IOSCO Research Report on Financial Technologies (Fintech)

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OICU-IOSCO

INTERNATIONAL ORGANIZATION OF SECURITIES COMMISSIONS

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ABOUT THIS REPORT

The Board of the International Organization of Securities Commissions (IOSCO) tasked the Committee on Emerging Risks (CER) to collaborate with other IOSCO Committees and lead a study on the evolution of *Financial Technologies,* including its intersection with securities markets regulation. IOSCO is the international body that brings together the world's securities regulators and is recognized as the global standard setter for the securities sector.

Working intensively with the G20 and the Financial Stability Board (FSB) on the global regulatory reform agenda, IOSCO develops, implements and promotes adherence to internationally recognized standards for securities regulation. The term *Financial Technologies* or *"Fintech"* is used to describe a variety of innovative business models and emerging technologies that have the potential to transform the financial services industry.

This report is the result of extensive collaboration among different IOSCO Committees, with overall coordination by the Vice Chair of the CER. It incorporates substantial contributions from the members of the CER, the Growth and Emerging Markets Committee (GEMC) and the Affiliate Members Consultative Committee (AMCC), including the results from three different surveys:

1)   In June 2016, the CER and the GEMC jointly conducted a survey among their respective members to gain further insight on the types of Fintech firms in the respective jurisdictions, key regulatory actions taken by members, and the practices of Fintech firms in onboarding investors. Responses were received from 54 CER and GEMC members to this follow-up survey: 9 respondents were from the Asia-Pacific region, 12 from Africa and the Middle East, 16 from Europe and 17 from the Americas.

2)   In May 2016, the CER, AMCC and World Federation of Exchanges (WFE), a member of the AMCC, jointly conducted a survey on DLT. The survey was issued by the WFE to its membership of global exchanges and post-trade infrastructures,[1] and by the CER to global DLT consortia, financial institutions, start-ups, consultancy firms and other stakeholders: 53 responses were received, including 25 from WFE members. 13 respondents were from the Asia-Pacific region, 1 from Africa, 2 from the Middle East, 14 from Europe and 23 from the Americas.

3)   In December 2015, the GEMC conducted a survey among its members to review the state of development of Fintech in emerging markets, including existing and potential regulatory implications. Responses were received from 41 emerging markets covering diverse geographical locations: 9 respondents were from the Asia Pacific region, 17 from Africa and the Middle East, 7 from Europe and 8 from the Americas.

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[1]   The published WFE survey report is based on the results of its membership of global exchanges and post-trade infrastructures, and can be found at: www.world-exchanges.org/home/index.php/files/18/Studies%20-%20Reports/349/WFE%20IOSCO%20AMCC%20DLT%20report.pdf .

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[2]   Since relocated to the French AMF.

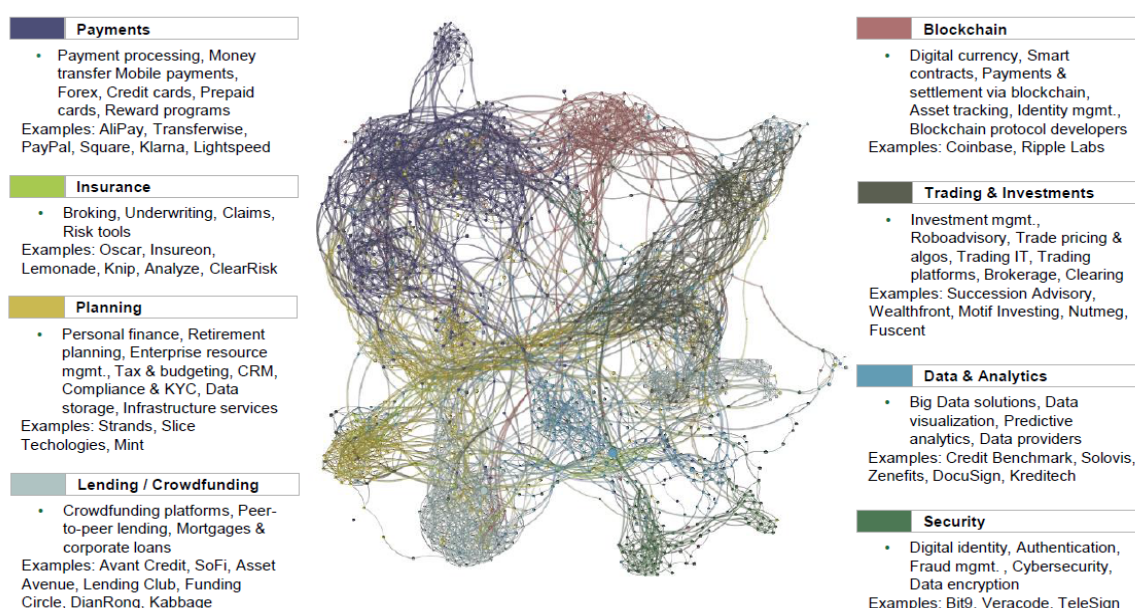# Chapter 1: Focus of this Report and Global Backdrop

1.1. Focus of this report

The term *Financial Technologies* or *"Fintech"* is used to describe a variety of innovative business models and emerging technologies that have the potential to transform the financial services industry:

- *Innovative Fintech business models* typically offer one or more specific financial products or services in an automated fashion through the use of the internet. By doing so, they unbundle the different financial services traditionally offered by service providers -- incumbent banks, brokers or investment managers. For example, equity crowdfunding platforms intermediate share placements; peer-to-peer lending platforms intermediate or sell loans; robo-advisers provide automated investment advice; and social trading platforms offer brokerage and investing services.

- *Emerging technologies* such as cognitive computing, machine learning, artificial intelligence, and distributed ledger technologies (DLT) can be used to supplement both Fintech new entrants and traditional incumbents, and carry the potential to materially change the financial services industry.

Figure 1 shows the Fintech landscape mapped across eight categories: payments, insurance, planning, lending and crowdfunding, blockchain, trading and investments, data and analytics, and security. Of these, certain aspects of planning, lending and crowdfunding, blockchain, trading and investments, data analytics, and security can intersect with securities regulation.

The global FinTech landscape can be mapped across 8 broad categories

Payments
- Payment processing, Money transfer Mobile payments, Forex, Credit cards, Prepaid cards, Reward programs
Examples: AliPay, Transferwise, PayPal, Square, Klarna, Lightspeed

Insurance
- Broking, Underwriting, Claims, Risk tools
Examples: Oscar, Insureon, Lemonade, Knip, Analyze, ClearRisk

Planning
- Personal finance, Retirement planning, Enterprise resource mgmt., Tax & budgeting, CRM, Compliance & KYC, Data storage, Infrastructure services
Examples: Strands, Slice Techologies, Mint

Lending / Crowdfunding
- Crowdfunding platforms, Peer-to-peer lending, Mortgages & corporate loans
Examples: Avant Credit, SoFi, Asset Avenue, Lending Club, Funding Circle, DianRong, Kabbage

Blockchain
- Digital currency, Smart contracts, Payments & settlement via blockchain, Asset tracking, Identity mgmt., Blockchain protocol developers
Examples: Coinbase, Ripple Labs

Trading & Investments
- Investment mgmt., Roboadvisory, Trade pricing & algos, Trading IT, Trading platforms, Brokerage, Clearing
Examples: Succession Advisory, Wealthfront, Motif Investing, Nutmeg, Fuscent

Data & Analytics
- Big Data solutions, Data visualization, Predictive analytics, Data providers
Examples: Credit Benchmark, Solovis, Zenefits, DocuSign, Kreditech

Security
- Digital identity, Authentication, Fraud mgmt. , Cybersecurity, Data encryption
Examples: Bit9, Veracode, TeleSign

Visualization based on ~1,800 FinTechs receiving the highest amount of private funding. Dataset mapped with Quid and allowed to cluster based on similar products, technologies, customers etc.
1) Data based on over 8,800 companies which were discovered across over 10 data sources. Total funding based on date of funding. Total companies based on founding year. Data as of November 2016.
Source: Quid, BCG /Expand/BCG Digital Venture/B Capital analysis

Source: Fintech Control Tower, Expand, November 2016

Figure 2 illustrates the growth of global Fintech investments across these eight categories from 2005 to 2016. Prominent clusters of relevance to securities regulators include trading and investments, lending and crowdfunding, and blockchain.

