The Future of Financial Stability and Cyber Risk."

[65] Dave Chaffey, "Global social media research summary 2019," Smart Insights, February 12, 2019

[66] Thomas Hale, "Bank Runs in the Digital Era," *Financial Times*. March 29, 2019.

[67] Ibid.

[68] Dr Michelle Tuveson and Simon Ruffle, "Diversity is the Way to Avoid Cyber Collapse," *Financial Times*. April 26, 2014.

[69] "FAQ," FS-ISAC, accessed 2019.

[70] "About," Financial Systemic Analysis and Resilience Center, accessed 2019.

[71] "Home," Sheltered Harbor, accessed 2019.

[72] Daniel E. Geer, Jr., *A Rubicon,* Aegis Series Paper No. 1801 (Stanford: Hoover Working Group on National Security, Technology, and Law, 2018), 3.

[73] "What We Do," National Cyber Security Centre, accessed 2019.

[74] Greer, *A Rubicon*, 14.

[75] Financial Stability Board, *FinTech and market structure in financial services: Market developments and potential financial stability implications,* (Basel, Switzerland: Financial Stability Board, February 14, 2019) 1

[76] FSB, *FinTech and market structure in financial services*, 1.

[77] Ibid.

[78] FSB, *FinTech and market structure in financial services*, 1.

[79] FSB, *FinTech and market structure in financial services*, 18.

[80] Leika Kihara, "IMF's Lagarde highlights potential disruptive nature of fintech," *Reuters*, June 7, 2019.

[81] Kihara, "IMF's Lagarde highlights potential disruptive nature of fintech."

[82] Ibid.

[83] "FinTech Trends: M&A and Mobile Payments Driving Recent Growth," Seeking Alpha, June 25, 2019.

[84] "Spending on Mastercard and Visa Cards Rose 9.5% in 2018 The Nilson Report," The Nilson Report, February 27, 2019.

[85] "China's Giant Money Market Fund Relaxes Investment Restrictions," *Reuters*, April 10, 2019

[86] John Engen, "Lessons from a mobile payments revolution," *American Banker*, accessed September 4, 2019.

[87] The Libra Association, *Libra White Paper* (Geneva, Switzerland: The Libra Association), accessed September 2, 2019.

[88] Kurt Wagner, Olga Kharif, and Julie Verhage, "Facebook Wants Its Cryptocurrency to One Day Rival the Greenback," *Bloomberg*, June 18, 2019.

[89] "Founding Members," The Libra Association, accessed September 4, 2019.

[90] Wagner, Kharif, and Verhage, "Facebook Wants Its Cryptocurrency to One Day Rival the Greenback."

[91] Ibid.

[92] Alastair Marsh and Olga Kharif, "Crypto Chiefs Novogratz, Allaire Say Facebook's Coin Is a Bullish Sign," *Bloomberg*, June 18, 2019.

[93] Michael Bloom, "Analysts love Facebook's cryptocurrency: 'Empower billions,' 'watershed moment'," CNBC, June 18, 2019.

[94] Ryan Browne, "Facebook's Libra Cryptocurrency Again Comes Under Fire from Global Policymakers" CNBC, updated July 11, 2019.

[95] Browne, "Facebook's Libra Cryptocurrency Again Comes Under Fire from Global Policymakers."

[96] Frances Coppola, "Congressional Committee Calls For A "Moratorium" On Facebook's Libra Project," *Forbes*, July 2, 2019.

[97] Dave Michaels and Paul Vigna, "Facebook Questioned on Cryptocurrency, But Battle Looms With Global Regulators," *The Wall Street Journal,* updated July 16, 2019.

[98] John Tamny, "Facebook's Libra Is a Global Reaction to Endless Currency Instability," *Forbes*, August 4, 2019.

[99] Todd Haselton, "Oprah Winfrey Had the Best Explanation for What the Weird Apple TV Event Was Really About," CNBC, updated March 27, 2019.

[100] Chris Giles, "Mark Carney calls for global monetary system to replace the dollar," *Financial Times*, August 23, 2019.

[101] Peter Coy, "The Almighty Dollar Needs a Rival," *Bloomberg*, August 29, 2019.

[102] Mark Carney, "The Growing Challenges for Monetary Policy in the current International Monetary and Financial System" (speech, Jackson Hole Symposium 2019, Wyoming, USA, August 23, 2019).

[103] Carney, "The Growing Challenges for Monetary Policy in the current International Monetary and Financial System."

[104] "China's Plan to Sideline Bitcoin," *Bloomberg*, December 13, 2018.

