



Faculty of Law,
Economics
and Finance

Law Working Paper Series
Paper number 2019-009

The Dark Side of Digital Financial Transformation

The New Risks of FinTech
and the Rise of TechRisk

Ross P. Buckley, University of New South Wales
ross.buckley@unsw.edu.au

Douglas W. Arner, University of Hongkong
douglas.arnier@hku.hk

Dirk A. Zetsche, University of Luxembourg
Dirk.Zetsche@uni.lu

Eriks Selga, University of Hongkong

05/11/2019



EBI Working Paper Series

2019 – no. 54

Ross P. Buckley/Douglas W. Arner/

Dirk A. Zetsche/Eriks Selga

The Dark Side of Digital Financial Transformation: The New
Risks of FinTech and the Rise of TechRisk

05/11/2019

The European Banking Institute

The European Banking Institute based in Frankfurt is an international centre for banking studies resulting from the joint venture of Europe's preeminent academic institutions which have decided to share and coordinate their commitments and structure their research activities in order to provide the highest quality legal, economic and accounting studies in the field of banking regulation, banking supervision and banking resolution in Europe. The European Banking Institute is structured to promote the dialogue between scholars, regulators, supervisors, industry representatives and advisors in relation to issues concerning the regulation and supervision of financial institutions and financial markets from a legal, economic and any other related viewpoint. The Academic Members of EBI are the following:

1. Universiteit van Amsterdam, Amsterdam, The Netherlands
2. Universiteit Antwerpen, Antwerp, Belgium
3. Πανεπιστήμιο Πειραιώς / University of Piraeus, Athens, Greece
4. Alma Mater Studiorum – Università di Bologna, Bologna, Italy
5. Academia de Studii Economice din București (ASE), Bucharest, Romania
6. Universität Bonn, Bonn, Germany
7. Trinity College, Dublin, Ireland
8. Goethe-Universität, Frankfurt, Germany
9. Universiteit Gent, Ghent, Belgium
10. Helsingin yliopisto (University of Helsinki, Helsinki, Finland)
11. Universiteit Leiden, Leiden, The Netherlands
12. Universidade Católica Portuguesa, Lisbon, Portugal
13. Universidade de Lisboa, Lisbon, Portugal
14. Univerze v Ljubljani / University of Ljubljana, Ljubljana, Slovenia
15. Queen Mary University of London, London, United Kingdom
16. Université du Luxembourg, Luxembourg
17. Universidad Autónoma Madrid, Madrid, Spain
18. Universidad Complutense de Madrid/CUNEF, Madrid, Spain
19. Johannes Gutenberg University Mainz (JGU), Mainz, Germany
20. University of Malta, Malta
21. Università Cattolica del Sacro Cuore, Milan, Italy
22. Πανεπιστήμιο Κύπρου / University of Cyprus, Nicosia, Cyprus
23. Radboud Universiteit, Nijmegen, The Netherlands
24. Université Panthéon - Sorbonne (Paris 1), Paris, France
25. Université Panthéon-Assas (Paris 2), Paris, France
26. Stockholms Universitet/University of Stockholm, Stockholm, Sweden
27. Tartu Ülikool / University of Tartu, Tartu, Estonia

Supervisory Board of the European Banking Institute:

[Thomas Gstaedtner](#), President of the Supervisory Board of the European Banking Institute

[Enrico Leone](#), Chancellor of the European Banking Institute

EBI Working Paper Series

EBI Working Paper Series are a project of the European Banking Institute e.V.. EBI Working Paper Series represent a selection of academic researches into the area of banking regulation, banking supervision and banking in general which have been drafted by professors and researchers of EBI Academic Members and selected by the Editorial Board.

Editorial Board

T. Bonneau, D. Busch, G. Ferrarini, P. Mülbert, C. Hadjiemmanuil, I. Tirado, T. Tröger, and E. Wymeersch.

The Dark Side of Digital Financial Transformation: The New Risks of FinTech and the Rise of TechRisk

Ross Buckley*, Douglas Arner**, Dirk Zetsche*** & Eriks Selga****

Abstract: Over the past decade a long-term process of digitization of finance has increasingly combined with datafication and new technologies including cloud computing, blockchain, big data and artificial intelligence in a new era of FinTech (“financial technology”). This process of digitization and datafication combined with new technologies is taking place in developed global markets and at times even faster in emerging and developing markets. The result: cybersecurity and technological risks are now evolving into major threats to financial stability and national security. In addition, the entry of major technology firms into finance – TechFins – brings two new issues. The first arises in the context of new forms of potentially systemically important infrastructure (such as data and cloud services providers). The second arises because data – like finance – benefits from economies of scope and scale and from network effects and – even more than finance – tends towards monopolistic or oligopolistic outcomes, resulting in the potential for systemic risk from new forms of “Too Big to Fail” and “Too Connected to Fail” phenomena. To conclude, we suggest some basic principles about how such risks can be monitored and addressed, focusing in particular on the role of regulatory technology (“RegTech”).

* KPMG Law and King & Wood Mallesons Chair of Disruptive Innovation, Scientia Professor, and Member, Centre for Law, Markets and Regulation, UNSW Sydney. Professor Buckley chairs the Digital Finance Advisory Panel of the Australian Securities and Investments Commission (ASIC) however the views expressed herein are strictly his own, not those of ASIC.

** Kerry Holdings Professor in Law and Co-Founder, Asian Institute of International Financial Law, Faculty of Law, University of Hong Kong.

*** Professor of Law, ADA Chair in Financial Law (Inclusive Finance), Faculty of Law, Economics and Finance, University of Luxembourg, and Director, Centre for Business and Corporate Law, Heinrich-Heine-University, Düsseldorf, Germany.

**** PhD candidate, University of Hong Kong.

The article develops further and expands ideas first raised in Douglas W. Arner, Dirk A Zetsche & Ross P Buckley, *FinTech, RegTech and Systemic Risk: The Rise of Global Technology Risk*, in Arner, Avgouleas, Busch, Schwarcz, (eds), *Systemic Risk in the Financial Sector: Ten Years after the Global Financial Crisis*, CIGI Press, 2019.

The authors are grateful for comments and remarks by participants of workshops and conferences at the Bank of International Settlement, the Financial Stability Board and the National University of Singapore.

Table of Contents

I. Introduction	2
II. Finance, Technology and Finance: Framework of Analysis	5
III. Cybersecurity and Data Risks	7
A. Sources of Systemic Risk	7
B. The Cyber Threat	9
1. Risk from the Growing Rate of FinTech Development.....	11
2. Risk from Lagging and Divergent International FinTech Governance.....	12
3. Risk from Conflating National Security and Financial Stability	13
4. Risk from Cyber-Monoculture	15
5. Addressing the New Cybersecurity Threat	15
C. Data Security and Privacy Risk.....	16
1. Data Manipulation Uncertainty Risk.....	16
2. FinTech Systemic Integration Risk	17
3. RegTech Monitoring and Intervention Capacity Risk	18
4. Addressing Data Security and Privacy Risks.....	19
IV. FinTech, TechFin, Size and Connectivity	19
A. BigTech.....	20
B. TechFin	21
C. Addressing Tech Risk.....	24
V. New Forms of Financial Infrastructure	25
VI. The New Risk Paradigm: IT and Model Risk as Drivers of Systemic Risk	28

I. Introduction

Over the past five decades, finance has undergone a process of digital transformation, encompassing digitization and datafication. Today, finance is not only the most globalized segment of the world's economy but also among the most digitized and datafied.¹

¹ Prashant Gandhi, Somesh Khanna, Sree Ramaswamy, 'Which Industries Are the Most Digital (and Why)?' (2016) *Harvard Business Review* <<https://hbr.org/2016/04/a-chart-that-shows-which-industries-are-the-most-digital-and-why>> accessed 28 October 2019.

This process can be seen across four major axes: the emergence of global wholesale markets, an explosion of financial technology (FinTech) startups since 2008, an unprecedented digital financial transformation in developing countries (particularly China), and the increasing role of large technology companies (BigTech) in financial services (TechFin) as well as increasing real time interconnectivity between systems. This process of digital financial transformation brings structural changes. These changes have positive aspects but also negative ones, in the form of new risks. While finance and technology have always interacted and supported each other, over the period since the 2008 Global Financial Crisis, the changes have been unprecedented, particularly in terms of speed of change and extent of new entrants. Speed of change can be seen particularly in the role of new technologies, often summarized as the ABCD framework: artificial intelligence (AI), blockchain, cloud and data, which are co-evolving at an increasing rate with finance. Many would also add mobile internet and internet of things (IoT) to this framework.

This long-term process of digitization and datafication of finance has increasingly combined with related technologies including big data² and artificial intelligence,³ distributed ledgers

² See, generally, Solon Barocas and Andrew D. Selbst, 'Big Data's Disparate Impact' (2016) 104 *California Law Review* 671; Daniel Martin Katz, 'Quantitative Legal Prediction – or – How I Learned to Stop Worrying and Start Preparing for the Data Driven Future of the Legal Services Industry' (2013) 62 *Emory Law Journal* 909; Omer Tene and Jules Polonetsky, 'Big Data for All: Privacy and User Control in the Age of Analytics' (2013) 11 *Northwestern Journal of Technology and Intellectual Property* 239; Dirk A. Zetsche et al, Ross P. Buckley, Douglas W. Arner, Janos Barberis, 'From FinTech to TechFin: The Regulatory Challenges of Data-Driven Finance' (2018) 14 *New York University Journal of Law and Business* 393.

³ In computer science, Artificial Intelligence is defined as devices that perceive their environment and take actions that maximize their chance of successfully achieving their task. The base line of artificial intelligence is a computer mimicking human 'cognitive' functions such as 'learning' and 'problem solving'. Artificial intelligence today can be used to detect unexpected correlations in large data pools, test expected correlations for causation or determine an empirical probability of a predefined pattern. See David Lynton Poole, Alan K Mackworth and Randy Goebel, *Computational Intelligence: A Logical Approach*. (Oxford University Press, 1998); Stuart J. Russel and Peter Norvig, *Artificial Intelligence: A Modern Approach* (Prentice Hall, 3rd ed, 2009).

and blockchain,⁴ initial coin offerings ('ICOs'),⁵ smart contracts,⁶ regulatory technology ('RegTech')⁷ and digital identity,⁸ in a new era of FinTech.⁹

Two major trends stand out in the current period of FinTech development. The first is the speed of change driven by the commoditization of technology, Big Data analytics, machine learning and artificial intelligence. The second is the increasing number and variety of new entrants into the financial sector, including pre-existing technology and e-commerce companies. Most attention to date has focused on the general trajectory that technologized financial services will take¹⁰ and how they will be regulated.¹¹ Special consideration has also

⁴ See Primavera De Filippi & Aaron Wright, *Blockchain and the Law: The Rule of Code* (Harvard University Press, 2018); Usha Rodrigues, 'Law and the Blockchain' (2018) 104 *Iowa Law Review* 679; Dirk A. Zetsche, Ross P. Buckley and Douglas W. Arner, 'The distributed liability of distributed ledgers: legal risks of blockchain' (2018) *University of Illinois Law Review* 1361-1407.