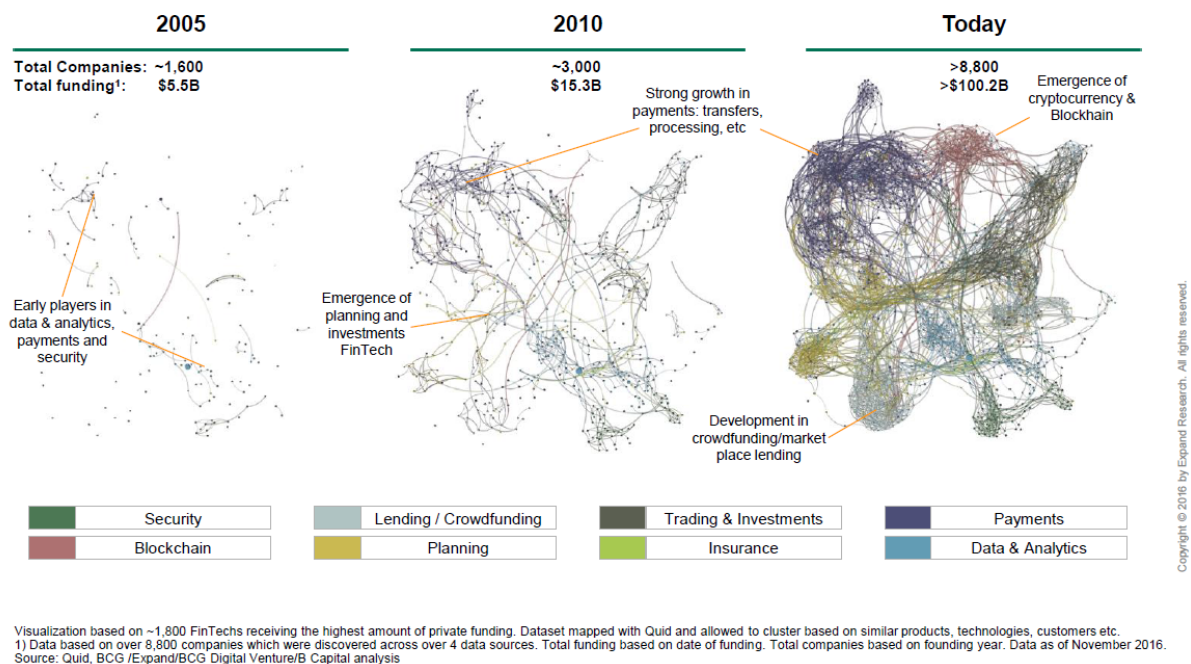## Since 2000, FinTech investments has grown dramatically

Visualization based on ~1,800 FinTechs receiving the highest amount of private funding. Dataset mapped with Quid and allowed to cluster based on similar products, technologies, customers etc.
1) Data based on over 8,800 companies which were discovered across over 4 data sources. Total funding based on date of funding. Total companies based on founding year. Data as of November 2016.
Source: Quid, BCG /Expand/BCG Digital Venture/B Capital analysis

Source: Fintech Control Tower, Expand, November 2016

Of these eight categories, this report focusses on the delivery of securities and capital markets products and services through the use of Fintech. In particular, the report examines:

- *Chapter 2: Financing Platforms*, including Peer-to-Peer (P2P) lending and equity crowdfunding (ECF);

- *Chapter 3: Retail Trading and Investment Platforms*, including robo-advisers and social trading and investing platforms;

- *Chapter 4: Institutional Trading Platforms*, with a specific focus on innovation in bond trading platforms; and

- *Chapter 5: Distributed Ledger Technologies (DLT)*, including application of the blockchain technology and shared ledgers to the securities markets.

Other categories of Fintech, such as those that make use of big data analytics and artificial intelligence, regulatory technologies (also referred to as Regtech[3]), and cyber security and

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[3] For a definition of Regtech, see Douglas Arner and Janos Barberis, University of Hong Kong – Faculty of Law, and Ross Buckley, University of New South Wales, Faculty of Law, *FinTech, RegTech and the Reconceptualization of Financial Regulation,* October 2016, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2847806 .

cloud-based technologies are also of relevance to IOSCO, but have either been studied separately[4] or may be studied separately in the future in the context of a similar report.

1.2.   Global backdrop

Fintech evolution is taking place in the context of various global trends, including but not limited to the growth of computing power enabling analysis of ever larger data sets, broader accessibility of goods and services, and disintermediation and re-intermediation. These trends in turn are happening against the backdrop of demographic and generational changes.[5]

(i)   Growth of computing power

As predicted in 1965 by Gordon Moore, the co-founder of Intel, computer processing power has more than doubled every 24 months. The cost of processing power has seen a 10 billion-times decrease in the first 50 years of the computer age, beginning in (approximately) 1950; memory cards have seen a 1,000 fold increase in memory power in the past 10 years; a laptop has flash storage of one terabyte, 100,000 times larger than 30 years ago; and a single smart phone has more computing power than NASA had in 1969.[6]

The implications of this have been and will continue to be profound, as explained for example in the *"Future of the Professions"*:[7]

> *"Our personal and working lives will continue to be overhauled by technology, including even more powerful processing power; artificial intelligence that can discern patterns, identify trends and make accurate predictions once reserved to humans; a cloud that offers seemingly limitless cheap storage capacity; lightning quick communications; ever greater miniaturization; and rapid decline in the cost of components.*
>
> *New capabilities are emerging on an apparently daily basis, and what is striking about most of these systems is that they could not have been delivered 5 years ago because we did not have the technological wherewithal: the mobile platforms, the bandwidth, the software and more.*
>
> *There are 6 billion mobile subscribers around the world, of which 2 billion are smart phone users, and this number is expected to double by 2020. When 3 billion people are connected, they communicate and research very differently; they also socialize, share, build communities, cooperate, crowd-source, compete and trade in ways and on a scale that has no analogous in the analogue world."*

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[4]   See for example *IOSCO Cyber Security in Securities Markets – An International Perspective,* April 2016, https://www.iosco.org/library/pubdocs/pdf/IOSCOPD528.pdf and *Guidance on cyber resilience for financial market infrastructures,* June 2016, https://www.iosco.org/news/pdf/IOSCONEWS433.pdf .

[5]   A three-year study from Scratch, an in-house unit of Viacom, issued in 2014 found that 33% of millennials (defined as a generation born between 1981-2000) believed they won't need a bank in the future, while 68% said that in 5 years the way we access our money will be totally different. For detail, see http://www.millennialdisruptionindex.com/.

[6]   See *The Future of the Professions*, by Richard and Daniel Susskind, Oxford University Press, 2015; *Frontiers of Financial Technology, Expeditions in future commerce, from blockchain and digital banking to prediction of markets and beyond*, edited by David Shrier and Alex Pentland of MIT, 2016; and other sources.

[7]   See *The Future of the Professions*, by Richard and Daniel Susskind, Oxford University Press, 2015.

The growth of computing power, combined with the decline in the cost of storing, processing, and collecting data, the exponential increase of accessible data and data sources, and the emergence of infrastructure and platforms where data can be shared and applications developed, also contributed to the emergence and growth of the various categories of Fintech illustrated in *Figures 1* and *2* above.

Through Fintech, issuers, investors, and intermediaries communicate, research, socialize, share, cooperate, crowd source, compete and trade in ways that are very different from the past, thereby challenging the regulatory paradigm. For example, on social trading sites, investors can follow a lead trader; on angel investment sites, investors follow a lead investor; on market data sites, artificial intelligence and social media analytics help inform retail investors' securities trading and investment decision making.

(ii)   Broader accessibility and decreasing cost of products and services

The internet has facilitated global connectivity and more broad-based access to products and services. It has also decreased, and in certain cases eliminated, the cost of certain goods and services.[8] Examples of full "demonetization" of products and services as a result of technological advances include digital photography, and digital video and telephone calls.[9]

Fintech is a manifestation of this trend. For example, through the use of technology, equity crowdfunding platforms provide access to private equity investment to retail investors, previously reserved to high net worth clients; robo-advisers provide modern portfolio theory-based investment to retail investors, previously reserved to institutional and private banking clients; and certain social trading platforms provide zero commission trading.

(iii)   Increasing disintermediation and re-intermediation

Closely related to the above is growing disintermediation and re-intermediation driven by technology and the internet. For example, Tripadvisor combined with online travel agencies has disintermediated human travel agents; Amazon has disintermediated bookstores; iTunes has disintermediated CDs; Airbnb and Tujia are disintermediating hotels; Uber and Didi Dache are disintermediating holders of official taxi operating licenses.

Innovative Fintech business models are similarly disintermediating and re-intermediating certain regulated activities. For example, online equity crowdfunding platforms intermediate share placements and disintermediate stock exchanges and underwriters; peer-to-peer lending platforms intermediate or sell loans and disintermediate banks and lenders; and robo-advisers provide automated investment advice and thereby disintermediate traditional advisors.

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[8]   See *Abundance*, by Peter Diamandis, Singularity University, 2015.
[9]   Idem.

1.3. Regulatory relevance

Figure 3 shows that innovative Fintech companies are already offering competing products and services in many of the key business lines of traditional brick-and-mortar intermediaries, including payments, wealth management, investment banking, retail banking, lending and treasury functions.

In addition, there are several potentially even more novel business models ahead, including artificial intelligence-driven research, investment and trading; and decentralized, border-less ledgers combined with self-executing contracts.

