

DTCC

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OCTOBER 2017

FINTECH AND FINANCIAL STABILITY

EXPLORING HOW TECHNOLOGICAL INNOVATIONS COULD IMPACT
THE SAFETY & SECURITY OF GLOBAL MARKETS



A WHITE PAPER TO THE INDUSTRY

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DEAR COLLEAGUE:

From its earliest days, financial services has successfully achieved higher levels of efficiency, speed and cost reduction, through the use of technology, but the current fintech revolution may deliver results that far surpass the benefits we've seen in the past. Recent innovations, such as distributed ledgers, cloud computing, artificial intelligence and robotics, have the potential to transform the global marketplace and produce significant changes in everything from market structure to post-trade processing. It's no wonder that this has sparked rapid growth within the fintech industry, which now routinely attracts multi-billion dollar investment flows month over month.

As the functional and geographical breadth of fintech grows larger, the discussion needs to evolve to also focus on the potential systemic risks posed by these new technologies and their impact on financial stability – both positive and negative. For all the investment in fintech and experimentation occurring today, we are still in the early days, making it the opportune time for the industry to thoughtfully consider this question.

DTCC, in its role as an industry-owned and governed critical market infrastructure, is responsible for protecting market stability and ensuring the integrity of the global financial system. At the same time, we have a 40-year history of leveraging technology to drive innovation and reduce risks and costs for our clients. Today, we are building on that legacy by actively exploring and advancing the use of fintech to achieve structural improvements in post-trade processing while ensuring future applications are consistent with our shared goals of risk mitigation, market safety, certainty, reliability and efficiency.¹ This new white paper, much like our previous ones on cyber security and interconnectedness risk, is intended to raise public awareness on the topic of fintech's impact on financial stability and proposes a set of nine factors that risk managers should consider to help identify and assess emerging fintech risks. We hope you take the time to read the paper, join us at upcoming events and conferences and share your own views with us as we continue to explore this in more detail.

Andrew Gray

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“Fintech has the potential to transform the way that financial services are delivered and designed as well as the underlying processes of payments, clearing, and settlement.”

Excerpt of a speech delivered by Lael Brainard, member of the U.S. Federal Reserve's Board of Governors, on December 2, 2016, at the Conference on Financial Innovation at the Board of Governors of the Federal Reserve System, Washington, D.C.

¹ DTCC has already published two fintech papers, outlining opportunities and articulating our strategy to realize them: DTCC. (2016, January). [Embracing Disruption – Tapping the Potential of Distributed Ledgers to Improve the Post-Trade Landscape](#). and DTCC. (2017, May). [Moving Financial Market Infrastructure to the Cloud](#).

EXECUTIVE SUMMARY

The key findings of this paper can be summarized as follows:

- Fintech developments have the potential to materially enhance, transform and/or disrupt business models, applications, regulatory oversight, processes or products in many areas of the financial services industry.
- Over the last few years, investment in fintech initiatives has grown exponentially across multiple sectors and could materially impact the financial ecosystem and financial stability – either positively or negatively – over the next five to ten years.
- Assessing the impact of fintech developments on financial stability must be done on a case-by case basis, taking into account how each individual application may affect the various dimensions of systemic risk. It is too early in the fintech revolution to fully understand whether these innovations are systemically beneficial or harmful.
- DTCC has developed an original framework to enable industry participants to analyze how specific fintech applications may impact financial stability. The framework covers a wide range of critical factors, including concentration and interconnectedness risk, fragmentation and substitutability of services and automated decision-making processes.
- Policymakers worldwide are working on a variety of initiatives to understand and manage the potential risks associated with fintech while supporting an environment that fosters innovation and experimentation. However, these initiatives must be coordinated closely across jurisdictions to avoid regulatory arbitrage and other undesirable outcomes, including the emergence of a shadow infrastructure sector.
- While the overall impact of fintech on the financial ecosystem remains limited at this time, potentially disruptive innovations will likely continue to unfold quickly and somewhat unpredictably. As a result, fintech developments must be closely monitored to help ensure that potential systemic risks or impacts are identified and addressed in a timely fashion.



DEFINITION AND CHARACTERISTICS

KEY TAKEAWAYS

Fintech is a relatively new term that, loosely defined, refers to technological innovations that affect financial services. Fintech developments have the potential to materially enhance, transform or disrupt business models, applications, regulatory oversight, processes or products in many areas of the industry.

While technology has always been an integral part of the financial services sector, the term fintech has only become widely used within the past few years. Interestingly, no industry-wide consensus around a single definition of fintech exists to date, but this isn't entirely surprising as the boundaries between technology providers and financial services firms are becoming increasingly blurred. Even regulatory bodies and leading global organizations have slightly nuanced definitions of fintech, ranging from the World Economic Forum (WEF), which describes it as "the use of technology and innovative business models in financial services," to the Financial Stability Board (FSB), which is more specific by describing it as "technologically-enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services."

Regardless of how the term is explained, two common characteristics emerge from these and many other definitions:

1. Fintech involves the use of innovative technologies for the provision of financial services

Innovative technologies typically include one or more of the following: cloud computing; robotics; artificial intelligence (AI) and machine learning; mobile applications; big data analytics; blockchain or distributed ledger technology (DLT); cryptography; and quantum computing. While some of these technologies have been in existence for several decades, the key aspect here is to what extent their particular application to the provision of financial services can be qualified as innovative.

2. Fintech has the potential to materially enhance, transform and/or disrupt business models, applications, regulatory oversight, processes or products

Fintech's potential to fundamentally change the financial services landscape is by far its most important characteristic, both from a risk perspective and from a functional point of view. This transformational potential is what distinguishes fintech from previous waves of technological innovations.

FINTECH SPOTLIGHT

While fintech encompasses a wide range of innovations, Distributed Ledger Technology (DLT) is one of the most prominent examples today. Broadly defined, DLT refers to a decentralized peer-to-peer network that maintains a consensus of replicated, shared, and synchronized digital data.

DLT's potential to reduce or eliminate operational inefficiencies has generated great interest from financial services firms. DLTs can be used to validate and track transactions on a distributed and decentralized platform without any central authority. As such, DLT-based platforms may provide a highly resilient and cost-effective alternative to today's centralized payment infrastructures.