⁵ See Shaanan Cohney, David Hoffman, Jeremy Sklaroff, & David Wishnick, 'Coin-operated Capitalism', 119 *Columbia Law Review* 591-672; Philipp Hacker and Chris Thomale, 'Crypto-Securities Regulation: ICOs, Token Sales and Cryptocurrencies under EU Financial Law' (2018) *European Company and Financial Law Review* 645-696; Dirk A. Zetsche, Ross P. Buckley, Douglas W. Arner, Linus Föhr, 'The ICO Gold Rush: It's a Scam, It's a Bubble, It's a Super Challenge for Regulators' (2019) 60 *Harvard International Law Journal* 305-349.

⁶ See Jeremy M. Sklaroff, 'Smart Contracts and the Cost of Inflexibility' (2017) 166 *University of Pennsylvania Law Review* 263; Kevin Werbach and Nicolas Cornell, 'Contracts Ex Machina' (2017) 67 *Duke Law Journal* 313; Max Raskin, 'The Law and Legality of Smart Contracts' (2017) 1 *Georgetown Law Technology Review* 304.

⁷ See Douglas W. Arner, Janos Barberis, and Ross P. Buckley, 'FinTech, RegTech and the Reconceptualisation of Financial Regulation' (2017) 37 *Northwestern Journal of International Law and Business* 371; Lawrence G. Baxter, *Adaptive Financial Regulation and RegTech: A Concept Article on Realistic Protection for Victims of Bank Failures*, 66 *DUKE L.J.* 567, 572 (2016) (arguing that technology assists banking regulators in updating regulation and keeping up with evolving markets); Dirk A. Zetsche, Douglas W. Arner, Ross P. Buckley & Rolf Weber, 'The Future of Data-driven Finance', (2020) *Common Market Law Review* – in press. Rolf Weber, 'The Future of Data-driven Finance', (2020) *Common Market Law Review* – in press.

⁸ Douglas W. Arner, Dirk A. Zetsche, Ross P. Buckley, Janos Barberis, 'The Identity Challenge in Finance: From Analogue Identity to Digitized Identification to Digital KYC Utilities' (2019) 20 *European Business Organisation Law Review* 55-80.

⁹ Cf. Douglas W. Arner, Janos Barberis and Ross P. Buckley, 'The Evolution of FinTech: A New Post-Crisis Paradigm?' (2017) 47 *Georgetown Journal of International Law* 1271.

¹⁰ Arner, Barberis and Buckley, above n 9, 1276-1285.

¹¹ See Allen, H.J. (2019), *Regulatory Sandboxes*, 87:3 *George Washington L. Rev.* 579-645; Chris Brummer, *Disruptive Technology and Securities Regulation*, 84 *FORDHAM L. REV.* 977 (2015); Brummer, C., & Yadav, Y., *FinTech and the Innovation Trilemma*, (2019) 107 *Geo L.J.* 235-307; Kathryn Judge, *Investor-Driven Financial Innovation*, 8 *HARV. BUS. L. REV.* 291 (2018); Omarova, S.T. (2019), *New Tech v. New Deal: Fintech As A Systemic Phenomenon*, 36 *Yale Journal on Regulation* 735-793; Magnuson, W.J. (2018), *Regulating Fintech*, 71 *Vanderbilt L. R.* 1168-1226; Dirk A. Zetsche et al, 'Regulating a Revolution: From Regulatory Sandboxes to Smart Regulation' (2017) 23 *Fordham Journal of Corporate and Financial Law* 31.

been given to FinTech's impact on banks and the payment services sector,¹² including the disruptive effects of crowdfunding and crowdlending¹³ on existing intermediaries. The darker side of digital financial transformation however can be unsettling: digital financial transformation raises many risks and challenges.¹⁴ These are the focus of this article.

The article proceeds, in Part II, with a framework of analysis for the consideration of risks old and new emerging from digital financial transformation so as to set the stage. This is followed by sections analyzing key areas of concern: cybersecurity and data risks (Part III), BigTech / TechFin (Part IV), and new technological risks (Part V.). Part VI then concludes, arguing for the need for coordinated approaches at both domestic and international levels, suggesting the basis of a set of principles which may serve as the basis of a framework to address these sorts of risks going forward.

II. Finance, Technology and Finance: Framework of Analysis

In 2019, Facebook announced it was leading a consortium to establish Libra. Libra is a new cryptocurrency to be created and to operate through a new global electronic payment system, combined with a Facebook-led digital identification infrastructure. Effectively, Facebook aims to create a new electronic payment system for its ecosystem of social media applications based on a new payment instrument linked to pools of fiat currencies (a “stablecoin”), allowing it to monetize the interactions of its 3.5 billion users globally, particularly in developing countries lacking similar sorts of infrastructure.¹⁵

This proposal highlights many of the key areas of concern raised by digital financial transformation: What if Libra is hacked and destroyed? (cybersecurity risk) What if Facebook uses the data acquired for its own purposes? (data protection and privacy risk) What if user data is stolen? (data security risk) What if Facebook dominates the international

¹² See Basel Committee on Banking Supervision, *Sound Practices: implications of fintech developments for banks and bank supervisors* (19 February 2018), Bank for International Settlements <<https://www.bis.org/bcbs/publ/d431.pdf>>; U.S. Department of the Treasury, *A Financial System That Creates Economic Opportunities: Nonbank Financials, Fintech, and Innovation* (31 July 2018) <https://home.treasury.gov/sites/default/files/2018-08/A-Financial-System-that-Creates-Economic-Opportunities---Nonbank-Financials-Fintech-and-Innovation_0.pdf>; Lerong Lu, ‘Decoding Alipay: Mobile Payments, a Cashless Society and Regulatory Challenges’ (2018) 33 *Butterworths Journal of International Banking and Financial Law* (forthcoming). Available at SSRN: <https://ssrn.com/abstract=3103751>

¹³ See John Armour and Luca Enriques, ‘The Promise and Perils of Crowdfunding: Between Corporate Finance and Consumer Contracts’ (2018) 81 *Modern Law Review* 51; Dirk Zetsche and Christina Preiner, ‘Cross-Border Crowdfunding: Towards a Single Crowdlending and Crowdinvesting Market for Europe’ (2018) 19 *European Business and Organisation Law Review* 217.

¹⁴ ‘Decentralised Financial Technologies: Report on Financial Stability, Regulatory and Governance Implications’ (Financial Stability Board 2019) <<https://www.fsb.org/2019/06/decentralised-financial-technologies-report-on-financial-stability-regulatory-and-governance-implications/>> accessed 24 October 2019.

¹⁵ See on Libra's set-up and regulation Dirk A. Zetsche, Ross P. Buckley & Douglas W. Arner, ‘Regulating Libra’, EBI Working Paper (2019), www.ssrn.com/abstract=3414401.

financial system as a result of Libra? (new systemically important financial institution risk)
What if Libra becomes the dominant international form of money? (technological infrastructure risk, threats to competition)

These risks are key considerations for financial regulation. In looking at financial regulation, its objectives can be summarized in four major categories: 1) financial stability, 2) financial integrity, 3) customer protection, and 4) financial efficiency, development and inclusion ('financial market functions'). Financial stability can be seen both negatively (as avoidance of crises) and positively (as appropriate functioning of the financial system). Financial integrity focuses on prevention of criminal activities and use of the financial markets, for instance in the context of money laundering, terrorist financing, international criminal organizations, and even state organized attacks. Customer protection focuses on systems to prevent abuses of consumers. Financial efficiency, development and inclusion focuses on how to support and enhance the positive functioning and role of the financial system.

While FinTech raises concerns in all of these areas, our focus is in the context of financial stability, a core focus of regulators around the world particularly since 2008. Prior to 2008, the focus in terms of supporting financial stability and preventing crises was on the identification of major forms of risk and building appropriate regulatory and supervisory frameworks to address these, with the Basel II Capital Accord the state of art embodiment at an international level. Basel II and financial stability regulation in general focused on a "microprudential" approach prior to 2008, in which regulators and supervisors placed the greatest emphasis on the safety and soundness of individual financial institutions through prudential regulatory standards such as Basel II.

This approach focused on five major categories of risk: credit / counterparty risk, market risk, payment risk, operational risk, and legal risk. Basel II included capital charges and related regulatory standards for the first four of these (with relatively little attention to legal risk).

In this framework, risks relating to technological and data issues were incorporated into the operational risk framework, thus incurring a relatively small cost in terms of capital charges and related risk management and compliance systems. Since 2008, financial stability regulation has focused very heavily on addressing "macroprudential" risks: risks arising not just from the potential failure of individual institutions but risks arising from interdependencies in markets, which were at the heart of the 2008 financial crisis and thus have been central to post-crisis financial regulatory reform processes. Related analyses are now beginning to extend to a range of considerations and risks from FinTech.

We suggest that in the context of digital financial transformation, this treatment is no longer sufficient nor appropriate to capture the full range of risks faced by financial institutions.

In looking at digital financial transformation, an appropriate framework of analysis encompasses: (1) new sources of traditional forms of risk; (2) new forms of risk; and (3)

entirely new markets and systems, including for regulation (such as regulatory technology: RegTech).

We develop this framework discussing a number of key areas of concern which have emerged during the process of digital financial transformation, in particular cybersecurity, data security and data privacy (infra, at III.), the emergence of new systemically important financial institutions (infra, at IV.) as well as the emergence of new financial market infrastructures and dependencies (infra, at V.).

III. Cybersecurity and Data Risks

Traditionally, issues relating to technology have been included in the context of operational risk, recognized as one key form of financial risk, along with credit risk, market risk and legal risk.¹⁶ As a result of the emergence of digitization and datafication, we suggest that technology risks (including risks relating to cybersecurity and data privacy) should be seen as a separate form of risk, beyond the traditional operational risk categorization. Technology risks can arise in the context of individual institutions and in the interconnections among institutions. Even more fundamentally, technology risks have the potential to impact financial sector confidence and stability directly. As a result of digital financial transformation, cybersecurity has become one of the major sources of systemic risk in the financial system.

A. Sources of Systemic Risk

Before we give a detailed view of the new tech-induced threats, some background on systemic risk may provide the context of our analysis.

Systemic risk¹⁷ has long been a major focus in the evolution of financial regulation, particularly banking regulation. According to the G20,¹⁸

¹⁶ See Basel Committee on Banking Supervision, *Basel III: A global regulatory framework for more resilient banking systems* (December 2017) < <https://www.bis.org/publ/bcbs189.pdf> >.