[105] Ibid

[106] Donald Trump, (tweet), Twitter, July 12 2019.

[107] *Global Risks Report 2019,* 14th Edition (Geneva: World Economic Forum)*, 5.*

[108] Network for Greening the Financial System, *A Call for Action: Climate Change as a Source of Financial Risk* (Network for Greening the Financial System, April 2019), 4.

[109] Network for Greening the Financial System, *A Call for Action: Climate Change as a Source of Financial Risk,* 13.

[110] CRO Forum, *The Heat Is on: Insurability and Resilience in a Changing Climate* (Amsterdam: CRO Forum, 2019), 7.

[111] Christopher Flavelle, "As Wildfires Get Worse, Insurers Pull Back From Riskiest Areas," *New York Times,* August 20, 2019.

[112] Joe Walsh, "Climate Change Prompts BMO to Pull Back on Reinsurance," *InsuranceERM,* August 30, 2019.

[113] Becca Habegger, "Insurance Commissioner 'Hopeful' He Can Help Homeowners Losing Coverage," ABC10, August 23, 2019.

[114] "Climate Change and Financial Stability," European Central Bank, May 2019.

[115] Network for Greening the Financial System, *A Call for Action: Climate Change as a Source of Financial Risk*, 4.

[116] Mark Carney, François Villeroy de Galhau and Frank Elderson, "The Financial Sector Must Be at the Heart of Tackling Climate Change," *Guardian,* April 17, 2019.

[117] Network for Greening the Financial System, *A Call for Action: Climate Change as a Source of Financial Risk*, 13.

[118] William Wilkes, "Insurers Worry a Financial Crisis May Come from Climate Risks," *Bloomberg,* February 22, 2019.

[119] Adam Morton, "Great Barrier Reef Faces Dire Threat with 2C Global Warming, UN Report Says," October 7, 2018.

[120] Network for Greening the Financial System, *A Call for Action: Climate Change as a Source of Financial Risk*, 17.

[121] Mark Carney, "Breaking the Tragedy of the Horizon—Climate Change and Financial Stability" (speech, Lloyd's of London, September 29, 2015).

[122] Network for Greening the Financial System, *A Call for Action: Climate Change as a Source of Financial Risk,* 13.

[123] Sarah Breeden, "Avoiding the Storm: Climate Change and the Financial System" (speech, Official Monetary and Financial Institutions Forum, London, April 15, 2019).

[124] Pilita Clark, "Bank of England to probe banks' exposure to climate change," *Financial* Times, June 16, 2017.

[125] Wayne Byres, "Reflections on a Changing Landscape" (speech, Risk Management Association Australia CRO Board Dinner, Sydney, August 26, 2019).

[126] Task Force on Climate-Related Financial Disclosures, *Recommendations of the Task Force on Climate-Related Financial Disclosures* (TCFD, June 2017), v.

[127] Financial Stability Board, "TCFD Report Finds Encouraging Progress on Climate-Related Financial Disclosure, but Also Need for Further Progress to Consider Financial Risks," news release, June 5, 2019.

[128] "Climate Change and Financial Stability," European Central Bank, May 2019.

[129] Christopher Cundy, Adam Leach, and Ronan McCaughey, "Climate change can't be captured in Solvency II capital, says Eiopa," *InsuranceERM*, June 3, 2019.

[130] Caroline Binham and David Crow, "Carney plans to test UK banks' resilience to climate change," *Financial Times*, December 17, 2018.

[131] UNEP Finance Initiative, "Principles for Sustainable Insurance," accessed September 18, 2019.

[132] Ibid.

[133] Network for Greening the Financial System, *A Call for Action: Climate Change as a Source of Financial Risk*, 4.

[134] "Power and Values," World Economic Forum, accessed September 15, 2019.

[135] Ibid.

[136] Jiyeun Lee, "Surging Trade Uncertainties about 10 Times Previous Peaks: IMF," *Bloomberg*, September 10, 2019.

[137] Alan Beattie, "Data protectionism: the growing menace to global business," *Financial Times*, May 13, 2018.

[138] Greenberg Center for Geoeconomic Studies, "The Rise of Digital Protectionism," Council on Foreign Relations, October 18, 2017.

[139] "Power and Values," World Economic Forum.

[140] Sam Meredith, "Saudi Arabia's pledge to quickly restore crude production has triggered a repricing of oil," *CNBC*, September 18, 2019.

[141] "Saudi Arabia faces weeks without oil production after attack," *Financial Times*, September 15, 2019,

[142] FSB, *FinTech and market structure in financial services*, 14.