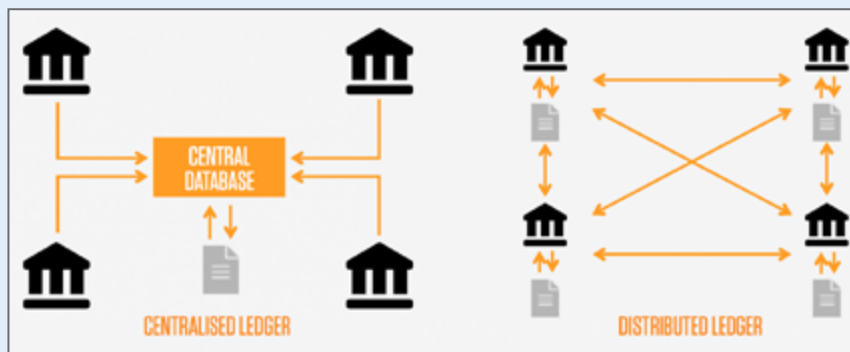


Diagram above sourced from: Harrison, S. (2016, May), What Blockchain Isn't? (Capco)

SCOPE, ACTIVITIES AND STRATEGIES

KEY TAKEAWAYS

The boundaries between fintech start-ups and traditional incumbents are blurring quickly as they become increasingly interconnected. Fintech players pursue a variety of strategic options to optimally position themselves in a wide range of financial services and products.

The fintech industry consists of a variety of players, but many of them tend to be start-ups that are narrowly focused on applying a particular technology to enhance or transform a specific process or financial service. Examples include robo-advisors, such as Wealthfront and Betterment, peer-to-peer lending companies such as Lending Club, and providers of digital wallets and on-line payment services like Venmo. However, another segment of the fintech industry consists of established technology companies, including Apple, Google, Facebook, IBM and Microsoft, which are using their deep knowledge and experience to enter into the financial services sector as a way to expand their activities and/or leverage their market position. At the same time, existing providers of financial infrastructure or payment and transaction technology are also becoming increasingly active in advancing new or emerging technologies, while a growing number of traditional banks and other financial institutions are starting to adopt fintech applications themselves to transform their own business processes.² The boundaries between these various types of companies are becoming even more blurred as they increasingly enter into partnerships with each other.

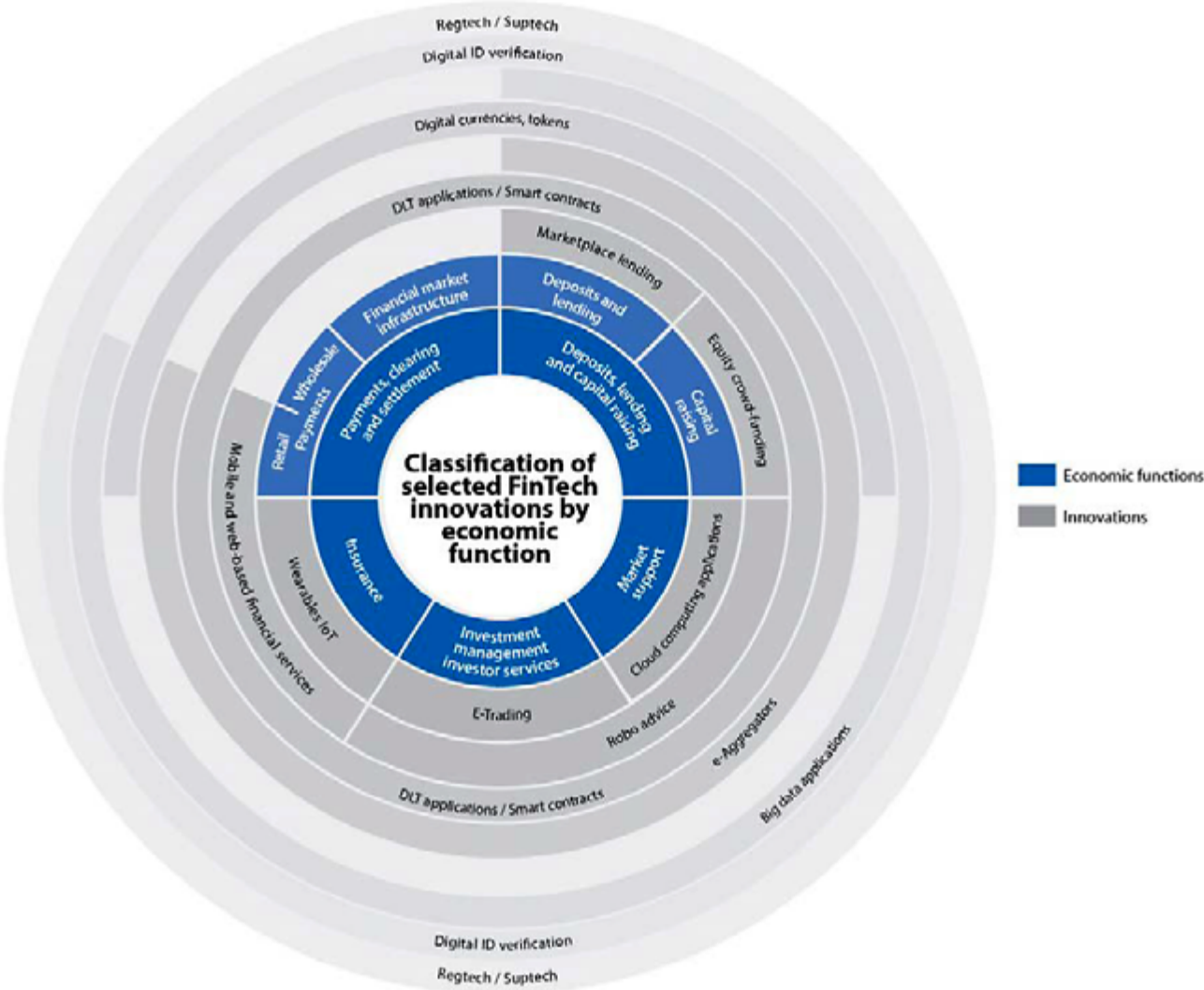
Fintech is used in a wide variety of financial areas, from retail-oriented services to capital markets and financial infrastructure. Several taxonomies have been developed to classify and map the universe of fintech applications, and the Financial Stability Board, building on earlier work by the World Economic Forum, recently proposed a classification into five broad areas: (i) payments, clearing and settlement; (ii) deposits, lending and capital raising; (iii) insurance; (iv) investment management; and (v) market support (see diagram on next page).³

Fintech companies that participate in core banking activities (i.e., deposits, lending and capital raising as listed under (ii) above) have to make a strategic choice that has important risk management implications – whether or not they will use their own balance sheet to fund these credit intermediation activities. Those that do are referred to as *balance sheet lenders*, while fintech companies that act as pure intermediaries between borrowers and lenders are known as *marketplace lenders*. At this point, a lot of fintech companies that are active in this area are adopting a hybrid model.