¹⁷ See the works by G.G. Kaufmann, an economist at the Federal Reserve, e.g. George G Kaufman, 'Bank Failures, Systemic Risk, and Bank Regulation' (1996) 16 *Cato Journal* 16 n. 5 quoting Alan Greenspan, the former head of the US Federal Reserve; George G. Kaufmann and Kenneth E. Scott, 'What Is Systemic Risk, and Do Bank Regulators Retard or Contribute to It?' (2003) 7 *The Independent Review* 371: at 371 'Systemic risk refers to the risk or probability of breakdowns in an entire system, as opposed to breakdowns in individual parts or components, and is evidenced by comovements (correlation) among most or all the parts.' Kaufmann and Scott refer to Kaufmann's earlier work in the 1990s; see also the contributions in Arner, Avgouleas, Busch, Schwarcz, (eds), *Systemic Risk in the Financial Sector: Ten Years after the Global Financial Crisis*, CIGI Press, 2019.

¹⁸ Group of Ten, *Report on Consolidation in the Financial Sector (25 January 2001)* International Monetary Fund, 126 < <https://www.imf.org/external/np/g10/2001/01/eng/pdf/file3.pdf> >.

‘[s]ystemic financial risk is the risk that an event will trigger a loss of economic value or confidence in, and attendant increases in uncertainty about, a substantial portion of the financial system that is serious enough to quite probably have significant adverse effects on the real economy.’

Prior to the 2008 Global Financial Crisis, financial stability regulation had emerged as a core regulatory function, focusing on the identification, prevention and management of systemic risk.¹⁹ The focus generally was in the context of banking – usually excluding non-bank financial institutions – and in particular in the context of size of individual institutions (the TBTF problem) and in the context of the payments system.

Despite decades of experience and analysis, systemic risk was a core feature of the 2008 Global Financial Crisis, highlighting distinct failures in financial stability regulation.²⁰

Following the 2008 Global Financial Crisis, there is a general consensus that systemic risk is usually the result of the financial intermediary’s size (Too Big to Fail: TBTF) or of interrelationships between intermediaries (Too Connected to Fail: TCTF). Both TBTF and TCTF are now seen as core aspects of financial stability regulation, both from the microprudential (TBTF) and the macroprudential (TCTF) standpoint.

Since the GFC, large volumes of research have sharpened the understanding of systemic risk. As a baseline, there is a common understanding that size of intermediaries and interconnectivity are core sources of systemic risk. As defined by former U.S. Federal Reserve, Chair Ben Bernanke, a systemically important financial institution (SIFI) ‘is one whose size, complexity, interconnectedness, and critical functions are such that, should the firm go unexpectedly into liquidation, the rest of the financial system and the economy would face severe adverse consequences.’²¹ SIFIs – particularly global SIFIs (G-SIFIs) – have thus become a central focus of the G20 / Financial Stability Board post-crisis regulatory reform agenda, as well as a key focus of domestic and regional regulatory reforms over the past decade.

¹⁹ See Douglas W Arner, *Financial Stability, Economic Growth, and the Role of Law* (2007).

²⁰ See Steven L. Schwarcz, ‘Systemic Risk’ (2008) 97 *Georgetown Law Journal* 193. Schwarcz demands an integrated view on markets rather than institutions. His view indirectly supports the position presented herein that systemic risk is an established feature of the Market Governance objective of financial law.

²¹ Testimony before the Financial Crisis Enquiry Commission, ‘*Causes of the Recent Financial and Economic Crisis*’, United States Congress, Washington D.C, 2 September 2010, (Ben Bernanke) <<https://www.federalreserve.gov/newsevents/testimony/bernanke20100902a.htm>>

In the context of the TBTF paradigm, systemic significance follows from the size of a financial institution.²² Under the TCTF paradigm, systemic importance follows from the fact that other financial intermediaries are engaged in business links with the intermediary which are crucial to the many intermediaries, while all of those intermediaries together are of critical importance for the financial system, and substitutes cannot be found for those links easily. The key post-crisis insight here is that interlinkages can take many forms, not just payment interlinkages, with a particular post-crisis focus on linkages from over-the-counter (OTC) derivatives and the related counterparty risk. In addition, interlinkages are now seen as arising from common business models (e.g. originate-to-distribute), contractual approaches (e.g. standardized documentation such as that of ISDA) and commonalities across risk-management systems.

One consequence of systemic importance is that governments are pressed to provide support to systemically important financial institutions if they face financial problems.²³

Much of the G20 / FSB post-crisis regulatory agenda thus focuses on prevention of systemic risk through a range of financial stability systems, including: (1) microprudential supervision of SIFIs, particularly G-SIFIs; (2) macroprudential supervision to identify interconnections and risks prior to any crisis trigger; and (3) strengthening core infrastructures, particularly in the context of systemically important infrastructures such as payment systems, securities settlement systems and central counterparties.²⁴ These have been undertaken through a wide range of efforts: domestic, regional and international, including regulatory changes and changes to the scope of regulatory mandates (in individual jurisdictions as well as through the Financial Stability Board) and the creation of new systemic risk supervisory structures (such as the European Systemic Risk Board in the EU and the Financial Stability Oversight Council in the US).

B. The Cyber Threat

Cybersecurity has become one of the leading areas of attention of financial regulators around the world as well as of governments and financial and tech firms. We would suggest that cybersecurity is now the most significant source of systemic risk, as well as one of the more significant issues of national security. Cyber attacks are consistently increasing in severity and frequency, with 15% more firms reporting having experienced a cyber event in 2018,

²² Luc Laeven, Lev Ratnovski, and Hui Tong, 'Bank Size and Systemic Risk', (IMF Staff Discussion Note No SDN/14/04, International Monetary Fund, May 2014) <<https://www.imf.org/external/pubs/ft/sdn/2014/sdn1404.pdf> >).

²³ See Bernanke, above n 6.21.

²⁴ See Ross P. Buckley, Emiliios Avgouleas and Douglas A. Arner (eds), *Reconceptualising global finance and its regulation* (Cambridge University Press, 2016). [Please cite specific chapters*]

from the year before.²⁵ Cyber insurance premiums have tripled in the past two years and reinsurers are questioning the viability of the business.²⁶ The economic impact of cybercrime has risen fivefold in the past six years.²⁷ Espionage and service disruption continues to be a growing motive for hacking.²⁸ Cybersecurity risk can thus be seen as a new source of traditional risk as well as an entirely new form of risk and one with potentially catastrophic consequences. The hacking of a Russian bank leading to the execution of \$400 million in trades swung the USD/Ruble exchange rate by 15%. While the weight of the international risks are significant, addressing them at a cross-border level is particularly challenging due to not only financial stability issues but also national security issues.

From the standpoint of SIFIs which have almost entirely digitized their operations, hacking, cybertheft, cyberterrorism, cyberactivism and cyberattacks pose grave risks. While financial institutions have long focused on all forms of fraud and theft risk, digitization and globalization raise the potential for even simple fraud and theft to take on much greater scale: instead of robbing one account, office or firm, an attacker can potentially rob or attack all accounts and offices of multiple firms in multiple jurisdictions at the same time. The challenge here is greater provided the wide range of motivations for attackers.

While regulators – both in individual jurisdictions as well as internationally and regionally – are focusing attention on related issues, the wide range of actors and motivations are a challenge: though it is clearly appropriate and necessary for all financial institutions and infrastructure providers to focus significant resources and efforts on cybersecurity, the broad presence of state and state-supported actors involved highlights the difficulties of pushing the entire burden onto the financial sector. Concurrently, the shift towards FinTech exacerbates certain cybersecurity threats that are unique to the financial system, and subsequently - financial stability. Vulnerabilities in the financial system stem from the high level of leverage, asset conversion chains, and procyclicality.²⁹ The growing dependence on complex digitalized information technology hubs without substitute is contrasted by the

²⁵ ‘Challenges to effective EU cybersecurity policy’ (*European Court of Auditors*, March 2019) <https://www.eca.europa.eu/Lists/ECADocuments/BRP_CYBERSECURITY/BRP_CYBERSECURITY_EN.pdf> accessed 22 October 2019

²⁶ See *Ibid* and Jeff Stone, ‘Demand for Cyber Insurance Grows as Volatility Scares off Some Providers’ (*CyberScoop*, 29 July 2019) <<https://www.cyberscoop.com/cyber-insurance-demand-cost-2019/>> accessed 24 October 2019.

²⁷ European Commission, President’s State of the Union 2017

²⁸ ‘Data Breach Investigations Report 2017’ (*Verizon*, 2017) <http://www.verizonenterprise.com/resources/reports/rp_DBIR_2017_Report_en_xg.pdf> accessed 22 October 2019

²⁹ Martin Boer and Jaime Vazquez, ‘Cyber Security & Financial Stability: How Cyber-Attacks Could Materially Impact the Global Financial System’ (2017) Institute of International Finance <<https://www.iif.com/Publications/ID/228/Cyber-Security-Financial-Stability-How-Cyber-attacks-Could-Materially-Impact-the-Global-Financial-System>> accessed 22 October 2019

growing amount of outwards facing FinTech, increasing cyber exposure.³⁰ Cyber attacks can exploit these security gaps to, for example, disrupt payment systems, corrupt data at custodian banks or Central Securities Depositories, or cripple infrastructure on which the financial system relies.³¹ While these are low-risk events, their occurrence will have high-impact consequences capable of snowballing into financial destabilization if not contained.

As a result of the increased state presence in cyberactivities (including cyberwarfare), there is a clear need for states to take a leading role in building systems to monitor and support key sectors of the economy – such as the financial sector – in addition to private and regulatory attention to issues of cybersecurity.

We posit three factors that transform cybersecurity into a new form of risk, and one that is much more material to financial stability. These are: (1) the growing rate of technological development and adoption in finance, (2) the lag and divergence in international FinTech governance and (3) the erosion of trust from the conflation of national security and financial stability in the cyber domain.

1. Risk from the Growing Rate of FinTech Development

The first layer of cyber risk stems from the high rate and typology of technological development and adoption of digital systems in finance. The growing transition to cloud infrastructure creates more concentrated data nodes, with less software diversity, requiring higher security measures.³² Endogenous threats to such nodes stem from compromises of internal firm or client information, and unauthorized access to systems by or via users or employees.³³ Exogenous threats involve breaches from interfacing with other third-party systems, or using fraudulently acquired privileged accounts credentials to access data and perform transactions.³⁴ Both threats form several concentric layers of security risk by depending on the security of third-party software in the likes of (i) colocation centres holding

³⁰ Artie W Ng and Benny KB Kwok, 'Emergence of Fintech and Cybersecurity in a Global Financial Centre' (2017) *Journal of Financial Regulation and Compliance* <<https://www.emerald.com/insight/content/doi/10.1108/JFRC-01-2017-0013/full/html>> accessed 22 October 2019.>

³¹ Martin Boer and Jaime Vazquez, 'Cyber Security & Financial Stability: How Cyber-Attacks Could Materially Impact the Global Financial System' (2017) *Institute of International Finance* <<https://www.iif.com/Publications/ID/228/Cyber-Security-Financial-Stability-How-Cyber-attacks-Could-Materially-Impact-the-Global-Financial-System>> accessed 1522 October 2019

³² 'Cyber Risk Outlook 2019' (*Cambridge Judge Business School*) 1 <<https://www.jbs.cam.ac.uk/faculty-research/centres/risk/publications/technology-and-space/cyber-risk-outlook/cyber-risk-outlook-2019/>> accessed 28 October 2019.