Figure 3: Innovation in different business lines
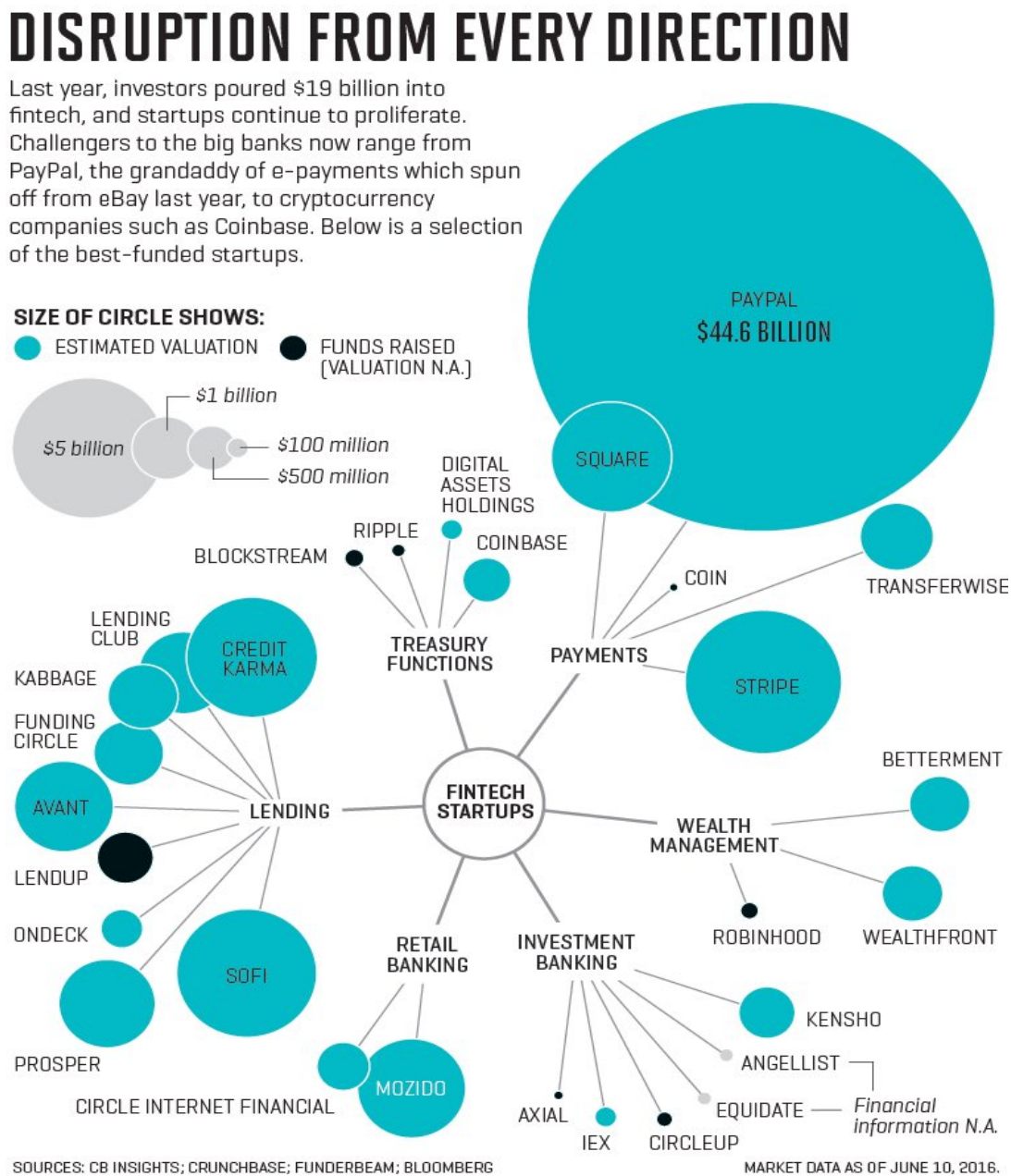
Source: CB Insights; Crunchbase; Funderbeam; Bloomberg, June 2016

Figure 4 shows this evolution even more clearly by looking at the financial sector focus of key technology companies in China.

Group				
	Alibaba	**Tencent**	**Baidu**	**JD**
Payments	✓	✓	✓	✓
Financing	✓	✓	✓	✓
Wealth Management	✓	✓	✓	✓
Insurance	✓	✓	✓	✓
Securities	✓	✓	✓	✓
Banking	✓	✓	✓	
Credit Scoring	✓	✓	✓	✓
Crowdfunding	✓	✓	✓	✓

Subsidiary running FinTech business				
	Ant Financial	**WeChat**	**Baidu Financial**	**JD Financial**
Valuation	$60b[35]	$83b[36]	< $3b[37]	$7b[35]
No. of registered users	c.500m Alipay[38]	c.400m Tenpay[39]	c.65m Baidu Wallet[39]	c.100m 7 FS[40]

Source: Ernst and Young, December 2016[10]

This, in turn, brings with it various questions that are relevant from a regulatory perspective, including:

- *What are the benefits/ opportunities and challenges/ risks of these new business models and technologies?*
- *What are the implications for IOSCO's key objectives: investor protection, market fairness and integrity, and financial stability?*
- *Is it too premature to consider whether international standards would be beneficial, given that certain technologies are still emerging?*

These questions are considered in *Chapters 2 to 5*, each of which analyse Fintech developments through four lenses: Market evolution/ size; Benefits/ opportunities; Challenges/ risks; and Regulatory relevance/ responses.

Chapter 6 analyses Fintech trends in Emerging Markets, where due to the lack of legacy infrastructure, Fintech is often able to leapfrog current technology and bring about greater financial inclusion.

Chapter 7 provides a broader overview of the regulatory challenges common to different areas of Fintech and the regulatory responses thereto.

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[10]   Ernst & Young, *China and U.K. FinTech, Unlocking opportunity, A guidebook to building a leading partnership between the China and U.K. FinTech sectors*, December 2016. See also H2 Ventures and KPMG, *2016 – Fintech 100*, https://h2.vc/reports/fintechinnovators/2016 .

Chapter 2: Alternative Financing Platforms

2.1. Introduction

One of the more notable developments in recent years has been the emergence of online alternative financing platforms, aimed at bringing together firms and individuals looking for capital and others that have money to lend, invest or donate.

While in recent years there is an increasing number of different types of financing platforms and different business models, this chapter focuses on peer-to-peer (P2P) lending[11] and equity crowdfunding (ECF):[12]

- *P2P lending* is a business model that in many cases allows investors, alone or with others, to provide financing to borrowers. The novelty of this business model is that financing may be obtained from many different lenders/ investors ranging from individuals to institutional investors.[13] In exchange for funding part of a company's need for finance, lenders/ investors can earn monthly interest income in addition to capital repayments. From a regulatory perspective, unless the platform is only providing balance sheet lending, P2P lending platforms often are issuers of securities or of interests in collective investment schemes, and consequently, often enter the securities regulatory remit.

- *ECF* is a business model that allows individuals to invest in a company, typically a start-up or early stage business, in exchange for shares of that company.[14] Traditionally

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[11] Also often referred to as "marketplace lending." These terms are used interchangeably herein.
For detailed breakdowns of geographic differences in focus (e.g. lending, equity, debt) and use of alternative funding (e.g. SMEs, consumers), see the following recent reports: A. Milne and P. Parboteeah, *The Business Models and Economics of Peer-to-Peer Lending, European Credit Research Institute*, No. 17/ May 2016, https://www.ceps.eu/system/files/ECRI%20RR17%20P2P%20Lending.pdf; B. Zhang, P. Baeck, T. Ziegler, J. Bone and K. Garvey, *Pushing Boundaries, The 2015 U.K. Alternative Finance Industry Report*, The Cambridge Centre for Alternative Finance and NESTA, February 2016, http://www.nesta.org.uk/sites/default/files/pushing_boundaries_0.pdf; R. Wardrop, R. Rosenberg, B. Zhang, T. Ziegler, R. Squire, J. Burton, K. Garvey, *Breaking New Ground: The Americas Alternative Finance Benchmarking Report,* 2, The Cambridge Centre for Alternative Finance and the Chicago Booth Polsky Center for Entrepreneurship and Innovation, 2016, https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/centres/alternative-finance/downloads/2016-americas-alternative-finance-benchmarking-report.pdf; and B. Zhang, L. Deer, R. Wardrop, A. Grant, K. Garvey, S. Thorp, T. Ziegler, Kong Ying, Zheng Xinwei, E. Huang, J. Burton, Hung-Yi Chen, A. Liu and Y. Gray, *Harnessing Potential, The Asia Pacific Alternative Finance Benchmark report*, March 2016, https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/centres/alternative-finance/downloads/harnessing-potential.pdf .

[12] While this chapter contains generic descriptions of P2P lending and ECF, given the different stages of growth and development of P2P lending and ECF in different jurisdictions, as well as the variance in jurisdictional regulations, this chapter does not intend to detail the state of development of these new business models or of the associated regulatory regime of every IOSCO member country. Reference is made in this regard to a recently published IOSCO report entitled: *Crowdfunding, Survey Responses Report*, December 2015, https://www.iosco.org/library/pubdocs/pdf/IOSCOPD520.pdf .

[13] As shown in the reports cited in footnote 11 above, in certain jurisdictions, such as the U.S., the financings may involve purchases of debt of the funding platform entity, acquisitions of borrower loans, funding of equity of the platform entity, or acquisition of interests in securitization vehicles. In other jurisdictions the business model is more limited, for example taking the form of pooled investments in loans.
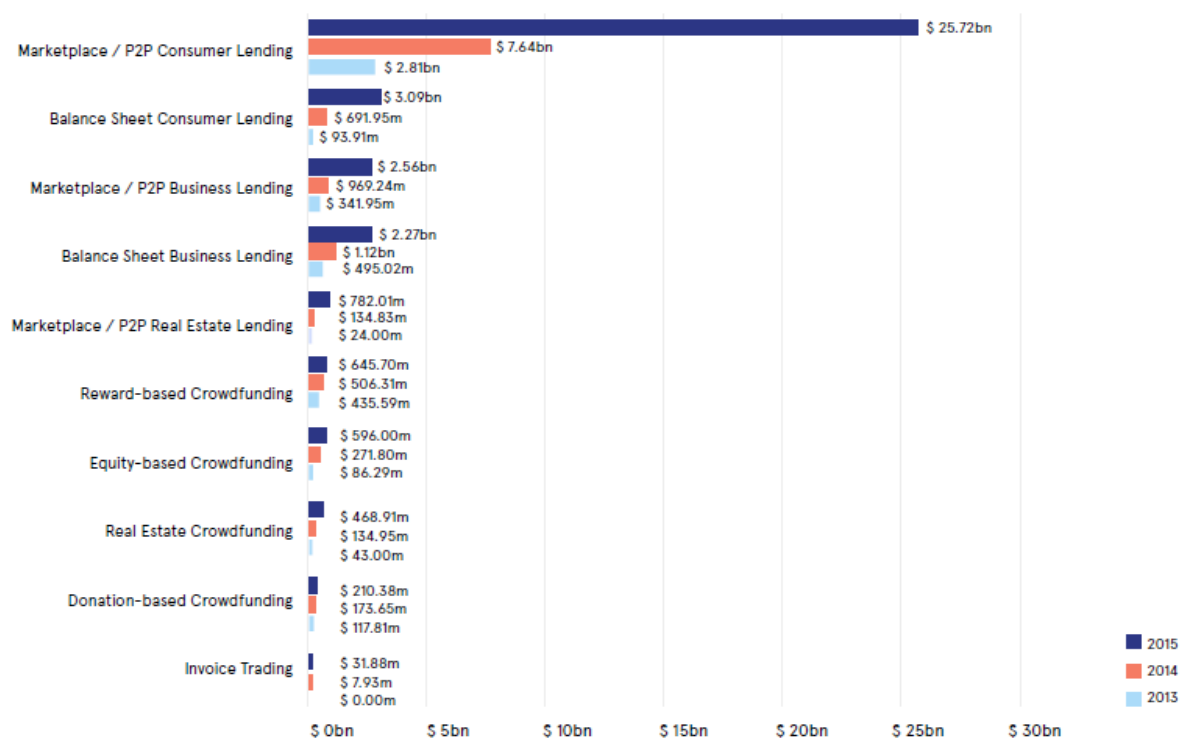
[14] As shown in the reports cited in footnote 11 above, crowdfunding may also involve debt securities, in which case investors may receive return of capital and return on capital (interest).