² See also PwC. (2016, April). @PwCFintech Q&A. and EY. (2016). UK Fintech: On the Cutting Edge.

³ Financial Stability Board. (2017, June 27). Financial Stability Implications from Fintech.

Stylized classification of selected fintech innovations by economic function⁴



⁴ Diagram sourced from: Financial Stability Board. (2017, June 27). Financial Stability Implications from Fintech.

GROWTH AND DRIVERS

KEY TAKEAWAYS

Fintech has grown exponentially in recent years. This growth is driven by a combination of demand factors, technological advances and cost pressures. Many expect this trend to continue and to fundamentally change the financial services landscape within the next decade.

Over the past few years, investments in fintech have grown dramatically in nearly every region around the world, with total global investment reaching as high as US\$25 billion in 2016, up from US\$9 billion in 2010.⁵ While this amount is still modest relative to the estimated US\$480 billion spent on IT by financial services companies in 2016 worldwide,⁶ the growth rate of these investment flows is remarkable. It is estimated that more than 10,000 fintech start-ups are active worldwide, with the number of companies reaching US\$1 billion valuations steadily rising.⁷

The growth of fintech is driven by a combination of factors, such as the ability to deliver financial services with more convenience and increased speed at a competitive price point; technological advances that have lowered the barrier to entry for start-ups and other non-financial firms; and continued cost pressures on banks, which have prompted them to find new, creative ways to realize savings.

The overall scale of fintech companies, while still modest compared to traditional players, is growing so fast that many analysts expect the financial services landscape to change dramatically over the next decade:

- Up to 35% of market share may migrate to non-bank players over the next five years, according to estimates by Accenture.⁸
- Absent any mitigating actions by banks, 10 to 40% of revenues could be at risk by 2025 in five major retail-banking businesses: consumer finance, mortgages, lending to small and medium-size enterprises, retail payments and wealth management, according to a recent McKinsey report.⁹
- Robo-advisors may have as much as US\$8 trillion in global assets under management by 2020, based on a forecast by BI Intelligence study.¹⁰
- Industry participants themselves seem to agree with these projections. In a global survey among financial services executives, 88% of respondents indicated that they are worried that part of their business is at risk to stand-alone fintech companies within the next five years.¹¹

5 KPMG. (2017). The Pulse of Fintech Q4 2016: Global Analysis of Investment in Fintech.

6 See International Data Corporation (IDC). (2016, April 27). Financial Services IT Spending to Reach \$480 Billion Worldwide in 2016, According to IDC Financial Insights [Press release].

7 McKinsey & Company. (2015). Cutting Through the Fintech Noise: Markers of Success, Imperatives for Banks.

8 McIntyre, A. (2017, July 7). Banks Haven't Gone the Way of Blockbuster — Yet.

9 Dietz, M., Khanna, S., Olanrewaju, T., & Rajgopal, K. (2016). Cutting Through the Noise around Financial Technology.

10 Meola, A. (2016, December 14). The Fintech Report 2016: Financial Industry Trends and Investment.

11 PwC. (2017). Redrawing the Lines: Fintech's Growing Influence on Financial Services.

RISKS AND BENEFITS – THE POTENTIAL IMPACT OF FINTECH ON FINANCIAL STABILITY

KEY TAKEAWAYS

While fintech developments hold considerable promise, they can also pose risks. This section presents an original framework that includes nine key factors designed to assess the potential systemic impact of specific fintech applications on financial stability. It also highlights recently published external analyses that explore how fintech can strengthen or weaken the financial system’s resilience.

Regulators around the world are pursuing various initiatives to address potential fintech-related risks while trying to preserve fintech’s potential to achieve material enhancements.

Coordination across policymakers, both domestically and internationally, will be crucial to help ensure the efficiency and effectiveness of regulatory guidance.

Fintech can enhance the financial services industry in many ways, from providing a better client experience to reducing friction, strengthening critical infrastructure components, increasing access to the financial system, realizing efficiencies and reducing costs for market participants and the investing public. For all these benefits, however, fintech may also pose negative consequences, such as exacerbating cybersecurity threats or amplifying third-party risks.

More broadly, fintech is likely to have a greater systemic impact through key transformational mechanisms, such as the disintermediation of incumbents, disaggregation of financial services and decentralization of networks. These effects, along with fintech’s potential to fundamentally alter competitive forces, market dynamics, financial inclusion, consumer rights and many other areas, could strengthen or weaken overall financial stability. This is a subject of great concern to DTCC due to our role as a critical market infrastructure and our mission of protecting the stability and integrity of the global financial system.

“The challenge for policymakers is to ensure that fintech develops in a way that maximizes the opportunities and minimizes the risks for society.”

Excerpt of speech given by Mark Carney, Financial Stability Board (FSB) Chair and Bank of England Governor

A FRAMEWORK FOR ASSESSING FINTECH'S IMPACT ON FINANCIAL STABILITY

The potential effect of fintech on financial stability is an issue of major importance, particularly during these early stages of experimentation and development. DTCC believes fintech offerings need to be analyzed on a case-by-case basis given the wide range of underlying applications, each with their own characteristics and their own specific context. DTCC has developed an original framework to help guide this analysis, based on nine key factors that need to be considered in order to gauge how a specific fintech offering may impact financial stability.

Factor 1: The provision of core banking functions by fintech firms

Fintech companies that provide core banking functions (i.e., credit, liquidity and maturity transformation) could enhance financial stability to the extent that these activities might diversify credit and liquidity risk within the financial system. Conversely, given their short track record and relative lack of banking experience, new entrants could also create systemic vulnerabilities, especially in an economic downturn or during periods of market stress.