³³ Polozov, Y., 'Trading Systems Manipulation: Metel/Corkow Trojan proof-of-concept attack,' (2016) Wapack Labs, FS-ISAC.

³⁴ Benton E Gup, *The Most Important Concepts in Finance* (Edward Elgar Publishing 2017) 43.

primary server data, or (ii) employee mobile and other IoT devices.³⁵ For example, in 2016 criminals stole \$81 million from the central bank of Bangladesh, by infecting a SWIFT server with malware.³⁶ With more interconnected and digitized technology, cyber security is only as strong as the weakest link in the network.

New FinTech, like distributed ledger technologies, blockchain, or stablecoins come with their own set of threats. While their novel methods of centralization (or decentralization) provide unique value to their users, they still tend to be based on traditional or cloud based infrastructure.³⁷ For example, a theft of 7000 bitcoins, stolen from one of the world's largest cryptocurrency exchanges through the use of phishing and viruses to gain user data, led to the value of the bitcoin falling by about 3 percent.³⁸ Depending on the level of centralization and 'chain' – related status, updating the infrastructure of the technology can also be difficult. With no clear contingency mechanism, a security breach can instantly disrupt the network.

2. Risk from Lagging and Divergent International FinTech Governance

The second layer of risk stems from lag and divergence in cyber governance in different countries. While cyberspace is a high-speed, frictionless global network, its regulation is fragmented, with at best, significant gaps, and at worst, normative clashes between various actors. At national levels, particularly less mature regulatory environments, severe discrepancies leave smaller private and public entities vulnerable, opening the wider system to cascading effects from breached entities.³⁹ Attempts to lessen such sectoral discrepancies are nascent and as yet untested for their impact.

The US, for example, has embraced public-private partnerships, with the Cybersecurity Information Sharing Act of 2015 inviting private entities and certain government agencies to share information on threats with federal agencies. The National Institute of Standards and Technology and the Financial Industry Regulatory Authority collect, identify, assess and respond to risks between public and private entities, exchanging best practices. However, these are largely soft measures with varying membership across sectors and size. Hard

³⁵ *Ibid* 45.

³⁶ Emanuel Kopp, Lincoln Kaffenberger and Christopher Wilson, 'Cyber Risk, Market Failures, and Financial Stability' (2017) IMF 4 <<https://www.imf.org/en/Publications/WP/Issues/2017/08/07/Cyber-Risk-Market-Failures-and-Financial-Stability-45104>> accessed 22 October 2019.

³⁷ 'Decentralised Financial Technologies: Report on Financial Stability, Regulatory and Governance Implications' (n 18).

³⁸ 'Hackers Steal \$40 Million Worth of Bitcoin From Binance Exchange' *Bloomberg.com* (8 May 2019) <<https://www.bloomberg.com/news/articles/2019-05-08/crypto-exchange-giant-binance-reports-a-hack-of-7-000-bitcoin>> accessed 15 October 2019.

³⁹ 'Challenges to effective EU cybersecurity policy' *European Court of Auditors* (March 2019) <https://www.eca.europa.eu/Lists/ECADocuments/BRP_CYBERSECURITY/BRP_CYBERSECURITY_EN.pdf> accessed 14 October 2019

measures generating systemic protection are rare and divergent. New York recently implemented comprehensive cybersecurity rules requiring financial service firms to appoint chief information security officers and to conduct periodic risk assessments and protect sensitive data.⁴⁰ California, for example, avoids prescriptive requirements in favor of risk-based security centered on consumer data protection.⁴¹

Likewise, the EU Network and Information Security Directive adopted in 2016 sets a minimum level of harmonization among Member States, setting a single point of contact and creating computer security incident response teams (CSIRTs).⁴² Yet, Latvia has 8 sectoral competent authorities, Estonia has one, and Spain splits them by public and private sectors.⁴³ In case an incident is recorded, cooperation among law enforcement is difficult, granted the number of jurisdictions involved and the inefficiencies persisting in crossborder collaboration.⁴⁴ These differences are capable of placing additional burdens on attempts at cooperation, facilitating hackers' business, and extending cyber incident contagion.⁴⁵

3. Risk from Conflating National Security and Financial Stability

The third layer of risk is tied to the convergence of national security and financial stability in the cyber domain. Where cybersecurity has conventionally been understood as a state responsibility, aimed at protecting internal critical infrastructure and cyberspace from national security incidents,⁴⁶ increasingly interconnected data and transaction flows necessitate broadening the mandate. However, the defense origins of cybersecurity can lead

⁴⁰ N.Y. COMP. CODES R. & REGS. tit. 23, § 500.00 (2017)).

⁴¹ California Consumer Privacy Act of 2018 (A.B. 375)).

⁴² Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union [2016] OJ L 194.

⁴³ See Sabrina Galli, 'NYDFS Cybersecurity Regulations: A Blueprint for Uniform State Statute' (2018) 22 NC Banking Inst 235 and John Ogle, 'Identities Lost: Enacting Federal Law Mandating Disclosure & Notice after a Data Security Breach' (2019) 72 Ark L Rev 221.

⁴⁴ See Sabrina Galli, 'NYDFS Cybersecurity Regulations: A Blueprint for Uniform State Statute' (2018) 22 NC Banking Inst 235 and John Ogle, 'Identities Lost: Enacting Federal Law Mandating Disclosure & Notice after a Data Security Breach' (2019) 72 Ark L Rev 221.

⁴⁵ See Loretta J Mester, 'Perspectives on Cybersecurity, the Financial System, and the Federal Reserve' (2019) Ohio Division of Financial Institutions, Columbus, OH <<https://www.clevelandfed.org/newsroom-and-events/speeches/sp-20190404-perspectives-on-cybersecurity-the-financial-system-and-the-federal-reserve>> accessed 22 October 2019.

⁴⁶ For example, major cybersecurity mobilization took place among international organizations after cyberattack experienced by Estonia in 2007, which disrupted its communication capabilities through denial of service attacks, when an Iranian nuclear facility was destroyed by a virus, or when the US financial sector experienced experienced DDOS attacks between 2011 and 2013. For more, see: Yoo S Christopher, "Cyber Espionage or Cyberwar?: International Law, Domestic Law, and Self-Protective Measures" (2016) University of Pennsylvania, Public Law Research Paper.

to vastly varying approaches to transnational cybersecurity cooperation, which may hamper the intelligence pooling necessary to effectively prevent cyber incidents. Recent challenges for CSIRTs – the national cyber incident first responder teams, are a representative microcosm.

Hundreds of CSIRTs across the world perform similar primary functions in both the public and private sectors, they: (i) coordinate prevention efforts against cyber-threats, (ii) disseminate information regarding cybersecurity practices and incidents, (iii) remediate damage by securing breached data, and (iv) recover public and private systems after a cyber-attack on national infrastructure.⁴⁷ To disseminate and develop intelligence and best practices among themselves, various informal cybersecurity networks were established connecting CSIRTs to one another aiming to foster collective cybersecurity.⁴⁸ Such ‘walled-gardens’ remain the main vehicles of best practice, toolset, and communication exchange between CSIRTs, mitigating the asymmetry of capacity between various teams.⁴⁹

As CSIRT functions evolve to meet the demands of their respective governments, their duties can expand to include law enforcement or intelligence activity. This can alter their ability to reveal vulnerabilities or raise the suspicion of network members to the use of received information for political purposes. Through no fault of their own, CSIRTs risk being isolated from the “web of trust”, cutting them off from access to the latest vulnerabilities and leaving them in an information vacuum.⁵⁰ CSIRT groupings can create significantly more cyber-resilience than individual units.⁵¹ As these networks are comprised of both public and private sector teams, limiting the access of one team to information can disable cybersecurity capacity, increasing financial destabilization risk.

⁴⁷ Yoo S Christopher, “Cyber Espionage or Cyberwar?: International Law, Domestic Law, and Self-Protective Measures” (2016) University of Pennsylvania, Public Law Research Paper.

⁴⁸ The largest network, FIRST was established in 1990. Membership has grown from a handful of CSIRTs in North America in the year of formation, to over 490 from 92 countries all over the world by 2019. Samantha Bradshaw, *Combating Cyber Threats: CSIRTs and Fostering International Cooperation on Cybersecurity* (2015), Global Commission on Internet Governance Paper Series, Paper No. 23.

⁴⁹ Isabel Skierka et al., *CSIRT Basics for Policy-Makers: The History, Types & Culture of Computer Security Incident Response Teams* (2015), Global Public Policy Institute Working Paper, Available at: www.gppi.net/publications/global-internet-politics/article/csirtbasics-for-policy-makers, at 8.

⁵⁰ Jaco Robertson, Marthie Lessing, and Simon Nare, ‘Preparedness and Response to Cyber Threats Require a CSIRT’ (2008) International Federation for Information Processing

⁵¹ Joseph S. Nye, ‘The Regime complex for managing global cyber activities. Global Commission on Internet Governance’ (2014) No. 1. Global Commission on Internet Governance <https://www.cigionline.org/sites/default/files/gcig_paper_no1.pdf> accessed 22 October 2019

Similar misalignments are present at higher policy levels. For instance, the US strategy labels certain private sector firms as a subset of critical infrastructure with catastrophic national effects on economic security. However, as of recently, the US cybersecurity policy has pivoted from defense to deterrence.⁵² The Financial Systematic Analysis and Resilience Center established in 2016 by the heads of eight large US financial service providers, launched a pilot project together with the US government to share threat data on nation-state actors that may pose threats to US national security.⁵³ The shift towards using major financial players as arms of US intelligence corps is a challenge for member states of the EU, generally practicing protective policies.⁵⁴ States must now carefully consider the extent to which US financial service providers with branches in their jurisdictions collect and transfer information, which may deter some from information sharing. A final challenge arises from adversary regimes intentionally and surreptitiously utilizing cyberspace against their rivals, in which case cooperation in cyber for the purpose of financial stability can be wholly precluded. However, in such cases states and regions tend to have separate, mutually independent, FinTech networks.

4. Risk from Cyber-Monoculture

One additional cyberrisk comes from the lag of cyberdiversity, that is: where most large institutions use the same IT features (software, infrastructure, cloud computing), cyberrisks increase since cyberattacks against one institution could also succeed against another institution that is running similar IT systems. Hence, not only the tech use, but the uniformity of tech applications (which are inherent in the tech economy) create new risks.