limited to venture capitalists and angel investors, ECF has opened up equity investing in private companies to a much wider range of individual investors. Investors may receive returns on their equity crowdfunding investments from dividends, the sale of the company, or through the sale of shares if the company becomes listed on a stock exchange. While this approach utilizes technology to attract investors, the real novelty is that the size of the companies involved is smaller than those typically associated with a public securities offering. From a regulatory perspective, ECF platforms may be viewed to offer and deal in securities, and consequently often enter the securities regulatory remit.

2.2.   Market evolution/ size

Even though P2P lending and ECF are distinctly different in structure, purpose and approach, they are discussed in one chapter because they are methods to obtain investor monies through online platforms to fund SMEs and, in the case of P2P lending, consumers and SMEs.[15] From a global perspective, both P2P lending and ECF are new industries. It is not surprising, therefore, that there are no definitive global estimates on the size of these industries, and that available data show large variance.

Figure 5 below shows estimated market volume in North America by alternative finance model for the period 2013–2015 in USD:[16]


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15   For detailed breakdowns of geographic differences in focus (e.g. lending, equity, debt) and use of alternative funding (e.g. SMEs, consumers), see the reports cited in footnote 11 above.
16   See footnote 11 above, *Breaking New Ground: The Americas Alternative Finance Benchmarking Report,* 2, 2016.

Figure 6 below similarly shows estimated market volume in China by alternative finance model for the period 2013–2015 in USD.[17]
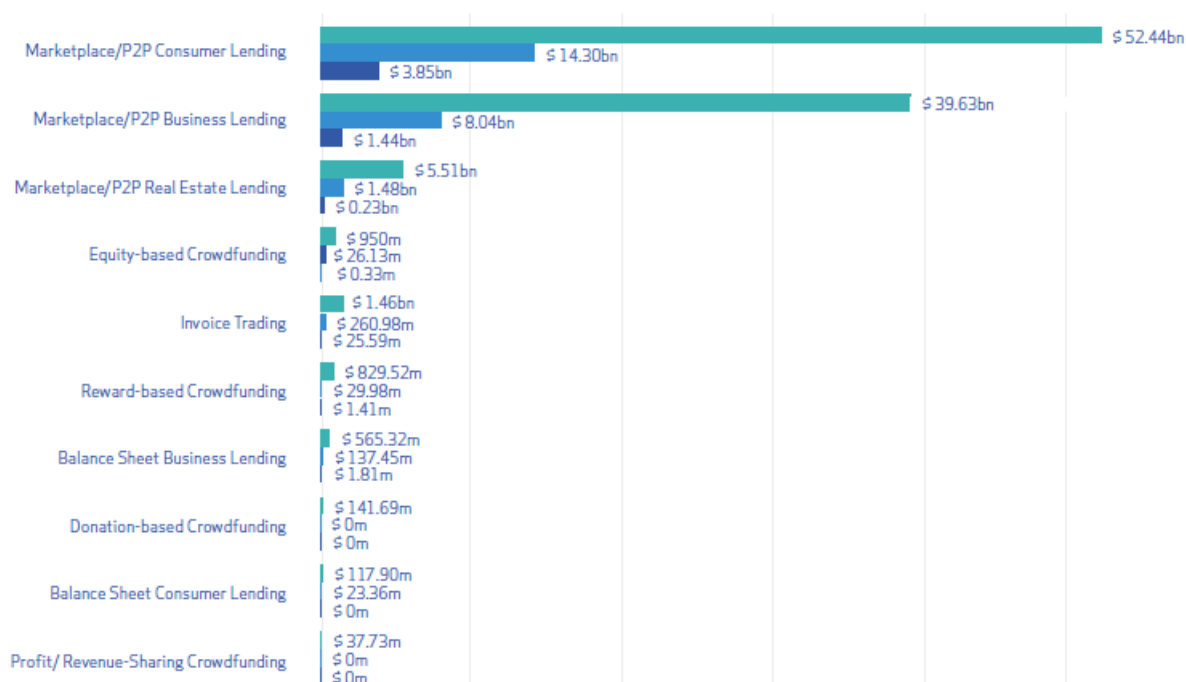
(i)   Growth of P2P Lending

The growth of P2P lending has been propelled by a series of supply and demand factors including the following:

1)   *Reduced technology costs.* P2P lending platforms use technology in a number of ways. For example, an internet interface could be used to onboard borrowers and lenders, algorithms could automate the assignment of credit scores, and algorithms could automate the selection and diversification of loan investments by the lenders.[18]

2)   *Previously underserved market segments.* P2P lending platforms offer the possibility for SMEs and start-ups that are traditionally less served by banks, as well as consumers, [19] to attract capital more quickly.

3)   *Low interest rates.* The post-crisis environment of low interest rates and very low or even negative yields on sovereign bonds has led investors to look for alternative

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[17]   See footnote 11 above, *Harnessing Potential, The Asia Pacific Alternative Finance Benchmark report*, March 2016: "China is the world's largest online alternative finance market by transaction volume, registering $101.7 billion (or RMB 638.79 billion) in 2015. In comparison, the total size of the UK online alternative finance market was $4.5 billion in 2015."

[18]   Morgan Stanley Research Blue Paper, *Global Marketplace Lending: Disruptive Innovation in Financials*, May 2015.

[19]   See footnote 11 above, *The Business Models and Economics of Peer-to-Peer Lending, European Credit Research Institute*, No. 17 / May 2016, noting: "Compared to the U.K., U.S. P2P lending is much more focused on consumer credit."

investments with potentially higher yields. Loans facilitated by P2P lending platforms typically offer those higher returns, though they may come with higher risk.

4) *Risk diversification.* P2P lending allows individual investors to invest in, or extend P2P loans, a segment previously limited to primarily institutional investors, or to holders of lending licenses.

Figure 7 below shows the growth trajectory of market place loan issuance in the U.S., China, the U.K. and Australia.
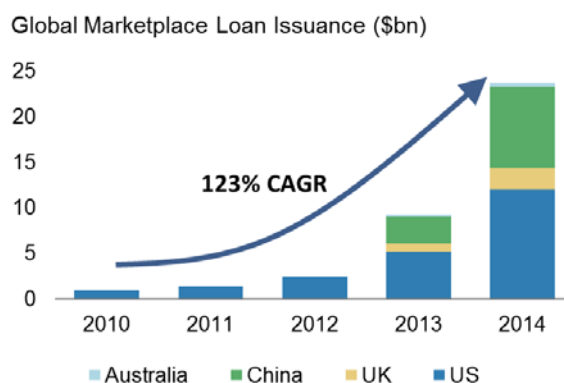
Source: Morgan Stanley Research, May 2015[20]

(ii)   Growth of ECF

While ECF is smaller than P2P lending as a source of finance (see, for example, *Figures 5* and *6* above for relative size of these segments in the U.S. and China respectively), the growth of ECF is similarly driven by supply and demand factors, including the following:

1) *Reduced technology costs.* ECF also uses technology in a number of ways. For example, an internet interface could be used to onboard issuers and investors, to show the issuer's business scope and related documentation, to enable the creation of lead investors and syndicates, and to automate the diversification of investments including through start-up fund structures.

2) *Previously underserved market segments.* ECF platforms offer the possibility for SMEs and start-ups that are traditionally less served by banks to attract capital more quickly. Also, early stage or small enterprises often cannot meet public listing criteria.

3) *Low interest rates.* The post-crisis environment of low interest rates has led investors to look for alternative investments, including early stage equity investment, and notwithstanding the fact that the returns are very long term and highly uncertain.

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[20]   Morgan Stanley Research Blue Paper, *Global Marketplace Lending: Disruptive Innovation in Financials*, May 2015.