While some fintech companies use their own balance sheet for the provision of credit or other services, most do not at this time – either because they rely on funding from banks or other financial institutions, or because their activities do not require credit or liquidity provision. As such, the impact of fintech on financial contagion through the credit or liquidity channel is likely to be relatively small right now, but this must be watched as the sector evolves.

Factor 2: The level of fintech-related fragmentation

The unbundling of financial services that is associated with the rise of fintech may benefit clients through increased competition and lower fees. At the same time, it also has the potential to fragment the creation and delivery of financial services across additional providers and platforms, which can have far-reaching implications, such as:

- Increasing the number of operational points of failure, as well as the risk of data breaches, hacking and other types of third-party risk.
- Obscuring the delineation of liability between distributors and manufacturers of financial services with respect to operational issues, product suitability, liability for damages and other responsibilities.
- Expanding the use of proprietary data standards, which could hamper interoperability, cause errors and lead to a less efficient financial system overall.

Factor 3: The impact of fintech on concentration risk

While the fintech sector is growing fast, its relative size in the overall financial system is still limited in most countries. However, the fintech sector is evolving rapidly and certain companies are becoming more concentrated in some areas of financial services and certain geographies. As a recent report by the Financial Stability Board notes, new credit providers could lead to a rapid rise in the systemic importance of non-traditional players.

However, the same report also explains that fintech could have the opposite effect – that is, it could reduce concentration by allowing new or non-traditional service providers to compete with existing players. For example, fintech credit platforms may help to diversify sources of capital, thus lowering the concentration of credit in the banking sector, which might be beneficial if there are problems idiosyncratic to banks.

Even if fintech-related developments were to create pockets of concentration in certain market segments, their impact on financial stability would also depend on the level of substitutability.

Factor 4: The substitutability of fintech services

A service is said to be highly substitutable if it can be replaced easily and quickly in case its provider fails. As such, substitutability is a key concept in assessing systemic risk. All else being equal, financial services that are highly substitutable create less systemic risk than those that are not.

The substitutability of fintech services depends entirely on the context, such as the nature of the service, the competitive landscape and the ease with which users of the service can switch to an alternative provider (or service) in the event of a failure. As such, the level of substitutability must be assessed on a case-by-case basis. For example, the failure of Apple Pay or a competing contactless payment service provider could be easily substituted by switching to credit and debit card payments. On the other hand, switching between fintech solutions that are offered as “platform-as-a-service” for core banking technology may take several months or longer to implement.

Factor 5: The effect of fintech on financial interconnectedness

The interconnectedness of financial service providers can have a significant impact on financial stability. In most circumstances, interconnectedness helps to reduce systemic risk by distributing financial stress across a wide variety of interconnected agents. However, in some cases, interconnectedness can become a vector for propagating the impact of very large shocks throughout the entire financial system.

As such, it is critical to analyze how fintech developments affect financial networks. Generally speaking, the impact of fintech on financial interconnectedness is threefold:

1. The emergence of new fintech entrants typically creates a more interconnected network, introducing additional points of failure and increasing the network's overall complexity. Even if a provider's services are specifically designed to improve the user experience and create efficiencies, they often introduce an extra layer in the value chain, which creates additional network nodes and interconnections.
2. Fintech partnerships, which are becoming increasingly common, create an even more interconnected network. As the number of contractual and other arrangements between fintech companies and other financial services firms grows, and as these arrangements become more complicated, interconnectedness and complexity risk will likely increase. Additionally, cybersecurity risks have been reported as top concerns by firms setting up fintech partnerships.
3. Some fintech applications tend to shift the traditional hub-and-spokes topology of financial networks towards a more decentralized structure, which is typically associated with lower concentration risk and higher resilience.

As mentioned previously, the level of fragmentation and substitutability should also be taken into consideration when assessing the overall impact of fintech-driven changes on financial stability.

Factor 6: The degree of competition vs. cooperation between fintech firms and traditional financial service providers

Fintech companies pursue a wide variety of strategies as they position themselves in the financial ecosystem. Initially, strategies based on a model of outright competition were predominant, with new fintech entrants competing against existing financial service providers, typically within a narrow market segment where they perceive a particular advantage. Nowadays, fintech companies and incumbents often decide to work together, either as preferred or exclusive partners, or through some other form of cooperative agreement. As an alternative strategy, some financial service providers have decided to develop fintech applications in-house, while others have chosen to acquire fintech firms.

Competitive pressures on banks could end up eroding their profitability, and thus potentially weaken their financial buffer. It could encourage them to pursue riskier strategies and lead to a race to the bottom. Therefore, an environment where fintech companies and incumbents cooperate in mutually beneficial arrangements is more likely to promote financial stability than an environment characterized by outright competition.

Factor 7: The degree of reliance on automated decision-making processes

By definition, fintech firms apply innovative technology to automate financial services processes in order to make them faster and more efficient. In doing so, business processes are redesigned to make them more streamlined and remove points of friction. As part of this effort, decisions that used to require human judgment are increasingly being replaced by data-driven algorithms, leveraging technological advances in artificial intelligence, machine learning and robotics.

This evolution creates a number of challenges and poses certain risks:

- Over-reliance on purely data-driven algorithms can lead to errors that may not have occurred in an environment that involves more human judgment calls. The increased speed of automated systems may also spread errors much faster and further, exacerbating the risk that the rapid propagation outpaces management's ability to take corrective action. The 2012 Knight Capital incident, where the malfunction of an order routing system resulted in a US\$440 million loss that was incurred in less than one hour, is a striking example of this type of risk.
- In addition to the potential for errors due to the inherent complexity of decision-making algorithms, their opaque nature can also hide biases that may be hard to identify. The Federal Trade Commission (FTC) recently unveiled a set of Principles for Algorithmic Transparency and Accountability that are designed to address concerns about the lack of transparency of algorithms. Other regulators may adopt similar proposals.
- Against this backdrop, AI risk management is quickly emerging as a new priority, which also creates ramifications related to human resources management. As a recent World Economic Forum report notes, companies will need to manage the balance between human-AI interactions and train their employees to effectively coexist with AI.