5. Addressing the New Cybersecurity Threat

Cybersecurity is generally considered mature where concerned with traditional critical infrastructure,⁵⁵ but the growth of data and money flows enabled by FinTech may create a dangerous interdependence that tends to avert stakeholder attention away from cyber-resilience. To address the aforementioned risks, we suggest expanding the breadth of cyber incident scenarios internationally, involving a variety of FinTechs to not only assess system weaknesses and costs, but to clarify liability assignment, which may be instrumental to reduce uncertainty in case of a cyber-caused crisis and aid in promoting a common legal

⁵² Joseph S. Nye, 'The Regime complex for managing global cyber activities. Global Commission on Internet Governance' (2014) No. 1. Global Commission on Internet Governance <https://www.cigionline.org/sites/default/files/gcig_paper_no1.pdf> accessed 22 October 2019

⁵³ Chris Bing, 'Project Indigo: The Quiet Info-Sharing Program between Banks and U.S. Cyber Command' *CyberScoop* (21 May 2018) <<https://www.cyberscoop.com/project-indigo-fs-isac-cyber-command-information-sharing-dhs/>> accessed 22 October 2019.

⁵⁴ Gil Baram and others, "Strategic Trends in the Global Cyber Conflict" [2018] 2 *Cyber Security: A Peer-Reviewed Journal*, <<https://www.ingentaconnect.com/content/hsp/jcs/2018/00000002/00000003/art00006>> accessed 22 October 2019.

⁵⁵ 'Cyber-Resilience: Range of Practices' (*Bank for International Settlements*, December 2018) <<https://www.bis.org/bcbs/publ/d454.htm>> accessed 22 October 2019.

framework. Such tests may also highlight the problems associated with moral hazard and TBTF and TCTF.

Considering national security concerns, we also suggest a comprehensive regulatory effort founded on already established grassroots operational initiatives with experience in pooling preventative, reactive, and proactive cybersecurity efforts. Careful examination should identify entities vulnerable to cyber breaches and capable of impacting financial stability, and relevant intelligence should be shared with other stakeholders at an international level. Policy differences are capable of inhibiting trust between stakeholders, so an apolitical mechanism may be appropriate. The International Committee of the Red Cross offers a model for a confidential and impartial coordinator entity working with independent national sub-structures, capable of tracking threats of contagion internationally.

C. Data Security and Privacy Risk

In addition to cybersecurity, the increasingly central role of data in the financial sector highlights the second major area of concern: data protection. Different policies are being developed in different economies, in part representative of fundamentally different societal approaches. The US, China and EU being the leading examples of diverging legal approaches to use, ownership and protection of data. These variations undergird major questions about the role of data in digitized and datafied societies and economies: who owns and controls data, and what does control entail?

As dissimilitude in national legal approaches and capacities tend to heighten data security and privacy TechRisks,⁵⁶ we identify three data security and privacy risks in particular: (1) data manipulation uncertainty risk, (2) FinTech systemic integration risk, and (3) RegTech intervention and capacity risk.

1. Data Manipulation Uncertainty Risk

The compound effects of increasingly concentrated data nodes with more levels and forms of analysis and subsequent use are yet unclear.⁵⁷ Given the current tendency towards ‘evidence based policy’ building so as not to unduly limit growth -- legal frameworks are generally not constructed to take into account macroprudential data risks.⁵⁸ The principle of precaution for data and privacy is thus still nascent. Impact assessments tests required by

⁵⁶ World Bank, *World Development Report 2020: Trading for Development in the Age of Global Value Chains* (The World Bank 2019) 245 <<http://elibrary.worldbank.org/doi/book/10.1596/978-1-4648-1457-0>> accessed 24 October 2019.

⁵⁷ Arvind Narayanan, Joanna Huey and Edward Felten, ‘A Precautionary Approach to Big Data Privacy’, vol 24 (2016).

⁵⁸ Stirling, A. ‘Precaution in the governance of technology’(2016) SWPS 2016–14 (July): Working Paper Series. Science Policy Research Unit. University of Sussex.

data controllers under the EU's GDPR, for example, remain "abstract or imprecise".⁵⁹ Regulators lack a clear understanding of harm caused from bad faith or negligent data interfacing and transfers across jurisdictions.⁶⁰

To avoid misconstruing data risks by setting narrow goal-based rules, a regulatory shift is taking place towards increasing the accountability of data manipulators by scrutinizing the technical construction of algorithms and the auditability of their data analytics.⁶¹ While helpful in retrospective investigations, these factors do not work well to mitigate or prevent loss.

2. FinTech Systemic Integration Risk

In 2018, Carstens highlighted the risks associated with FinTech expansion into financial intermediation or 'online money market funds'.⁶² The size of certain FinTechs is cause for credit and liquidity, and cascading investor run, risks.⁶³ Traditional banks will combine small deposits into large loans, while FinTech relies on a mixture of internal sources, syndicated loans and onselling originated credit.⁶⁴ The use of proprietary or second-hand non-traditional banking data to evaluate credit risk may import different levels of risk depending on the size of the data samples available, thereby precluding one-size fits all regulatory solutions. China, for instance, established *sui generis* norms for BigTech companies (explored later), requiring reserves on custodial accounts and for payments to be channeled through an authorized clearing house.

The compound network effects enjoyed by firms with access to large data panels allows for pattern recognition unreachable to new entrants, thereby dampening competition.⁶⁵ Even if

⁵⁹ Amir Shayan Ahmadian and others, 'Supporting Privacy Impact Assessment by Model-Based Privacy Analysis', *Proceedings of the 33rd Annual ACM Symposium on Applied Computing* (ACM 2018) <<http://doi.acm.org/10.1145/3167132.3167288>> accessed 20 October 2019.

⁶⁰ Luiz Costa, 'Privacy and the Precautionary Principle' (2012) 28 *Computer Law & Security Review* 14.

⁶¹ Paulette Lacroix, 'Big Data Privacy and Ethical Challenges' in Mowafa Househ, Andre W Kushniruk and Elizabeth M Borycki (eds), *Big Data, Big Challenges: A Healthcare Perspective: Background, Issues, Solutions and Research Directions* (Springer International Publishing 2019) <https://doi.org/10.1007/978-3-030-06109-8_9> accessed 20 October 2019.

⁶² Agustín Carstens, 'Big Tech in Finance and New Challenges for Public Policy' <<https://www.bis.org/speeches/sp181205.htm>> accessed 20 October 2019. See also 'FinTech and Banks. Friends or Foes?' (*European Economy*) <<https://european-economy.eu/book/fintech-and-banks-friends-or-foes/>> accessed 20 October 2019. Carstens. See also 'FinTech and Banks. Friends or Foes?'

⁶³ Carstens, above n 62.

⁶⁴ *Ibid.*

⁶⁵ 'FinTech and Market Structure in Financial Services: Market Developments and Potential Financial Stability Implications - Financial Stability Board' (Financial Stability Board 2019) <<https://www.fsb.org/2019/02/fintech-and-market-structure-in-financial-services-market-developments-and-potential-financial-stability-implications/>> accessed 24 October 2019.

policy attempts to remedy such imbalances by restricting data collection and retention, the incumbent data provides a plethora of derivative readings and forms of analysis capable of avoiding traditional compliance, which can continuously challenge regulators.⁶⁶ Firms with access to high amounts of data also benefit from a high symmetry of information in its operating markets – any attempts to galvanize the firm in a certain direction will necessarily face international challenges, exacerbated by fragmented regulatory frameworks.

3. RegTech Monitoring and Intervention Capacity Risk

If data risks are shared between the public and private sectors, regulators will require sufficient legal and technical capacity to effectively assess and impact the data-driven economy. In this regard, three data attributes create particular challenges:⁶⁷ (1) the strain placed on resources by the vastly varying data that needs to be monitored for a holistic investigation, (2) the vast variety of data structures running through proprietary systems that may need to be transposed into a form that meets regulatory standards, and (3) data quality assessment that requires understanding and comparing to upstream and vertical data origins and points, thereby exponentiating the investigative burden. Data investigation difficulties are also particularly strained by cross-jurisdictional coordination burdens, like heterogenous methodological approaches and investigative mandates and capacities.

Globally standardization initiatives, such as legal entity identifiers (LEIs), assist with data alignment, but they are slow and offer limited macroprudential entry points.⁶⁸ However, data access sharing is scarce, and even contentious. For example, the US CLOUD Act obligates cloud providers like Google and Amazon to submit data to law enforcement under warrant or subpoena, even if the data is in another country. EU authorities report that the act clashes with the EU's General Data Protection Regulation, highlighting an "urgent" need for updates to Mutual Legal Assistance Treaties encompassing principles of proportionality and data minimization.⁶⁹ For companies to comply with both, they may need to fully segment their network, relegating vulnerabilities to divested branches. If data access remains an uneven playing field, the asymmetry of information will limit preventative and reactive risk management.

⁶⁶ See, for example, the discovery of profitability bias in Amazon's algorithms. Dana Mattioli, 'WSJ News Exclusive | Amazon Changed Search Algorithm in Ways That Boost Its Own Products' *Wall Street Journal* (16 September 2019) <<https://www.wsj.com/articles/amazon-changed-search-algorithm-in-ways-that-boost-its-own-products-11568645345>> accessed 20 October 2019.

⁶⁷ Mark Flood, HV Jagadish and L Raschid, 'Big Data Challenges and Opportunities in Financial Stability Monitoring' (2016) *Financial Stability Review* 129.

⁶⁸ *Ibid.*

⁶⁹ Email from EDPB and EDPS to Mr. Lopez Aguilar (Brussels, 10 July 2019) <https://edpb.europa.eu/sites/edpb/files/files/file1/edpb_edps_joint_response_us_cloudact_coverletter.pdf> or <https://edpb.europa.eu/our-work-tools/our-documents/letters/epdb-edps-joint-response-libe-committee-impact-us-cloud-act_en> accessed 22 October 2019

4. Addressing Data Security and Privacy Risks

Data security and privacy risk differ from cybersecurity by relating to the utilization and veracity of collected data, instead of its protection. Consequently, regulators should consistently canvas the public sector for weaknesses in its integrity, risks of re-identification, etc. This demands sufficient resources and mandates to investigate the complex data streams. Once investigated, legal risk management frameworks can be created and updated. To effectively follow data trails, regulation should be harmonized internationally.

Similar to cyberactivity, the most effective way to advance more effective data assessments is through networks of data specialists exchanging best practices.⁷⁰ We posit supporting already existing initiatives, and reinforcing public private partnerships to better understand technical risks and events capable of drawing opprobrium from stakeholders, especially FinTechs with potential impact on cross-jurisdictional institutional trust.