2.3. Benefits/ opportunities

Closely linked to the growth drivers, the most commonly cited benefits of P2P lending and ECF include:

1) *Greater access to capital.*

    - P2P lending can provide credit to borrowers, especially SMEs, who do not have access to bank loans, thus increasing total loans provided to the small business sector.[21]

    - ECF opens new possibilities of access to equity finance. According to research by the OECD, Equity financing is especially relevant for companies that have a high risk-return profile, such as new, innovative and high growth firms.[22]

2) *Cost advantages.*

    - P2P lending platforms have cost advantages compared to banks. Their overhead costs are low since they leverage technology and data, and have less "brick and mortar" related costs. As a result, they can work with low interest margins.[23]

    - Through ECF platforms entrepreneurs can raise equity financing without the procedures and costs of an initial public offering that requires preparing a prospectus, which according to research by the OECD can be prohibitive for the entrepreneurs or small businesses.[24]

3) *Market-driven system.*

    - Both P2P lending and ECF operate through an open, market-driven system, where large numbers of people choose whether or not a firm or an individual should receive funding.

    - In this regard, P2P lending and ECF platforms can financially enable certain segments of the population, such as women and minorities, who traditionally have found it more difficult to obtain financing from the traditional financial channels.[25]

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[21] OECD, *New Approaches to SME and Entrepreneurship Financing: Broadening the Range of Instruments,* 2015, https://www.oecd.org/cfe/smes/New-Approaches-SME-full-report.pdf .

[22] Idem.

[23] A. Milne and P. Parboteeah, *The Business Models and Economics of Peer-to-Peer Lending, European Credit Research Institute*, No. 17/ May 2016.

[24] OECD, *New Approaches to SME and Entrepreneurship Financing: Broadening the Range of Instruments,* 2015.

[25] *Pushing Boundaries, The 2015 U.K. Alternative Finance Industry Report*, The Cambridge Centre for Alternative Finance and NESTA, February 2016: "We estimate that approximately 8% of fundraisers/ entrepreneurs that raised capital through equity-based crowdfunding platforms, were women. This figure is perhaps higher than that of offline venture capital and angel investing. However, the gender gap could definitely be further bridged; especially when considering female participation rates are so much higher in other online alternative finance models. For instance, while 21.1% of SME borrowers on peer-to-peer lending platforms are female, the percentage of female fundraisers is 46.2% on reward-based crowdfunding and 65.5% on donation-based crowdfunding platforms."

4) *Investor choice and diversification.*

   - P2P lending platforms have provided individual investors with a new asset in the form of un-collateralised debt. Individual investors can spread small sums of money across many loans at a low cost.[26]

   - ECF platforms also have provided individual investors with a new asset in the form of early stage equity investment in innovative businesses that they are interested in. Institutional investors also can use ECF platforms to review and compare many investment opportunities.[27]

Other commonly cited benefits more specific to ECF include:

1) *Early validation.* A successful ECF campaign is positive for the product or venture, and thereby increases the ability to attract interest from more traditional sources of capital such as angel investors and venture capitalists.

2) *Network effect.* Some of the distinguishing features of ECF are the network effect, and the intellectual contributions from investors. ECF can sometimes enable direct access and exchange between investors and entrepreneurs. Investors who participated in the crowd funding campaign may lend their support to the venture by offering their contacts, insight, experience and information.[28]

2.4. Challenges/ risks

This section analyses risks from the perspective of IOSCO's three key objectives: investor protection; fair, transparent and efficient markets; and financial stability. This section should be read in conjunction with Chapter 7 which mentions several other risks and challenges that are common to financing, investment and trading platforms, including *cyber security risk* and *the need for investor education.*

(i)   Risks common to different types of platforms

Certain risks to investors may exist in either or both P2P lending platforms and ECF platforms. These may include:

1) *Risk of conducting general solicitation/ unlicensed activities.* Platforms may contend that they do not engage in regulated activities because they only offer execution-only services, information services, and matching services. However, in most cases the fact that the platform and the offerings on it are widely accessible, that it offers a large series of tools to investors, and that it receives compensation for these services, may lead the platform to cross the line into the realm of "regulated activities", including possibly

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[26]   E. Kirby and S. Worner, *Crowdfunding, An infant industry growing fast,* IOSCO Research Department Staff Working Paper, 2014.

[27]   Goldman Sachs Research, *The Future of Finance - Part 3, the Socialization of Finance*, March 13, 2015.

[28]   Idem.

general solicitation, advising on securities, broker-dealer activities, or offering of collective investment schemes. The definition and boundaries of these regulatory concepts, and, as a result, the protection of investors, varies considerably among jurisdictions.

2) *Disclosure risks.* Investment proposals on P2P lending and ECF platforms may lack standardization and provide less detail than securities in the public markets.[29] For example, not all P2P lending platforms disclose clear and comparable default data on their loan portfolios. Disclosure practices in relation to ECF also vary considerably. An early-stage company may be able to provide only limited information about its business plan and operations because it does not have fully developed operations or a long history to provide more disclosure.[30] However, disclosure that is not detailed or standardized is not necessarily either inadequate or misleading. The adequacy of disclosure will depend on specific facts and circumstances of the issuer and the offering.

3) *Cross-border risk.* A few platforms have started cross-border activities whereby they distribute loans/ securities of individuals and firms from certain jurisdictions to lenders/ investors based in other jurisdictions. It is often unclear in such cases under which law the lender/ investor can seek redress in case of default/ bankruptcy.

4) *Risk of collapse, fraud or malpractice by the platform.* A study conducted by the University of Cambridge and NESTA asked platforms what they saw as the biggest risks to the future growth of the market. Ranking highest was the potential of a collapse of one or more of the well-known platforms due to malpractice.[31] In recent years, certain cases of platform fraud have materialized.[32]

5) *Risk of fraud by the users of the platform.* In addition to fraud of the platform operator, fraud can occur with parties offering (and buying) securities on the platform. The online aspect of the digital platforms creates anonymity. If the platform users are not duly checked by the platform operator, fraud by platform users can be a source of risk for investors.

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[29] E. Kirby and S. Worner, *Crowdfunding, An infant industry growing fast,* IOSCO Research Department Staff Working Paper, 2014.

[30] See also *SEC Office of Investor Education and Advocacy (OIEA) Investor Bulletin: Crowdfunding for Investors*, February 16, 2016: "The company is also only obligated to file information annually regarding its business, including financial statements. A publicly listed company, in contrast, is required to file annual and quarterly reports and promptly disclose certain events—continuing disclosure that you can use to evaluate the status of your investment."

[31] See footnote 11 above, *Pushing Boundaries, The 2015 U.K. Alternative Finance Industry Report*, The Cambridge Centre for Alternative Finance and NESTA, February 2016.

[32] For example, see the CBRC focus in respect to Ezubao: http://www.crowdfundinsider.com/2016/03/83063-chinese-regulators-vow-to-get-tough-on-online-lending/. The fraud case involved approximately USD7.6 billion and 900,000 investors, mostly retail, over the span of 18 months.

(ii)   Risks more specific to P2P lending

1)   *Default risk of the borrower.* A loan through a P2P platform exposes the investor to the risk of borrowers failing to make timely interest and loan repayments. In certain cases borrowers may fail to repay at all, thereby causing the loss of the entire investment. Some, not all platforms, have funds set aside to cover bad debts, but the amount varies among platforms. Furthermore, not all P2P lending platforms have or publish clear and comparable default data on their loan portfolio. P2P lending platforms have not gone through a full economic cycle of expansion and contraction, and cyclically adjusted default percentages are therefore not available. One of the implications is that average default rates could be higher than anticipated when, for example, interest rates rise or economic growth falters.

2)   *Liquidity risk/ lack of secondary market liquidity for the loans.* Some P2P platforms may allow investors to sell their loan investments before the loan is fully repaid, but the investor's ability to sell their loan depends on another investor's interest in that loan. Investors may find it difficult to sell their loans if the borrower is experiencing any kind of strain, for example negative news reports or a repeated late payment history. Some P2P lending platforms may also suspend loan sales to protect new investors from investing in a loan where there is a known issue.

(iii)   Risks more specific to ECF

1)   *Risk of bankruptcy of the issuer.* While estimates vary, failure rates of start-ups are estimated to range between 50-90%.[33] Unlike an investment in a mature business where there is a track record of revenue and income, the success of a start-up or early-stage venture often relies on the development of a new product or service that may or may not find a market.[34] Also, investment horizons are very long, further increasing the probability of failure.

2)   *Liquidity risk/ lack of secondary market liquidity for the equity investments:* Securities purchased through ECF platforms have very limited secondary market liquidity. Small enterprises and start-ups that are funded through equity crowdfunding often do not meet the listing requirements for an IPO, thereby limiting exit avenues for investors. In comparison, listed securities generally provide greater opportunities for investors to exit their investments.

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[33]   The *"Startup Genome Report Extra on Premature Scaling"*, 2011, coauthored by Berkeley & Stanford faculty members and with 10 startup accelerators as contributors, analyzed 3,200 high growth web/mobile startups. Within 3 years, 92% of startups failed. Of those who failed 74%, failed due to premature scaling, https://s3.amazonaws.com/startupcompass-public/StartupGenomeReport2_Why_Startups_Fail_v2.pdf .
E. Kirby and S. Worner, *Crowdfunding, An infant industry growing fast,* IOSCO Research Department Staff Working Paper, 2014, "In equity crowd-funding the risk of default/investment failure is estimated to be around 50%." This is similar to the statistics noted in: http://www.statisticbrain.com/startup-failure-by-industry/ .
According to very recent data from CB Insights, in 2016, just 11% of companies raised funding after their seed round compared to 34% in 2015. See also CB Insights for the most common reasons why start-ups fail, https://www.cbinsights.com/research-reports/The-20-Reasons-Startups-Fail.pdf .

[34]   See *SEC OIEA Investor Bulletin: Crowdfunding for Investors*, February 16, 2016.