Factor 8: The sustained growth and adoption of fintech services

As described previously, the fintech sector is growing very rapidly, especially in terms of funds invested in fintech start-ups. The valuation of fintech firms is quickly increasing as well. Notwithstanding this growth, the industry-wide impact of fintech – and, by extension, its potential effect on financial stability – depends on the extent to which this technology will become a mainstream part of the financial ecosystem and to what extent it will ultimately be used for delivering critical services.

While expectations for meaningful adoption of new technologies are very high, some analysts see signs of a passing hype and expect consolidation in the fintech sector. As was the case in the early days of the internet boom, predicting winners and losers is virtually impossible. The interaction of competitive pressures, industry dynamics, customer preferences and regulatory decisions are only a few of the many factors that will shape the evolution of fintech.

While the final outcome of this evolutionary process is unpredictable at this point, it is entirely conceivable that fintech may significantly disrupt certain areas of finance or specific market segments while leaving other areas largely unaffected. Similarly, fintech's adoption may end up differing widely across geographies. Whatever the case may be, the outcome of this process will greatly determine fintech's eventual impact on financial stability.

Factor 9: The evolution of the regulatory environment

Regulators around the world have taken notice of fintech's growing prominence. A global survey launched by the Financial Stability Board's Fintech Issues Group in February 2017 indicates that 20 of 26 jurisdictions contacted have already taken some measures to respond to fintech, with five additional jurisdictions planning to follow suit.

The importance of the regulatory context in which fintech companies operate cannot be overstated. Policy decisions and regulatory actions will directly determine to what extent fintech will impact financial stability for years to come. Additionally, regulations are also bound to have a very significant, albeit indirect, impact as they will play a crucial role in shaping the evolution of each of the other factors described above.

In order to help ensure a level playing field, it is crucial that regulatory initiatives be harmonized across jurisdictions. Close coordination between financial supervisors globally is required to avoid regulatory arbitrage and other undesirable outcomes, such as the emergence of a shadow infrastructure sector.

Given the potential for fintech to affect the financial ecosystem in ways that could be positive and/or negative, the regulatory community's main challenge is to create policies that manage to effectively curtail fintech's risks while preserving its promise to fundamentally enhance the provision of financial services. Regulatory sandboxing is one of the tools used to help achieve this balance

Note: *Appendix 1 at the end of this paper includes an overview of regulatory initiatives that pertain to fintech – both domestically and around the world.*

“Regulators need to understand the impact that developments in fintech can have on financial stability, especially given the rapid rise of innovation in this space.”

Excerpt of comments made by Carolyn Wilkins, Senior Deputy Governor,
Bank of Canada and Chair of the FSB's Fintech Issues Group

WHAT ARE REGULATORY SANDBOXES?

The term “sandboxing” refers to the practice of isolating newly developed software code in a separate environment to make sure it is safe before releasing it in production.

In the context of fintech applications, certain jurisdictions offer so-called regulatory sandboxes as a ‘safe space’ in which businesses can test innovative products and services in a live environment without being immediately subject to the regulatory requirements that would normally be associated with their activities. In addition to providing temporary relief to fintech developers, sandboxing also provides regulators with a chance to ‘preview’ the impact of applications on the financial system in an isolated environment.

ADDITIONAL ANALYSES AND INITIATIVES

Most literature on fintech risks focuses on specific applications or industry segments. At this time, publications that take a more comprehensive view to assess the effects of fintech on financial stability are less common. Recent papers by the Financial Stability Board (FSB) and the International Monetary Fund (IMF) to better understand and address fintech's systemic risk impact deserve to be highlighted.¹²

Note: Appendix 2 at the end of this paper provides additional details on these initiatives and the publications mentioned above.

“[Fintech] opportunities are likely to reshape the financial landscape to some degree but will also bring risks.”

Excerpt of a blog written by Christine Lagarde, Managing Director of the International Monetary Fund¹³

¹² We are specifically referring to the following three papers: (1) Financial Stability Board. (2017, June 27). Financial Stability Implications from Fintech; (2) Working Group established by the Committee on the Global Financial System (CGFS) and the Financial Stability Board (FSB). (2017, May 22). Fintech Credit - Market Structure, Business Models and Financial Stability Implications.; and (3) He, D., Leckow, R., Haksar, V., Mancini-Griffoli, T., Jenkinson, N., Kashima, M., Khiaonrong, T., Rochon, C., and Tourpe H. (2017). Fintech and Financial Services: Initial Considerations. IMF Staff Discussion Note 17/05.

¹³ Lagarde, C. (2017, June 20). Fintech: Capturing the Benefits, Avoiding the Risks [Web log post].

CONCLUSION

The rapid emergence of fintech applications is arguably one of the most promising and exciting developments in financial services today. Fintech's exponential growth, the breadth of its scope across sectors and markets and its worldwide reach combine to create a powerful force that could spur transformational change over the next several years.

At the same time, these developments could also impact financial stability in both positive and negative ways. While many of these technologies are at a nascent stage at this time, there is little doubt that fintech will likely alter the risk landscape in the future, produce unintended consequences and lead to new types of risks.

It is too early to provide a definitive assessment of associated systemic risks or benefits of fintech at this time, but we are confident that the most appropriate way to gain a better understanding of fintech's potential impact on financial stability is to identify the most relevant questions that should be considered.

The framework we have developed includes nine key factors to consider when assessing the potential systemic impact of fintech applications on a case-by-case basis. While these factors build on insights related to interconnectedness, substitutability and other systemic risk concepts, they also leverage DTCC's expertise as a critical market infrastructure, our legacy of using technology to improve the post-trade process and the work we have done recently to advance the use of fintech innovations.

We hope this paper helps contribute to a better understanding of fintech's potential to strengthen or weaken financial stability. As we have done in the past, we intend to use it to engage with clients, regulators and other stakeholders to discuss topics and questions that will likely remain a focus area for many years to come.

We actively encourage you to share your thoughts and participate in the ongoing dialogue we are looking to foster.