IV. FinTech, TechFin, Size and Connectivity

Beyond cybersecurity and data protection, the involvement of new financial participants such as FinTechs and BigTech raises potential concerns.⁷¹

From a systemic risk perspective, we do not believe that the risk stems from FinTechs as such. FinTechs are problem-driven firms, and though trying to become big, tend to start small.⁷² Most FinTechs do not seek to disrupt the existing intermediaries; rather they want to collaborate and seek intermediaries as clients. It is here where the true FinTech innovation takes place – and at a rapid pace. As such, balanced proportional approaches to regulation are most appropriate, as we have analysed in detail elsewhere.⁷³

However, the involvement of large data firms ('BigTech') in financial matters is a reason for concern.⁷⁴

⁷⁰ Konstantina Vemou and Maria Karyda, 'Evaluating Privacy Impact Assessment Methods: Guidelines and Best Practice' (2019) Information & Computer Security <<https://www.emerald.com/insight/content/doi/10.1108/ICS-04-2019-0047/full/html>> accessed 20 October 2019.

⁷¹ See Jon Frost, Leonardo Gambacorta, Yi Huang, Hyun Song Shin & Pablo Zbinden, 'BigTech and the Changing Structure of Financial Intermediation', BIS Working Papers No. 779 (Apr. 2019)

⁷² Daniel Drummer et al, *Fintech – Challenges and Opportunities*, (May 2016) McKinsey & Company <https://www.mckinsey.de/files/160525_fintech_english.pdf>.

⁷³ Zetzsche et al, above n 11.

⁷⁴ Current regulatory attention focuses on the systemic risk dimension of technology firms. The BIS/BCBS has entered into a global consultation, in particular, on the role of 'BigTech'. See Basel Committee on Banking Supervision, *Sound Practices: implications of fintech developments for banks and bank supervisors* (19 February 2018), Bank for International Settlements <<https://www.bis.org/bcbs/publ/d431.pdf>> at 15.

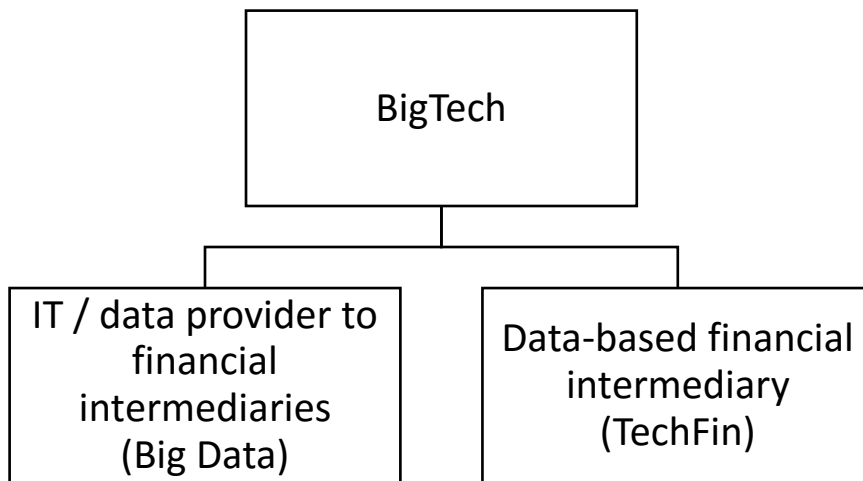
A. BigTech

According to the Basel Committee on Banking Supervision,

‘BigTech refers to large globally active technology firms with a relative advantage in digital technology. Bigtech firms usually provide web services (search engines, social networks, e-commerce etc) to end users over the internet and/or IT platforms or they maintain infrastructure (data storage and processing capabilities) on which other companies can provide products or service.’⁷⁵

These BigTechs are linked to financial markets in two ways. First, they can function as third party providers to financial intermediaries. Use cases include the cloud services provided by Amazon and others, or data feeds to banks and asset managers which are used to inform risk models and calculations. Second, BigTech firms can move more directly into the provision of financial services, initially serving as conduits linking the financial service providers with the customers that the BigTech typically already has, and over time potentially beginning to provide the financial service itself directly to customers: as TechFins.⁷⁶

Figure 1: BigTech’s Function in Finance



Both BigTech business models – be it third-party IT services (Big Data) or TechFin-like provision of financial services – have the potential to create systemic risk, albeit in different ways.

As to TBTF, we will highlight the rapid build-up of size drawing on the example of **TechFins** (data giants moving into financial services, such as Amazon and Alibaba). Large

⁷⁵ BIS/BCBS, Sound Practices: Implications of fintech developments for banks and bank supervisors – Consultative Document, August 2017, at 15.

⁷⁶ Zetzsche et al, above n 1.

tech firms are increasingly moving into finance, often benefiting from: (a) regulatory gaps and/or disparities in treatment with traditional financial institutions, (b) economies of scope and scale, and (c) network effects (i.e. a tendency towards concentration in both data and finance). This combination suggests that TechFins may in fact potentially increase TBTF risks, in addition to raising concerns about competition and data protection.

As to TCTF, we argue that in a world of digitized finance, all is connected via the data feed, and such connectivity creates systemic risk. In particular, traditional bank-owned and bank-run infrastructure is replaced by new systemically important infrastructure owned by someone else and that someone else is potentially not a financial intermediary in the traditional sense, i.e. not regulated at all and not subject to measures we associate with systemic risk (bail-in/bail-out, segregation of critical infrastructure etc.). Examples include market concentration in data feeds, cloud services (non-financial firm providing data and hosting services for financial firms and regulators), and others. In addition, cybersecurity risks arise dramatically across all aspects of finance.

We argue that BigTech's involvement in finance pairs size with connectivity – a combination which creates sizable potential systemic risks. The lack of transparency and the potential to build up (further) size in financial services very rapidly complete a story that suggests strongly that regulatory action with regard to BigTech should be on regulatory agendas.

B. TechFin

In contrast to FinTechs, TechFins – BigTech firms entering into finance - are often very significant firms beyond financial services prior to stepping into the financial sector. Due to their scale TechFins are connected to many institutions from the moment they enter the financial services market by, for example, functioning as a conduit to licensed institutions. Moreover, because of their data power, TechFins exercise influence over connected financial institutions from their moment of entry, and may often quickly control whole market segments when they finally begin to provide regulated financial services.

The governance and disclosure frameworks for financial services are not designed to accommodate Techfins: Financial intermediaries should be experts in processing financial information so as to channel cash flows to their most efficient use, in terms of expected risk-return ratios. This paradigm is challenged by TechFins. If TechFins have better data than traditional financial institutions, TechFins may provide the financial intermediary function more effectively. However, TechFins, at least today, operate for the most part in an unregulated environment. Until rather late in their journey into financial services, when they apply for a financial services license, TechFins will not be subject to

client/customer/investor protection rules nor to measures that ensure the functioning of financial markets and prevent the build-up of systemic risk.⁷⁷

Moreover, from the perspective of incumbent licensed financial intermediaries, TechFins provide unbalanced, and arguably unfair, competition. The fixed costs of an initial license and the ongoing costs of supervision and related reviews by advisors etc., will mean licensed intermediaries bear higher costs than unlicensed ones. In the long run, licensed intermediaries are doomed to lose these contests, given their higher cost-base and limited flexibility to respond to competitive challenges. Such an uneven playing field clearly raises risks of regulatory arbitrage as well as unfair competition.

Risks arise from the potential for very rapid scaling in the TechFin context, something we have previously highlighted in the context of the speed with which a firm or product can now move from “too small to care” to TBTF – a core feature of the FinTech era which has emerged over the past decade.⁷⁸ For instance, Ant Financial runs a wealth management platform named Yu’e Bao. In its first ten months of operation Yu’e Bao⁷⁹ became the fourth largest money market fund in the world, which led to a swift, restrictive response from Chinese regulators.⁸⁰ In April 2017, after China’s regulators had lifted the shackles, and only four years after its creation, Yu’e Bao assumed the top spot among all money market funds globally.⁸¹ Alibaba’s decision to separate Ant into a separate licensed financial services holding company – albeit under its continued control – by renaming its subsidiary Alipay in October 2014 was the direct result of regulators’ fears over possible systemic risk arising from both Alipay and Yu’e Bao, and resulted in China’s decision to build a regulatory system to address FinTech.⁸² In a similar way, mobile money platforms such as M-Pesa have assumed systemic importance in some African countries,⁸³ as well as MercadoLibre (with

⁷⁷ Cf. Dirk Zetsche ‘Investment Law as Financial Law: From Fund Governance over Market Governance to Stakeholder Governance?’ in Hanne S. Birkmose, Mette Neville, and Karsten Engsig Sørensen (eds), *The European Financial Market in Transition* (Kluwer Law International, 2012), 339-343.

⁷⁸ Arner, Barberis and Buckley, above n 9.

⁷⁹ Jamil Anderlini, ‘Explosive Growth pushes Alibaba online fund up global rankings’, *Financial Times* (online), 10 March 2014 < <https://www.ft.com/content/748a0cd8-a843-11e3-8ce1-00144feab7de> >.

⁸⁰ Zhou Weihuan, Douglas W. Arner and Ross P. Buckley, “Regulation of Digital Financial Services in China: Last Mover Advantage” (2015) 8 *Tsinghua China Law Review* 25.

⁸¹ See Yifan Xie and Chuin-Wei Yap, ‘Meet the Earth’s Largest Money-Market Fund’, *The Wall Street Journal* (online), 13 September 2017 < <https://www.wsj.com/articles/how-an-alibaba-spinoff-created-the-worlds-largest-money-market-fund-1505295000> >

⁸² See above n 41.

⁸³ See, e.g., Kiarie Njoroge, ‘Report: This is What Would Happen to Kenya’s Economy if M-Pesa was to Collapse’, *Nairobi News* (online), 30 November 2016 < <http://nairobi.news.nation.co.ke/news/treasury-report-reveals-fears-m-pesas-critical-role-economy/>>; Frank Jacob, ‘The Role of M-Pesa in Kenya’s Economic and Political Development’ in *African Histories and Modernities* (2016, Palgrave MacMillan) 89.

payments and financial subsidiaries) and Russian financial platform provider Tinkoff in their respective home markets.

While arguably bringing important consumer benefits, the emergence of TechFins highlights the emergence of large new firms which must be carefully considered from the standpoint of their potential risks, arising from their size, interconnectivity and their roles in providing systemically important infrastructure. Often in the past trust and control of important market segments in financial services being in the hands of the few has led to major financial crises. Examples include the early-2000s accounting frauds⁸⁴ and of the credit ratings agencies in the 2008 crisis⁸⁵ as well as the the roles of SIFIs in many crises, not just the most recent.⁸⁶ Accounting firms and rating agencies are mere data providers linked to the system (similar to early stage TechFins), while SIFIs are typically very large (like TechFins that offer regulated services).⁸⁷ All three, unlike the TechFins, are at last strictly regulated today.⁸⁸

Yet TechFins are by no means risk free. Without experience and monitoring, **we simply do not know all the risks created by technology since information flow to financial regulators is not mandatory as long as TechFins are beyond the scope of monitoring or supervision.** We will only experience the outcome if the service is not performed properly, with often surprising results. This will be particularly so as Artificial Intelligence and Machine Learning (AI/ML) applications to large / novel data sets become more prevalent in financial services, because the underlying algorithms are very complex, almost opaque, and the behavior of the self-learning algorithms becomes impossible to predict. Further, we lack experience with AI/ML based pricing models over a full business cycle.