(iv)   Financial stability considerations

Several of the risks to investors cited above can also create risk to the operation of fair and efficient markets. However, past work of the staff of the IOSCO Research Department on P2P lending and ECF concluded that the sector did not pose a systemic risk on the basis of the relatively small size of the sector, and lack of interconnections with global financial markets.[35]

Today, P2P lending has grown substantially in certain jurisdictions. Consequently, certain jurisdictions have taken further regulatory action in relation to P2P lending. For example, in the Peoples Republic of China (PRC), the China Banking Regulatory Commission (CBRC) issued new regulations in 2016 to mitigate the risks brought about by the fast growth of P2P lending.[36] Similarly in the U.K.[37], the regulatory authorities are more closely reviewing P2P lending.

As for interconnectedness with other parts of the financial system, securitization of P2P loans is increasing in certain markets such as the U.S., and bank involvement is growing. This opens the P2P lending market to new investment, but also connects the rest of the financial market to exposure to packaged P2P loans that are often unsecured. While this segment of the market is still small, and therefore currently not a source of systemic risk, it may warrant continued monitoring.

2.5.   Regulatory relevance/ responses

For a comprehensive analysis of the regulatory response to crowdfunding, reference is made to the *IOSCO Crowdfunding 2015 Survey Responses Report*.[38]

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[35]   E. Kirby and S. Worner, *Crowdfunding, An infant industry growing fast,* IOSCO Research Department Staff Working Paper, 2014.

[36]   See *The Peterson Institute for International Economics,* https://piie.com/blogs/china-economic-watch/p2p-series-part-2-regulating-chinas-plethora-p2p-players: "Under the new regulations, P2P lending platforms in China are defined as information intermediaries under a registration system. Caps are imposed according to which individuals are allowed to borrow a maximum of RMB 200,000 per platform, with the total borrows per person capped at RMB 1 million. Companies are allowed to borrow RMB 1 million per platform, with a total limit of RMB 5 million per borrower. The rules ban P2P lending platforms from taking deposits, providing guarantees for lenders, or raising funds for their own use. P2P lending platforms are barred from selling wealth management products, or from issuing asset-backed securities, and must use third-party banks as custodians of investor funds. Existing P2P lending platforms will be given 12 months to transit their businesses."

[37]   https://www.ft.com/content/7663e4b4-44fb-11e6-b22f-79eb4891c97d .

[38]   IOSCO*, Crowdfunding 2015 Survey Responses Report*, December 2015, https://www.iosco.org/library/pubdocs/pdf/IOSCOPD520.pdf .

As is apparent from this report, regulations for P2P lending and ECF vary by jurisdiction,[39] and can fall under existing current securities regulations in some cases, or tailored regulatory regimes in others.[40]

In jurisdictions without a tailored regime for ECF, capital raising activities are typically subject to current prospectus and financial services provider licensing regimes, as well as applicable exemptions.[41] Jurisdictions that opted to implement a new, tailored regulatory regime, have typically chosen to do so because of the perceived novel and unique features of P2P and ECF.[42]

When developing regulatory responses, most regulators aim to balance the benefits of fostering capital formation, particularly for SMEs, against the risks that those types of operations may pose to lenders and investors.[43] For example, this goal is clearly stated by the Dutch AFM in the context of a study on crowdfunding and its supervision.[44] According to the regulator, it prioritized addressing risks "considered large enough and on which it could act." Moreover, its proposed regulatory response sought to "stimulate growth in the crowdfunding sector in a sustainable and responsible manner."[45]

This section presents some of the principal regulatory responses to the risks discussed above:

1)   *Risk of conducting general solicitation/ unregistered activities.* In many markets P2P lending and ECF may constitute regulated activities and consequently require licensing or registration. As regards to what constitutes general solicitation, in France there is a concept known as "progressive-access website."[46] In Singapore, prospectus exemptions are available for certain types of offers made on a crowdfunding website provided that information about the offers is made accessible only to customers that have been pre-qualified in accordance with regulatory guidelines.[47] CNMV Spain expressly allows for

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[39]   Idem, p.3. In jurisdictions where financial market supervision is conducted by one integrated regulator, all investment crowdfunding activities fall under the remit of the single regulator. Conversely, in jurisdictions that have adopted a twin-peaks regulatory model, the two regulators usually share responsibility for the oversight, each within its own remit. In other jurisdictions supervisory responsibilities in the financial sector are divided on the basis of the type of entity and the activity conducted, and/or the financial product offered. In this context, there may be a number of responsible authorities with its specific remit for the securities market, or the banking, or the insurance and/or pension funds sectors. There may be also a mixture of twin peaks and sectorial-based division of responsibilities.

[40]   Idem, p.4. Slight majority of jurisdictions surveyed.

[41]   Idem, p.4-5.

[42]   Idem, p.6.

[43]   See for example, Securities and Exchange Commission release No. 33-9974 regarding Crowdfunding: https://www.sec.gov/rules/final/2015/33-9974.pdf . Such balancing, in the U.K., has been done through a principles-based (instead of prescriptive) regulation: *Financial Conduct Authority Policy Statement PS14/4*: https://www.fca.org.uk/publications/policy-statements/ps14-4-fca%E2%80%99s-regulatory-approach-crowdfunding-over-internet-and .

[44]   Idem, p.17. Autoriteit Financiële Markten (AFM), *Crowdfunding – Towards a sustainable sector. A review of (supervision of) the crowdfunding sector*, 2014, p.174, https://www.afm.nl/en/professionals/nieuws/2014/dec/rapport-crowdfunding .

[45]   Idem, p.24. Meaning that a number of preconditions, such as professionalism of platforms, a minimum level of transparency, a certain degree of protection for lenders and borrowers and cooperation between platforms were to be achieved.

[46]   Idem, p.64. Crowdfunding: Mapping EU markets and events study.

[47]   *Response to Feedback Received on the Consultation Paper on Facilitating Securities-based Crowdfunding*: http://www.mas.gov.sg/~/media/MAS/News%20and%20Publications/Consultation%20Papers/Crowdfunding/Response%20to%20Feedback%20Received%20%20Facilitating%20Securitiesbased%20Crowdfunding.pdf; *Guidelines on Personal Offers made pursuant to the Exemption for Small Offers*:

general solicitation of offers, when they are selected based on objective and non-discriminatory criteria, neutrality and other principles.[48]

2) *Disclosure risks.* Many jurisdictions impose that only qualified investors can participate in ECF offers,[49] or impose caps in maximum investment per year/platform, sometimes including some flexibility for qualified investors.[50,51] In some jurisdictions, the crowdfunding platform is limited in function and is prohibited from making recommendations or determining suitability[52], while in other jurisdictions the very opposite may be true.[53] Furthermore, despite the formal status crowdfunding platform may carry, some jurisdictions have exempted them from the requirement to assess the suitability of investments for relatively small investment amounts.[54] Also, some jurisdictions utilize investor education requirements such as mandatory review of educational materials or of risk warnings.[55]

3) *Credit risk/ investment risk.* As noted above, many jurisdictions have adopted caps on the lender/ investor and borrower/ issuer side. In addition, there may be caps on the maximum amount of capital an issuer/ borrower can raise via P2P lending and ECF in a particular period.[56] Some jurisdictions require platforms to conduct due diligence on the borrower/ issuer and/or on the loan/ offer to reduce the risk of default.[57] Jurisdictions such as Chinese Taipei, Malaysia and Korea have introduced investment limits for retail investors and options such as a "cooling off" period to withdraw investments made through financing platforms. Further, to protect investors, some markets use the "all-or-nothing" funding model whereby funds raised would only be released to the issuer/borrower if the target amount of funds to be raised is met. In the event that fundraising targets are not met, the funds must be returned to investors/lenders. This is

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http://www.mas.gov.sg/Regulations-and-Financial-Stability/Regulations-Guidance-and-Licensing/Securities-Futures-and-Funds-Management/Guidelines/2016/Guidelines-on-Personal-Offers-made-pursuant-to-the-Exemption-for-Small-Offers.aspx; and
Guidelines on Advertising Restrictions: http://www.mas.gov.sg/Regulations-and-Financial-Stability/Regulations-Guidance-and-Licensing/Securities-Futures-and-Funds-Management/Guidelines/2016/Guidelines-on-the-Advertising-Restrictions.aspx .

[48] Idem, p.11.
[49] Idem. Such as in Mexico. In Italy, 5% of the offer must be subscribed by qualified purchasers or investment companies.
[50] Idem, p.24. Canada (higher limits for qualified investors), Japan, Korea (no limits for qualified investors), Netherlands (no limits for qualified investors), Spain (no limits for qualified investors), U.S. (higher limits for qualified investors). In Europe, such caps are based on self-declaration.
[51] From the GEMC survey conducted, Chinese Taipei (no limits for institutional angels), Malaysia (no limits for sophisticated investors, higher limits for angel investors), Thailand (limits for retail investors).
[52] Idem, p.8-9. U.S. (when registered as "funding portal") and Italy (non MiFID). Those jurisdictions introduce other mitigation measures for mis-selling risk.
[53] Idem, p.9-10. In some European Union countries, such as Netherlands, Germany, crowdfunding portals which are registered as MiFID intermediaries which provide investment advice must abide by the conduct of business rules and conduct suitability checks. French CIPs are not MiFID entities but yet must provide investment advice and conduct suitability checks. In Japan, suitability checks are mandatory for the portals. Other countries surveyed reported that the general regulatory framework applies in this regard.
[54] Idem, p.8. Canada, Korea.
[55] Idem, Appendix B. Canada, France, Italy, U.S., U.K. and Spain.
[56] Idem, Appendix B. Canada, France, Japan, Korea, Spain and U.S. See also footnote 36 above regarding the PRC.
[57] Idem, Appendix B. Canada, France, Italy, Japan, Korea, Malaysia, and Thailand (obligation to deny access to fraudulent issuers, what implies some due diligence).

to mitigate situations where insufficient funds raised may decrease the likelihood of an issuer's initiative succeeding.