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APPENDIX 1 – REGULATORY INITIATIVES

Some noteworthy regulatory initiatives related to fintech across the globe include the following:

In the UK, the Financial Conduct Authority (FCA) has assisted over 300 fintech companies in navigating the regulatory system as part of Project Innovate, an initiative launched in 2014. The Bank of England runs a Fintech Accelerator, a partnership that supports innovative firms while helping the Bank's understanding of how fintech could impact financial stability and other policy objectives. These programs are universally recognized as examples worth following. In the words of CFTC Acting Chairman Christopher Giancarlo, "British efforts have become the gold standard for thoughtful regulatory engagement with emerging technological innovation."¹⁴

Asian regulators have introduced several initiatives as well:¹⁵

- The Financial Services Agency (FSA) in **Japan** has established a fintech support desk and a Panel of Experts on fintech-related matters.
- The **Hong Kong** Monetary Authority (HKMA) and the Securities and Future Commission have set up a Fintech Facilitation Office, as well as a Fintech Contact Point and a Fintech Advisory Group.
- The Monetary Authority of **Singapore** (MAS) has created a Fintech Office to serve as a "one-stop virtual entity" for fintech businesses, in addition to a Fintech & Innovation Group that develops regulatory policies and strategies to promote the use of innovative technology.
- The **Australian** Securities & Investments Commission has established an Innovation Hub to assist fintech companies.

In the U.S., fintech activities fit within the broader framework of financial regulation and thus can be subject to a variety of regulators, either at the state or federal levels.¹⁶ Several regulatory bodies have taken steps to promote fintech developments while safeguarding financial stability:

- **The Office of the Comptroller of the Currency (OCC)** announced the establishment of an Office of Innovation in October 2016 to "ensure that institutions with federal charters have a regulatory framework that is receptive to responsible innovation and the supervision that supports it."¹⁷ In December 2016, the OCC announced that it was considering granting special purpose national bank (SPNB) charters to fintech companies.¹⁸ These charters would allow fintech firms to operate under a single national standard across the country, rather than having to comply with separate chartering and licensing requirements in each state where they conduct business. This announcement triggered a jurisdictional debate over regulatory authority that led to two separate but related lawsuits against the OCC, which are currently pending.¹⁹

¹⁴ Giancarlo, C. (2017, May 17). LabCFTC: Engaging Innovators in Digital Financial Markets. Speech presented before the New York FinTech Innovation Lab, New York City.

¹⁵ Asia Securities Industry & Financial Markets Association. (2017, June). Best Practices for Effective Development of Fintech.

¹⁶ See Tsai, G. (2017, July 9). Fintech and the U.S. Regulatory Response. Speech presented at the 4th Bund Summit on Fintech, Shanghai, China.

¹⁷ See Office of the Comptroller of the Currency. (2016, October 26). OCC Issues Responsible Innovation Framework [Press release].

¹⁸ Office of the Comptroller of the Currency. (2016, December). Exploring Special Purpose National Bank Charters for Fintech Companies.

¹⁹ On April 26, 2017, the Conference of State Bank Supervisors (CSBS) alleged that the OCC's plan to charter fintech companies as special purpose national banks is unlawful. On May 12, the New York State Department of Financial Services (DFS), which is one of the state bank regulators that make up the CSBS, separately sued the OCC, similarly alleging that the OCC exceeded its authority in planning to issue the charter - see Comizio, V., & Brownback, N. S. (2017, June 4). State Bank Regulators Challenge OCC's Authority to Issue Fintech Charters [Web log post]. and Alberts, J., & He, I. (2017, July 17). OCC vs. New York DFS: Battle for the Future of FinTech.

- **The Commodity Futures Trading Commission (CFTC)** launched its own fintech initiative, titled [LabCFTC](#), in May 2017 to: (i) provide greater regulatory certainty that encourages responsible fintech innovation; and (ii) accelerate the adoption of fintech and regtech solutions that may enable the CFTC to carry out its mission more effectively and efficiently.²⁰
- **The Consumer Financial Protection Bureau (CFPB)** actively engages with fintech companies, regulators and other stakeholders through [Project Catalyst](#), an initiative launched in 2012 to better understand and monitor innovative technologies in the consumer financial marketplace. In order to allow innovators to try out products without fear of regulatory enforcement, the CFPB has launched a no-action letter policy, considered by some as falling short of expectations.²¹

Additional guidance with respect to fintech has been published by a number of **international standard setting bodies**:

In August 2017, the **Basel Committee on Banking Supervision (BCBS)** published a consultative document ([BCBS415](#)) on the implications of fintech for banks and their supervisors.²² The document describes future potential scenarios and highlights associated risks and opportunities.

The **International Organization of Securities Commissions (IOSCO)** and the **Committee on Payments and Market Infrastructures (CPMI)** have also issued comprehensive principles, guidelines and standards that, while they don't explicitly mention the term fintech, are nonetheless relevant for fintech applications in areas such as banking, securities markets, payments and clearing and settlement. Similarly, certain microfinancial risks of fintech activities, such as credit, leverage, liquidity and maturity mismatch, may fall within the FSB shadow banking policy framework.

²⁰ See Giancarlo, C. (2017, May 17). LabCFTC: Engaging Innovators in Digital Financial Markets. Speech presented before the New York FinTech Innovation Lab, New York City. and <http://www.cftc.gov/LabCFTC/Overview/index.htm>

²¹ For additional information, see Consumer Financial Protection Bureau. (2016, October). Project Catalyst Report: Promoting Consumer Friendly Innovation. and McHenry, P. (2017, April 25). CFPB's 'Project Catalyst' Failed. Fintech Deserves Better.

²² Basel Committee on Banking Supervision. (2017, August). Sound Practices: Implications of Fintech Developments for Banks and Bank Supervisors.

APPENDIX 2 – ADDITIONAL ANALYSES AND INITIATIVES

ANALYSES AND INITIATIVES BY THE FINANCIAL STABILITY BOARD (FSB)

The Financial Stability Board (FSB) is an international body that promotes global financial stability. It was established in 2009 at the initiative of the Group of Twenty (G20) as the successor to the Financial Stability Forum (FSF). As part of its mandate, the FSB monitors vulnerabilities in the global financial system and makes recommendations to address associated risks.

In February 2016, FSB Chairman Mark Carney included an assessment of systemic risks and other implications of fintech innovations as one of five top priorities for the upcoming year.²³

At the November 2016 FSB Plenary meeting, a dedicated working group was created to identify key issues with respect to fintech developments from a financial stability perspective. On June 27, 2017, the FSB published a [report](#) that analyzes the potential financial stability implications from fintech with a view toward identifying supervisory and regulatory issues that merit authorities' attention. The FSB report identifies 10 areas, three of which are considered priorities for international collaboration in order to safeguard financial stability while fostering more inclusive and sustainable finance:

- The need to manage operational risk from third-party service providers;
- mitigating cyber risks; and
- monitoring macrofinancial risks that could emerge as fintech activities increase.