If financial law does not apply, potential systemic risk may build up unobserved, unmitigated and uncontrolled, and, looking longer-term, the next global financial crisis may well come from weaknesses in TechFins rather than authorised financial institutions.

⁸⁴ See, e.g., Sean Farrell, 'The world's biggest accounting scandals', *The Guardian* (online), 22 July 2015 <<https://www.theguardian.com/business/2015/jul/21/the-worlds-biggest-accounting-scandals-toshiba-enron-olympus>>; C. William Thomas, 'The Rise and Fall of Enron' (2002) 193(4) *Journal of Accountancy* 41.

⁸⁵ Amanda J Bahena, *What Role Did Credit Rating Agencies Play in the Credit Crisis?* (March 2010) <www.colorado.edu/AmStudies/lewis/ecology/rolecreditagencies.pdf> .

⁸⁶ Financial System Inquiry, *Too-big-to-fail and moral hazard* (7 December 2014) <<http://fsi.gov.au/publications/interim-report/05-stability/too-big-to-fail/>> .

⁸⁷ Mustafa Yuksel, *Identifying Global Systemically Important Financial Institutions* (December 2014), Reserve Bank of Australia <<https://www.rba.gov.au/publications/bulletin/2014/dec/pdf/bu-1214-8.pdf>> .

⁸⁸ See e.g., Siegfried Utzig, 'The Financial Crisis and the Regulation of Credit Rating Agencies: A European Banking Perspective' (Working Paper No. 188, Asian Development Bank Institute, January 2010).

C. Addressing Tech Risk

While the cause of systemic risk in case of BigTechs is increased by connectivity, a connectivity could be diversified away, but at some cost, the systemic risk perspective of TechFins rests on the assumption of **size and connectivity**, so diversification does not help.

At the core of our concern is the TechFin's conduit function in their early stage when they stand between the financial intermediary and its clients. One could respond that the early stage TechFin conduit function is merely one of data delivery; and data delivery is not a special activity warranting regulation.

Yet data provision in a highly concentrated market has prompted regulators to require financial institutions to diversify their data sources. The difference with TechFins is that data delivery is a back-end function, while TechFins also provide front-end, overlay services to the financial institutions, framed as a financial ecosystem or platform technology. TechFins' conduit function cannot be addressed by diversification requirements since the financial institution cannot readily change the 'service provider' as it can a back-end relationship – terminating the cooperation with the TechFin would cost the financial institution the link to its most precious asset: its clients.

For that reason we have proposed elsewhere to regulate data gathering and analytics by virtue of a moderate regulatory intervention, along the business evolution from (1) too small to care, to (2) too large to ignore and then to (3) too big to fail (TBTF).⁸⁹

As TechFins often do not seek access to client funds directly, many established financial regulatory thresholds based on balance sheet size, exposures or assets under management will fail to be triggered. In order to set appropriate thresholds, regulators must develop new criteria. These could include an overall number of data points, or holding data on a significant share of a population in the reference market, or other measures that reflect a very substantial data set.

If financial data gathering and analytics becomes a regulated activity, systemic risk measures will apply as soon as TechFins become essential to financial stability, and this will be determined by the TBTF or too complex / too connected to fail (TCTF) tests. If the TechFin is the main client channel for one important bank or for many banks which together are of systemic importance, the importance of the TechFin becomes like that of a new CEO or a new business model rather than merely that of infrastructure. To the same extent that a new bank CEO and other key staff would be subject to regulatory scrutiny, we would ask the TechFin to meet the 'fit and proper' requirement, and ask for adequate resources to maintain that function on the side of the TechFin. This is where a systemic risk perspective indicates a case for regulation of TechFins.

⁸⁹ *Ibid.*

Once regulators come to the conclusion that the TechFin is of **systemic importance**, for instance once TechFin data is essential for a systemically significant financial institution, or the TechFin provides the main client access for several financial institutions which together are of systemic significance, we recommend measures to control and limit systemic risk. In the first case this could require the significant financial institution to diversify its data sources. In the second case we recommend (a) structural requirements for TechFins (quarantine provisions as to 'Fin' with respect to entity, IT, capital; minimum capital for maintenance and clean-up; and country-by-country, or market-by-market, respectively, segregation of activities, the price to pay may be an increase in costs for the consumers), (b) empowering regulators to shut down the activity (while preserving customer data), or (c) to appoint a commissioner to run the quarantined TechFin part of the business in the public interest. As part of the resolution scheme regulators must ask the service provider how to ensure access to essential facilities in times of a crisis. In the case of data driven business models such as those of a TechFin, the resolution plan must lay out how continued access to data is ensured even if the financial business is bankrupt. For instance, we would ask data intensive financial firms to provide for licensing contracts with their data-driven mother subsidiaries that ensure business continuity (i.e. further data feeds) even if the financial firm itself is bankrupt for a certain period of time. Since without the data the whole firm will be threatened, and rarely will the TechFin arm of a BigData firm have full ownership of the data it is supplying.

Systemic risk intervention could go even one step further. Since running a crucial data provider in the public interest is not a long term solution, mandating an open data policy under certain circumstances, as a particular systemic risk measure for data driven financial services, may reduce the need for additional regulatory intervention long-term. Note that, in contrast to open banking proponents, we do not argue for open data policies in all cases, but only as a specific crisis measure imposed on very large data driven financial services firms.

V. New Forms of Financial Infrastructure

In addition to new risks from the digital environment (particularly relating to cybersecurity and data protection and privacy) and from new financial institutions (particularly scale and network effects), new risks also arise from the evolution of new forms of digital financial infrastructure. BigTech has played a particularly salient role in this development. In China, for example, BigTech mobile payments reach 16% of GDP in 2017, providing services to more than half of the overall population through the use of proprietary payment services without dependence on traditional banks.⁹⁰ The activities of these firms are rapidly expanding into credit provision, insurance, and investment services, creating complex interconnected webs across several sectors.⁹¹

⁹⁰ John Frost and others, 'BigTech and the Changing Structure of Financial Intermediation' (2019) No 779 6 <<https://www.bis.org/publ/work779.htm>> accessed 24 October 2019.

⁹¹ *Ibid* 7.

While in regions where incumbent bank-based payments are dominant, like the US or Europe, new payment services are still underpinned by traditional bank infrastructure - the growing market share of FinTech would foresee a convergence of traditional banking into a new infrastructure.⁹² The rate and scope of such change, as exemplified by China, can cause tectonic shifts in financial structure.

Concerns about financial infrastructure are by no means new, with financial regulation focusing on payment systems since the failure of Bankhaus Herstatt in 1974 and on securities clearing and settlement systems particularly since the failure of the Hong Kong stock and futures exchanges in 1987, with both addressed by the BIS Committee on Payment and Settlement Systems and the International Organisation of Securities Commissions (IOSCO). Since 2008, concerns about and focus on “financial market infrastructures” (FMIs) have increased dramatically, with leadership taken by the FSB and the renamed joint BIS-IOSCO Committee on Payment and Market Infrastructures. Since 2008, there has been an ongoing debate about risks in central clearing houses and whether the benefits in terms of reducing counterparty risk are exceeded by new risks of concentration and systemic reliance.

Clearly, cybersecurity issues relate directly to CCPs and similar infrastructures. There are also TB2F / TC2F concerns, particularly as new entrants using new technologies such as blockchain or stablecoins try to disrupt existing markets and participants.

However, beyond these, we have also seen the emergence of new forms of digital financial infrastructure, particularly in the context of cloud services. Cloud services and cloud service providers are taking an increasing role in the financial sector. This is particularly the case with new FinTechs which are often cloud natives, with often their entire business being cloud based – an example of the extent to which digitization and datafication have evolved. At the same time, traditional financial institutions are increasingly using cloud services to not only provide backup to existing systems but also to build new systems and in an increasing number of cases to replace existing outdated core systems (often based on old mainframes running seriously out-of-date software).

In the case of IT/data provision to financial intermediaries, the intermediaries are exposed to operational, in particular cyber, risks from those third-party service providers. For instance, when Amazon’s cloud computing data centre in Hong Kong failed, the website of the US SEC, plus many consumer oriented services, such as Netflix, went down.⁹³ We can also allocate here the development of large IT service platforms to which many financial intermediaries outsource core functions. For instance, Aladdin – the back office software

⁹² *Ibid* 6; Carstens (n 70) 3.

⁹³ Elaine Ou, *Can’t Stream Netflix: The Cloud May Be to Blame*, (3 March 2017) Bloomberg View <<https://www.bloomberg.com/view/articles/2017-03-02/can-t-stream-netflix-the-cloud-may-be-to-blame>>

platform developed by Blackrock, the world's largest asset manager⁹⁴ – is relied on by approximately 25,000 investment professionals⁹⁵ around the world and is used to manage approximately 7 percent of the world's financial assets, including the assets of other top ten asset managers.⁹⁶

Financial supervision typically does not apply to the Big Data providers. IT/data providers usually fall outside the scope of financial regulation: financial regulators lack information regarding such firms and their potential roles in interconnectivity across the financial sector as well as tools of supervision or regulation.

Financial law usually responds to risks created by non-supervised firms by imposing **strict outsourcing requirements** on financial firms. In particular, the financial firm needs to ensure systemic stability at all times, regardless of the outsourcing of information technology. But how should a bank (even a JP Morgan or Goldman Sachs) ensure that a major tech company (for example Amazon, Apple, Google or Microsoft) provide appropriate service? Banks cannot police firms whose market value is a multiple of that of their own (if worst came to worst, Apple could buy Deutsche Bank with its pocket cash), nor **can they apply controls that ensure that BigTech's cloud centres work.**

The alternative to control over the service provider is **diversification**. For instance, financial law could require that any financial firm must have mirror cloud servers at three different providers, and that these providers be unrelated to each other. While mandatory diversification ensures some additional security and also has some positive effects on market structure in the provider market, it also comes with increased costs and other problems.

The first other problem is **cybersecurity**. The more providers hold the intermediaries' financial data, the greater is the risk of data corruption (stealing, manipulation or abuse) from the inside or a cyber attack from the outside. Second, mandatory diversification of data streams and server space **takes away some of the benefits of datafication**. It slows down IT processes and creates risk of confusion: If data are stored on a blockchain comprising many different cloud providers the storing of data on a blockchain itself costs time and resources. If a brokerage system runs on three different data streams simultaneously, and one of the streams shows different data from the other two, which of the three datasets is correct, and on which should the broker base a multi-billion US\$ transaction? These risks are exacerbated by the fact that the market for cloud storage and related analytics as well as

⁹⁴ See Aladdin by BlackRock <<https://www.blackrock.com/Aladdin>>.