4) *Liquidity risk/ lack of secondary market.* Aside from disclosure requirements, some jurisdictions have adopted initiatives to foster a secondary market. According to the GEMC survey conducted in December 2015, in China, some P2P platforms have developed a secondary market dedicated to the trading of their P2P loans. Similarly, subject to any terms and requirements by the regulators, crowdfunding platform operators in Malaysia may choose to establish a secondary market as an avenue for investors to exit investments. Korea established a secondary market that caters only to crowdfunded securities and various matching funds to provide additional funding to crowdfunding issuers as well as to buyback individual investors' crowdfunded shares.

5) *Operational risk/ risk of platform fraud and failure.* In Europe, platforms registered under MiFID must meet minimum capital requirements as a buffer against operational risk. Some jurisdictions mandate the use of a third-party custodian[58] and restrict the platforms from handling customer money. Some jurisdictions impose specific requirements to mitigate operational risk. In Italy, for example, the platform must identify the sources of operating risks, adopt adequate procedures and controls and provide suitable back-up facilities. The securities market regulator examines internal procedures (including IT) at registration and on ongoing basis.[59] Similar rules are prescribed in France, Spain and Japan.[60]

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[58] Idem. Japan, Korea, Malaysia, Spain.
[59] Idem, p.15. The Dutch AFM examines internal procedures and IT systems as well.
[60] Idem, p.15.

Chapter 3: Retail Trading and Investment Platforms

3.1. Introduction

Over the past 25 years, online investment and trading platforms have evolved significantly, pressuring traditional brokerage houses and asset management firms to provide customers access to products and services across multiple distribution channels. This has also led to an increasingly cost-competitive environment, prompting the use of technology to automate processes and increase product breadth and depth.

The following types of online trading and distribution platforms have become more "mainstream" as a result of this evolution:[61]

1) *Online brokerage platforms.* Online brokerage firms offer platforms to customers to enable them to access and manage account information, conduct research, utilize online tools, invest in a large selection of products (typically exchange traded products, mutual funds, and OTC securities), place orders, and connect to a financial professional, if requested.[62]

2) *Online asset management platforms.* Asset management firms also offer funds to clients through the online channel. Funds offered can be from the fund company itself or other third-party funds. Similar to brokerage firms, these platforms provide customers the ability to access and manage account information, conduct research, utilize online tools to place orders, and connect to a financial professional, if requested.[63]

3) *Exchange-based distribution platforms.* Fund products can be distributed through platforms operated by exchanges.[64] There are different operating models for exchange distribution platforms: some facilitate the subscription and redemption of funds, some involve market makers for secondary trading, and some offer a combination. Certain exchange distribution platforms provide information that can assist the retail investor to make his or her own assessment prior to investing.

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[61]   *This chapter contains reference to a number of private companies and financial service providers involved in Fintech, including in the exhibits. As also noted under "About this Report", these references should not be construed as an endorsement by IOSCO or by any of its members, nor do they imply any conclusion about the status of any product or service described under applicable law, but instead are offered as illustrative of new business models and emerging technologies currently being contemplated, proposed or offered.*

[62]   The generic term "financial professional" as used in this report may refer to a broker-dealer and/or an investment adviser who provides financial or investment advice to clients.

[63]   Examples include Vanguard, Fidelity and BlackRock in the U.S.; Alipay and Taobao in China; Funds Online in Korea; Fundsupermart, which has operations across both developed and emerging markets, including Hong Kong, India, Malaysia and Singapore; and WealthMagik in Thailand.

[64]   Examples include the NYSE-Euronext and Deutsche Börse; in Asia, the ASX and the Shenzhen Stock Exchange have similar platforms.

3.2. Market evolution/ size

In recent years innovation in retail trading and investment platforms has further accelerated, driven by changing investor demands and online usage behaviour, the speed of technological developments, such as artificial intelligence, natural language processing, big data analysis and cloud computing, and the use of media, social media, metadata and open-source data to support retail trading and investment decision making on such platforms.

A review of technology enabled retail trading and investment shows a growing variety not only of online trading and investment platforms, but also of technologies that support retail investor decision-making on such platforms. For the purposes of this chapter, we have categorized and organized the new Fintech business models as follows:

(i)   Comparison websites
(ii)   Financial aggregator platforms
(iii)   Robo-advisers
(iv)   Social trading and investing platforms
(v)   Social media sentiment analysis, research and networking platforms
(vi)   Other innovative business models.

We have taken this approach because investors, especially the younger generation, increasingly will manage their investments by making use of one or more of these business models.[65] As illustrated in *Figure 8*, comparison websites inform decision-making, financial aggregator platforms inform daily spending, savings and investment management, while robo-advisers, social trading platforms and other innovative business models allow for mobile-based management of personal finances for customers and investors of any income levels.

Figure 8: Trading and investment tools

Informs investment decision making
- Comparison website
- Sentiment analysis and networking

Informs daily investment management
- Financial aggregator platform

Mobile/ automated
- Robo-advisers
- Social trading platforms
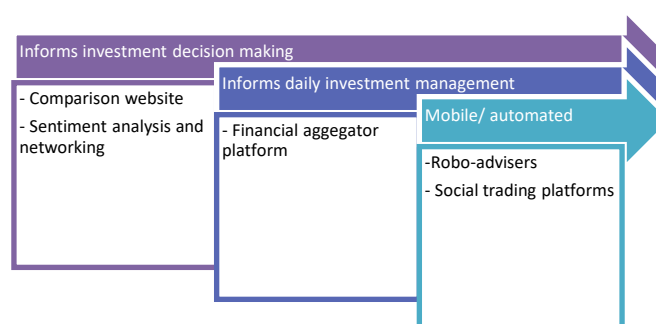
Source: IOSCO research

(i)   Comparison websites

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[65]   See, for example, Goldman Sachs Research, *The Future of Finance - Part 3, the Socialization of Finance*, March 13, 2015: "Millennials, who experienced two significant recessions during their formative years, have less trust in wealth advisors and the philosophy of active investments compared to prior generations. Millennials also trust their social network for personal investing advice with 84% of Millennials saying their purchase decisions are influenced by user generated content."

The internet has facilitated growth in financial comparison websites for banking, insurance and investment products, particularly in developed markets. Examples include MoneyWise and Nerdwallet. In less mature markets, such as in Asia, comparison websites for banking, insurance or investment products are relatively new. Nascent platforms in Asia are CompareAsia and GoBear, providing comparison for banking and insurance products. *Exhibit 1* below shows an example of a comparison site.
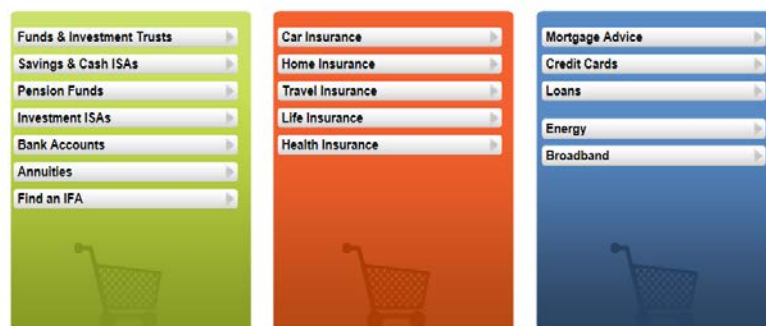
Comparison websites are typically paid on a "cost-per-click" basis, and/or through fees. While a "cost-per-click" may not amount to providing advice, comparison websites that provide investment advice or receive transactions-based compensation may require regulatory licenses in certain jurisdictions. *Exhibit 2* below shows the compensation model of a comparison site:
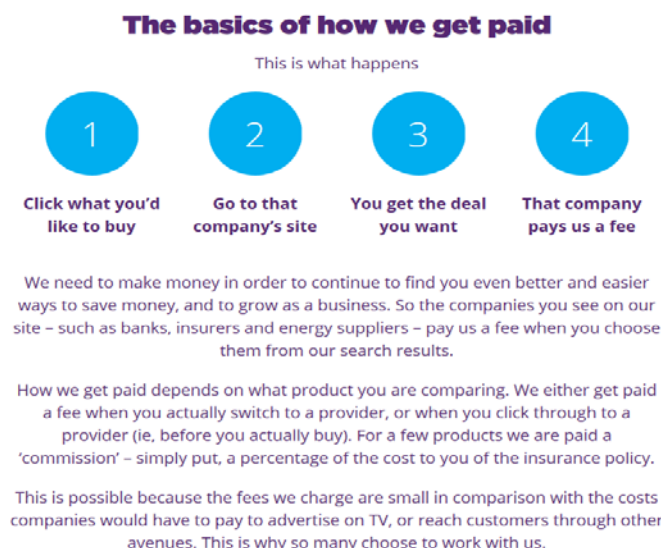
(ii)   Financial aggregator platforms

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[66]   See footnote 61 above.
[67]   See footnote 61 above.

Investors are increasingly making use of financial aggregator platforms to consolidate information concerning their financial accounts. These platforms allow the user to link accounts across multiple financial institutions. Mint is an example of this type of platform.