The report concludes that, while there are currently no compelling financial stability risks from emerging fintech innovations given the relatively small size of the fintech sector relative to the financial system, experience shows that they can emerge quickly if left unchecked. It also underscores the need for international bodies and national authorities to take fintech into account in their risk assessments and regulatory frameworks.

In addition, the FSB Financial Innovation Network and the Committee on the Global Financial System (CGFS) published a [report](#) in May 2017 on the growth in fintech credit, which aims to help policymakers understand the functioning and evolution of these activities.²⁴

Both FSB reports emphasize that official data on fintech activities is limited at this point, and conclude that data availability and quality may warrant increased attention from authorities as this sector further develops.

ANALYSES AND INITIATIVES BY THE INTERNATIONAL MONETARY FUND (IMF)

The International Monetary Fund (IMF) is an organization of 189 countries, working to foster global monetary cooperation, secure financial stability, facilitate international trade, promote high employment and sustainable economic growth, and reduce poverty around the world.²⁵

The IMF's primary purpose is to ensure the stability of the international monetary system. In its April 2017 [Global Financial Stability Report](#), the IMF provides a forward-looking analysis of the long-term evolution of the banking sector. As part of this analysis, the IMF states that "[...] if current trends in financial technology continue, the long-time preeminence of banks in payment services is not guaranteed."²⁶

The IMF has also published other research, which is specifically dedicated to fintech issues. A 2016 [paper](#) that

²³ See Carney, M. (2016). To G20 Finance Ministers and Central Bank Governors [Letter written February 22, 2016].

²⁴ Working Group established by the Committee on the Global Financial System (CGFS) and the Financial Stability Board (FSB). (2017, May 22). Fintech Credit - Market Structure, Business Models and Financial Stability Implications.

²⁵ Copied from <http://www.imf.org/en/About>

²⁶ See International Monetary Fund (IMF). (2017). Global Financial Stability Report: Getting the Policy Mix Right.

analyzes the potential benefits and risks associated with virtual currencies (VC)²⁷ concludes the following:

While risks to the conduct of monetary policy seem unlikely at this stage given VC's very small scale, it is possible that risks to financial stability may eventually emerge as new technologies come into more widespread use.

In March 2017, the IMF established a new High Level Advisory Group on Fintech, composed of prominent leaders in the field of finance and technology.²⁸ The Group will provide advice to help IMF staff deepen its understanding of fintech issues. The Group will also work closely with the IMF's Interdepartmental Working Group on Finance and Technology to study the economic and regulatory implications of fintech developments.²⁹

On June 19, 2017, the IMF published a [paper](#) that assesses the impact of fintech developments on a wide array of financial services.³⁰ The paper finds that boundaries among different types of service providers are blurring and that competitive forces are shifting as a result of changes in barriers to entry. With respect to policy issues, the IMF argues that regulators need to carefully balance efficiency and stability trade-offs. The IMF paper also highlights the importance of international cooperation.

27 He, D., Habermeier, K., Leckow, R., Haksar, V., Almeida, Y., Kashima, M., . . . Verdugo-Yepes, C. (2016). Virtual Currencies and Beyond: Initial Considerations.

28 DTCC's Managing Director and Chief Information Officer Robert Garrison is one of the members of the IMF's High Level Advisory Group on Fintech.

29 See also International Monetary Fund (IMF). (2017, March 15). IMF Managing Director Welcomes Establishment of High Level Advisory Group on Fintech [Press release].

30 He, D., Leckow, R., Haksar, V., Mancini-Griffoli, T., Jenkinson, N., Kashima, M., Khiaonrong, T., Rochon, C., and Tourpe H. (2017). Fintech and Financial Services: Initial Considerations. IMF Staff Discussion Note 17/05.

APPENDIX 3 – DTCC FINTECH INITIATIVES

Distributed Ledger Technology (DLT)

DTCC has made progress advancing the development and application of new technologies. Toward that end, DTCC is one of the founding members of the *Hyperledger Project*, a consortium promoting open source development to advance DLT, and recently joined the *Enterprise Ethereum Alliance* (EEA). It is also a member of the Digital Chamber of Commerce and has made a financial investment in Digital Asset, a leading provider of DLT.

DTCC is replatforming its *Trade Information Warehouse* (TIW) for credit derivatives – one of the first and largest blockchain initiatives to date based on industry scale. The project is expected to streamline, automate and reduce the cost of derivatives processing across the industry and follows a successful proof-of-concept for North American single name Credit Default Swaps (CDS) that was completed in 2016. The new solution is expected to go live in early 2018. The TIW automates the record keeping, life cycle events, and payment management for more than US\$11 trillion of cleared and bilateral credit derivatives.

DTCC is also working very closely with Digital Asset to explore areas where we can leverage the technology to enhance certain post-trade processes.

Cloud Computing

DTCC has been leveraging cloud services for almost five years and is evaluating opportunities to strategically expand the use of the cloud more broadly across its external services and applications where it makes sense, with a goal of leveraging cloud capabilities to reduce risk and cost and improve the resiliency and security of DTCC's systems. In its 2017 white paper, *Moving Financial Market Infrastructure to the Cloud*, DTCC argues that capabilities, resiliency, and security of services provided by public cloud vendors have surpassed in-house data center capabilities.

Robotics and AI

DTCC is in the process of launching an enterprise-wide automation program to develop a repeatable, scalable approach to deploy automation effectively in a highly-regulated environment. DTCC, in collaboration with leading experts in the field, has created a holistic organizational and technical strategy to support the development of an automation strategy. The program is focused on leveraging Robotic Process Automation (RPA) in low-risk areas in which “bots” would manage highly manual and repeatable processes. As DTCC continues to mature the program, it will look for additional opportunities to use automation technologies in other areas.