⁹⁵ Aladdin Platform Overview, < <https://www.blackrock.com/aladdin/offerings/aladdin-overview> >

⁹⁶ 'The monolith and the markets', *The Economist* (online), 7 December 2013 < <https://www.economist.com/briefing/2013/12/07/the-monolith-and-the-markets> >.

data provision for financial markets is highly concentrated.⁹⁷ Financial intermediaries have little choice, and cyberattacks have easy targets.

Other examples come from reliance on a small number of data providers, which in turn raises risks of interconnections due to similarities of business models (as occurred with securitization prior to 2008) as well as to concentration and reliance risks.

VI. The New Risk Paradigm: IT and Model Risk as Drivers of Systemic Risk

We do not believe that systemic risk will be created so large as to warrant intervention from new forms of tech investments into tech products, be it blockchain, cryptocurrencies or token sales. While the growth of initial coin offering volumes has been impressive indeed,⁹⁸ we lack evidence of significant involvement of regulated financial intermediaries in such products. Given the public statements by bank CEOs quite the opposite seems to be true.⁹⁹ However, this may change and first indicators of such a change may be found in the apparently growing numbers of so-called crypto hedge funds and regulated investment funds getting involved in those markets.¹⁰⁰ Given the rapid growth of the ICO markets, regulators are well advised to enforce existing laws strictly, monitor developments closely and cooperate globally to ensure that systemic risk is kept under control.¹⁰¹

Rather, the clear risk of digitization – a process which in many cases covers entire businesses – is that of security, namely cybersecurity and data protection. Even if policy makers and regulators follow our recommendations one thing does not change and cannot be changed: the dependence on technology and the exposure to tech **and human** failures. At the same time, financial risks have not been reduced. Cyberrisks, data risks, technological risks and financial risks accumulate. This new type of risk, tech risk, now comprises another major

⁹⁷ See Zetsche et al, above n 11,31. See Douglas W. Arner, Dirk A Zetsche & Ross P Buckley, *FinTech, RegTech and Systemic Risk: The Rise of Global Technology Risk*, in Arner, Avgouleas, Busch, Schwarcz, (eds), *Systemic Risk in the Financial Sector: Ten Years after the Global Financial Crisis*, CIGI Press, 2019, S. xxx.

⁹⁸ See Dirk A. Zetsche et al, 'The ICO Gold Rush: It's a Scam, It's a Bubble, It's a Super Challenge for Regulators' (2019) 69 *Harvard International Law Journal* (forthcoming). Available at SSRN: <https://ssrn.com/abstract=3072298>. See Zetsche et al, 'The ICO Gold Rush', supra n 5.

⁹⁹ See, for e.g., Anthony Cuthbertson, 'Bitcoin trading comes to Goldman Sachs after investment bank hires first cryptocurrency trader', *The Independent* (online) 3 May 2018 < <https://www.independent.co.uk/life-style/gadgets-and-tech/news/bitcoin-trading-latest-goldman-sachs-digital-asset-trader-investment-banks-a8334171.html> >; Tae Kim, 'Jamie Dimon says he regrets calling bitcoin a fraud and believes in the technology behind it', *CNBC Markets*, 9 January 2018 < <https://www.cnbcm.com/2018/01/09/jamie-dimon-says-he-regrets-calling-bitcoin-a-fraud.html> >.

¹⁰⁰ See Jemima Kelly and Maiya Keidan, 'Bitcoin boom failing to attract big name investors', *The Independent* (online), 23 October 2017 < <https://www.independent.co.uk/news/business/news/bitcoin-investers-crypto-currencies-hedge-funds-a8014666.html> > citing Autonomous NEXT, *Crypto Fund List* (05 April 2010) < <https://next.autonomous.com/cryptofundlist/> >.

¹⁰¹ See Zetsche et al, above 'The ICO Gold Rush', supra n 5.

form of risk, alongside the other traditional categories of financial risks. Digitization / datafication, cybersecurity and TBTF/TCTF considerations together create a world where the financial system is more vulnerable than before. Where tech risks are new drivers of instability, regulators are well advised to focus on these new forms of risk in terms of their connections to other forms of risk and independently.

In a sense, many of the characteristics of the international financial system and its participants can be transposed to the international cyber networks and their participants – in particular, TechFins. Both concern large concentrated, relatively frictionless movements, necessitating increased transparency and control. Both are undergoing discussions regarding the merits of international centralization, or regionalization – except instead of currency, it is data. Both are now scrutinized for their potential volatility, risk susceptibility, and contagion effects. Both have demanded structural attention. It is therefore unsurprising that TechFins, through their growing roles in several concurrent fields – including finance – would require prudential regulation and supervision, for which previous experience can be a helpful compass.

To conclude, we present some basic principles of how cybersecurity and tech risks can be regulated and monitored, but also outline the deficiencies of existing / traditional approaches. The deficiencies in the regulatory system with regard to technology risks are similar to those that we experienced with respect to macroprudential risks prior to the 2008 Global Financial Crisis. Those deficiencies include lack of understanding, deficiencies in mandates, loopholes in regulation, lack of coordination among regulators, information asymmetries, lack of expertise on the part of financial intermediaries and regulators etc. We encourage a new risk agenda that responds to technology risks proactively.

In terms of importance, cybersecurity and tech risk, as categories of operational risk, have complemented (traditional) financial risks. Rather than market developments, we believe that tech risk functions as a new driver of instability, and that regulators are well advised to focus on this new risk category.

How should regulators respond to this new reality? The deficiencies in the regulatory system with regard to global technology risks are similar to those that we experienced with regard to other new forms of systemic risk prior to the GFC. Those deficiencies include loopholes in regulation, lack of coordination among regulators, information asymmetry, lack of expertise on side of financial intermediaries and regulators, and lack of awareness or investment on the side of intermediaries.

We encourage a new risk agenda that responds to global technology risks proactively. Such an agenda must include, from a regulatory perspective, five steps.¹⁰²

¹⁰² We have advanced this agenda before in DW Arner, RP Buckley & DA Zetsche, “FinTech, RegTech and Systemic Risk: The Rise of Global Technology Risk”, in Arner, Avgouleas, Busch & Schwarcz (eds), *Systemic Risk in the Financial Sector: Ten Years after the Great Crash*, CIGI Press, 2019, 69.

First, regulators must **prioritize tech risks**, and this prioritization must take place both internally and externally. The result of this prioritization is that tech risks should play an equally important role as financial risks. This is particularly important in the context of monitoring these new sorts of risk and collecting non-traditional forms of information. This could be done by appointing a Chief Technology Risk Officer (CTRO) for the supervisory authority or creating a similar role at board level in order to emphasise the significance of these sorts of risks. At the same time, financial intermediaries should be required to appoint Chief Technology Risk Officers or equivalent senior management officers responsible for cyber and technology risk, as a main contact point, with board monitoring, perhaps at the least in the context of any firm's risk committee. Further, the CTRO's report on cyberrisk should be a core agenda item at all meetings of the authorities' as well as of intermediaries' senior management.

Second, regulators need to **strengthen in-house tech expertise** to understand the sources of these new exposures of the ecosystems which they monitor and supervise, and to be able to discuss tech matters with intermediaries. We encourage, in particular, tech councils and tech expert groups at global policy bodies such as the FSB, IOSCO and others.

Third, regulators must continue to **enhance reporting requirements** with regard to details on the intermediaries' tech risk management strategies and the budget invested into and human resources devoted to systemic stability and cybersecurity. These reports should include tech details, and be read by the supervisor's tech department.

Fourth, **regulators must prioritize** these sorts of risks in the context of both on- and off-site supervision to understand whether intermediaries have understood those risks and how they address them; when they visit they need to speak to tech people rather than upper management or the legal department. Of course, on the authorities' side, technology and regulatory experts should be present as well.

Fifth, regulators must strive to **depoliticize** cybersecurity where related to financial stability, to foster the development of intergovernmental or sectoral networks capable of preventing and defending against cyber incidents, especially considering the growing financial interconnectedness. An isolated cybersecurity island that is still connected to the datafied financial network poses increasing risks of contagion.

Sixth, regulators will have to **make use of new technologies themselves**, since only the user understands the issues with the application. This can be part of a major RegTech strategy which – in many instances – is overdue anyway, in order to respond to the enormous data streams regulators receive in response to GFC-related additional reporting requirements. We admit that regulators may also suffer from the failures of technology, but if they do they will also learn to handle large tech projects – and know what they have to ask for from the intermediaries.

Seventh, regulators should continually seek to **harmonize** normative cyber and data policies to avoid friction and uncertainty, and not allow rules with potential impacts on financial

stability to entrench themselves in the long run. This may prevent races to the bottom that can intensify destabilizing behavior.

The world has become riskier with tech risk becoming a prime driver of risk levels as a result of FinTech. The new tech risk will translate into financial risk sooner or later. A regulatory system that waits until financial risks have materialized as long-term impacts of tech risk has failed in its core function. Regulators need to face rather than fear the unknown and develop a degree of tech expertise matched only by the large – yet entirely unregulated – data driven firms. This is a very demanding challenge for all regulators and academics, but not one they can avoid.



Address

European Banking Institute e.V.

TechQuartier (POLLUX)

Platz der Einheit 2

60327 Frankfurt am Main

Germany

For further information please visit our website www.ebi-europa.eu or contact us at info@ebi-europa.eu

www.ebi-europa.eu

The European academic joint venture for research in banking regulation

 UNIVERSITEIT VAN AMSTERDAM	 UNIVERSITY OF PIRAEUS	 universität bonn Rheinische Friedrich-Wilhelms- Universität Bonn	 UNIVERSIDAD COMPLUTENSE MADRID CUNEF CENTRO UNIVERSITARIO DE ESTUDIOS FINANCIEROS	
 Trinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin	 GOETHE UNIVERSITÄT FRANKFURT AM MAIN	 UNIVERSITEIT GENT	 UNIVERSITY OF HELSINKI	
 Universiteit Leiden	 EBI European Banking Institute		University of Ljubljana 	
 Queen Mary University of London	 UNIVERSITÉ DU LUXEMBOURG	 JOHANNES GUTENBERG UNIVERSITÄT MAINZ	 UNIVERSITY OF MALTA L-Università ta' Malta	 UNIVERSITÀ CATTOLICA del Sacro Cuore
 University of Cyprus	 Radboud Universiteit	 Universiteit Antwerpen	 PANTHÉON - SORBONNE - UNIVERSITÉ PARIS 1	 UNIVERSITÉ PARIS II PANTHÉON - ASSAS
 Stockholm University	 UNIVERSITY OF TARTU	 CATÓLICA FACULDADE DE DIREITO	 U LISBOA UNIVERSIDADE DE LISBOA	 UA UNIVERSIDAD AUTÓNOMA DE MADRID