BIBLIOGRAPHY

- Accenture & American Bankers Association. (2016). *Fintech Playbook*.
- Ainger, N. (2017, June 16). Coming Technology: Fintech Developers Tell You what to Look for and Why the Fintech Revolution Arose..
- Alberts, J., & He, I. (2017, July 17). OCC vs. New York DFS: Battle for the Future of FinTech.
- Asia Securities Industry & Financial Markets Association. (2017, June). *Best Practices for Effective Development of Fintech*.
- Basel Committee on Banking Supervision. (2017, August). *Sound Practices: Implications of Fintech Developments for Banks and Bank Supervisors*.
- BI Intelligence. (2016, September 16). Digitization can Reduce Investment Banks' Operational Costs by up to 25%.
- Bobeldijk, Y., & Agini, S. (2017, April 6). Fintech Partnerships Reveal Innovation Insecurities.
- Brainard, L. (2016, December 2). *The Opportunities and Challenges of Fintech*. Speech presented at Conference on Financial Innovation in Board of Governors of the Federal Reserve System, Washington, D.C.
- Carney, M. (2016). To G20 Finance Ministers and Central Bank Governors [Letter written February 22, 2016].
- Carney, M. (2017). *The Promise of Fintech - Something New Under the Sun?* Speech presented at the Deutsche Bundesbank G20 conference on "Digitising Finance, Financial Inclusion and Financial Literacy" in Wiesbaden, Germany.
- Cisco. (2016). *A Roadmap to Digital Value in Retail Banking*.
- Consumer Financial Protection Bureau. (2016, October). *Project Catalyst Report: Promoting Consumer Friendly Innovation*.
- Comizio, V., & Brownback, N. S. (2017, June 4). State Bank Regulators Challenge OCC's Authority to Issue Fintech Charters [Web log post].
- Crosman, P. (2016, October 5). Where Fintech VCs Will Place Their Bets in 2017.
- Deloitte. (2017). *Connecting Global Fintech: Interim Hub Review 2017*.
- Dietz, M., Khanna, S., Olanrewaju, T., & Rajgopal, K. (2016). Cutting Through the Noise around Financial Technology.
- DTCC. (2016, January). *Embracing Disruption – Tapping the Potential of Distributed Ledgers to Improve the Post-Trade Landscape*.
- DTCC. (2017, May). *Moving Financial Market Infrastructure to the Cloud*.
- EY. (2016). *UK Fintech: On the Cutting Edge*.
- Federal Trade Commission and Association for Computing Machinery US Public Policy Council (USACM). (2017, January 12). Statement on Algorithmic Transparency and Accountability.
- Financial Stability Board. (2017, June 27). *Financial Stability Implications from Fintech*.
- Finextra. (2017, June 27). What are the Financial Stability Implications from Fintech?
- Giancarlo, C. (2017, May 17). *LabCFTC: Engaging Innovators in Digital Financial Markets*. Speech presented before the New York FinTech Innovation Lab, New York City.
- He, D., Habermeier, K., Leckow, R., Haksar, V., Almeida, Y., Kashima, M., . . . Verdugo-Yepes, C. (2016). *Virtual Currencies and Beyond: Initial Considerations*.
- He, D., Leckow, R., Haksar, V., Mancini-Griffoli, T., Jenkinson, N., Kashima, M., Khiaonarong, T., Rochon, C., and Tourpe H. (2017). Fintech and Financial Services: Initial Considerations. IMF Staff Discussion Note 17/05.
- Institute of International Finance. (2016, March). *Regtech in Financial Services: Technology Solutions for Compliance and Reporting*.
- International Data Corporation (IDC). (2016, April 27). *Financial Services IT Spending to Reach \$480 Billion Worldwide in 2016, According to IDC Financial Insights* [Press release].
- International Monetary Fund (IMF). (2017, March 15). *IMF Managing Director Welcomes Establishment of High Level Advisory Group on Fintech* [Press release].
- International Monetary Fund (IMF). (2017). *Global Financial Stability Report: Getting the Policy Mix Right*.
- IOSCO. (2017). *IOSCO Research Report on Financial Technologies (Fintech)*.
- KPMG. (2017). *The Pulse of Fintech Q4 2016: Global Analysis of Investment in Fintech*.
- Lagarde, C. (2017, June 20). Fintech: Capturing the Benefits, Avoiding the Risks [Web log post].

Mayer Brown. (2016, November). *The ABC of Fintech – Acquisitions, Brexit and Collaboration*.

McHenry, P. (2017, April 25). CFPB's 'Project Catalyst' Failed. Fintech Deserves Better.

McIntyre, A. (2017, July 7). Banks Haven't Gone the Way of Blockbuster — Yet.

McKinsey & Company. (2015). *Cutting Through the Fintech Noise: Markers of Success, Imperatives for Banks*.

Meola, A. (2016, December 14). The Fintech Report 2016: Financial Industry Trends and Investment.

Office of the Comptroller of the Currency. (2016, October 26). *OCC Issues Responsible Innovation Framework* [Press release].

Office of the Comptroller of the Currency. (2016, December). *Exploring Special Purpose National Bank Charters for Fintech Companies*.

PwC. (2017). *Redrawing the Lines: Fintech's Growing Influence on Financial Services*.

PwC. (2016, April). @PwCFintech Q&A.

Santander InnoVentures, Oliver Wyman, & Anthemis. (2015). *The Fintech 2.0 Paper: Rebooting Financial Services*.

Schindler, John (2017). "FinTech and Financial Innovation: Drivers and Depth," Finance and Economics Discussion Series 2017-081. Washington: Board of Governors of the Federal Reserve System, <https://doi.org/10.17016/FEDS.2017.081>.

Schueffel, P. (2016). Taming the Beast: A Scientific Definition of Fintech. *Journal of Innovation Management*, 4(4).

Tsai, G. (2017, July 9). *Fintech and the U.S. Regulatory Response*. Speech presented at the 4th Bund Summit on Fintech, Shanghai, China.

Working Group established by the Committee on the Global Financial System (CGFS) and the Financial Stability Board (FSB). (2017, May 22). *Fintech Credit - Market structure, Business Models and Financial Stability Implications*.

World Economic Forum and Deloitte. (2017, August). Beyond Fintech: A Pragmatic Assessment of Disruptive Potential in Financial Services.

World Economic Forum: Global Agenda Council on the Future of Financing & Capital. (2015). The Future of Fintech: A Paradigm Shift in Small Business Finance.