In addition, aggregators may also mine the associated data, and may in certain cases offer other services, for example, investment advice, in connection with and using the data mining. Offering other services such as investment advice may require meeting some licensing requirements. Personal Capital is an example of a platform that also offers investment management and advice. *Exhibit 3* shows an example of aggregator and comparison website combined:
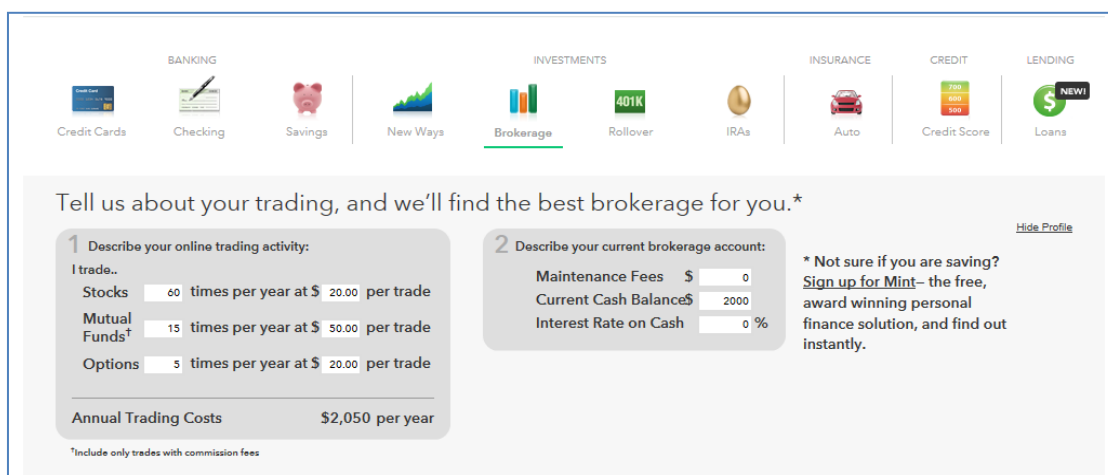
Source: Mint[68]

(iii) Robo-advisers

Robo-advisers provide largely automated portfolio management advice, strategies and services for investors. In order to use these services, new investors must complete a profile that helps determine their risk appetite and/or investment objective, which is then used to build a portfolio for the investor.

Robo-advisers utilize algorithms to construct, manage and rebalance investment portfolios, typically using a pre-determined mix of exchange-traded funds (ETFs) to build low-cost, diversified, and liquid portfolios tailored to the investor's objectives. The compensation models used by these firms include fees based on the percentage of assets under management on an annual basis, or charging a flat fee for the service. Because these platforms offer securities dealing and/or investment advice, they typically require registration or licensing.

Some robo-advisers have been established by technology start-ups, such as Betterment and WealthFront in the U.S., Nutmeg in the U.K. and 8 Securities in Asia. While these independently operated robo-advisers account for only a small fraction of the overall global asset management industry, their presence has not gone unnoticed by incumbents. Firms such

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68   See footnote 61 above.

as Vanguard, Blackrock, Charles Schwab and Fidelity, as well as retail banks and private banks, have launched or bought[69] their own robo-advisory platforms in response to this trend.[70] Operators of robo-advisory platforms typically distinguish between fully automated robo-adviser platforms, and human assisted robo-advisory platforms.[71]

Increasingly robo-advisers are incorporating the concept of goals-based investing, where the investor can set a long-term goal such as saving for retirement or saving for children's schooling and the portfolio is tailored to meet that goal. Quantifeed in Asia is offering a business-to-business (B2B) goals-based robo-advisory solution. Ellevest in the U.S. is a business-to-customer (B2C) goals-based robo-adviser targeting the female segment of the population.

Exhibit 4: Example of a robo-adviser
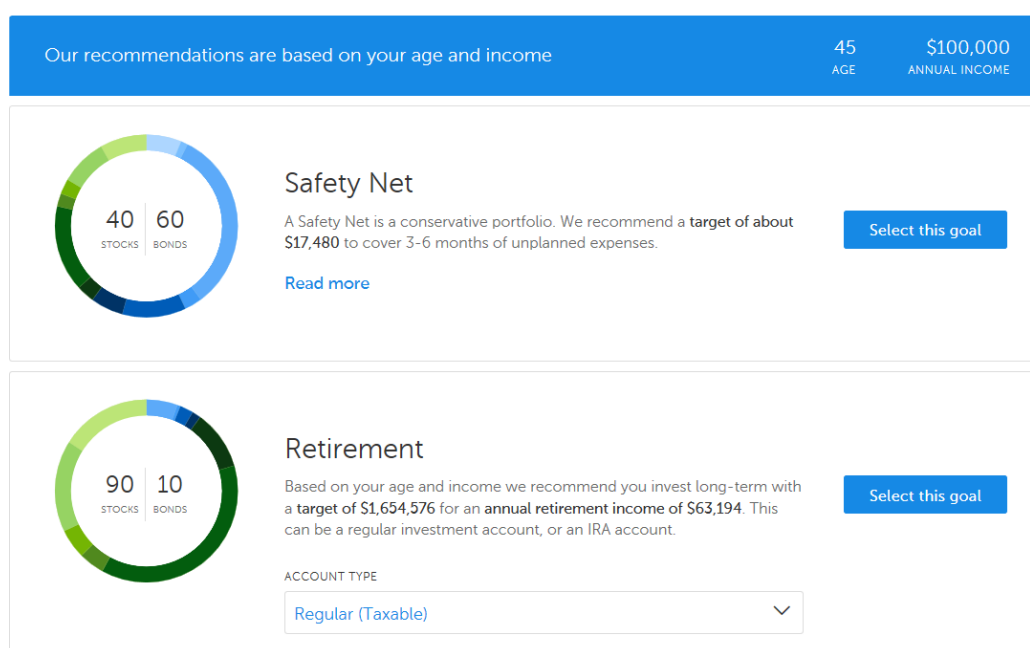
Source: Betterment[72]

(iv)   Social trading and investing platforms

The terms "social, mirror, and copy trading and investing" appear to be used interchangeably.[73] These business models typically offer a social approach to trading and investment where

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69   Blackrock bought FutureAdvisor: http://fortune.com/2015/08/26/blackrock-robo-advisor-acquisition/ .

70   See http://www.visualcapitalist.com/robo-advisor-arms-race/, which estimates 2016 market size at USD 0.3 trillion, showing also relative market size of the main market participants. Per Bloomberg, "the top four robo-advisers boosted their assets by almost 80 percent last year, with Schwab and Betterment more than doubling their take. Vanguard, the biggest participant in the computer advice market, grew its assets under management by 68 percent to $52 billion." https://www.bloomberg.com/news/articles/2017-01-31/humans-are-coming-for-robo-advisers-as-betterment-adds-cfps .

71   See Bloomberg "Betterment LLC will begin offering recommendations from certified financial planners and other experts alongside its computer-driven service. [...] Like Schwab, Vanguard offers a hybrid that combines tech with human advisers available by phone or video chat.", https://www.bloomberg.com/news/articles/2017-01-31/humans-are-coming-for-robo-advisers-as-betterment-adds-cfps

72   See footnote 61 above.

73   Mirror trading is similar to auto trading but with minor differences, https://www.the-fca.org.uk/firms/copy-trading .

followers follow a leader of their choice. The leader can be a professional, licensed individual, or not, depending on the platform. The services provided can be portfolio management or trading.

The regulatory approach to "social, mirror, and copy trading and investing" differs depending on the jurisdiction. For example:

- In the context of the EU MiFID Directive, the European Securities Markets Authority (ESMA) has considered copy and mirror trading as automatic execution of trade signals.[74] According to ESMA´s guidance, copy trading is classified as portfolio or investment management if no manual input is required from the account holder other than the conclusion of an agreement between the service provider and the client.

- In the U.S., depending on the services offered, a different registration status applies. Some securities mirror trading sites and their model managers are registered as investment advisers or avoid registration by relying on a "newsletter exemption" on the basis that they are publishers of financial data. Other mirror trading sites are registered as broker-dealers. Other mirror trading sites direct their customers to broker-dealers where they can open an account to execute trades that mirror those of the model manager partner.

Research reveals a very large number and very high diversity of "social, mirror, and copy trading and investing" platforms.[75] The products offered vary across the full spectrum of asset classes including ETFs, stocks, currencies, commodities and derivatives, including OTC leveraged products.[76]

The licensing status of these platforms is also varied, heightening cross-border regulatory risks, as well as risks of regulatory arbitrage, elaborated upon in further detail below.

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[74] https://www.esma.europa.eu/sites/default/files/library/2015/11/2012-382.pdf .
[75] See also the *Update to the Report on the IOSCO Automated Advice Tools Survey,* dated December 2016, http://www.iosco.org/library/pubdocs/pdf/IOSCOPD552.pdf .
[76] See also the *Report on the IOSCO Survey on Retail OTC Leveraged Products,* dated December 2016, http://www.iosco.org/library/pubdocs/pdf/IOSCOPD550.pdf, which highlights the following products:
  - Rolling-spot forex contracts: contracts where the payout is based on the fluctuation of foreign exchange rates and the initial maturity of two business days is automatically extended one business day at a time if the contract is still open at the close of trading on the second business day. This product family includes economically equivalent leveraged forex contracts;
  - Contracts for differences (CFDs): contracts where the pay-out is based on the fluctuation of any of a variety of underlying financial rates and prices and which stay open until closed by one of the parties;
  - Binary options: contracts where the payout, based on any of a variety of underlying financial rates and prices, is either zero or a fixed amount or a specified percentage of the price (amount invested) of the option.

(v)   Social media sentiment, research and networking platforms

Over the past few years, a series of other business models have emerged that typically get combined with standing business models such as professional research and brokerage, as well as with some of the newer retail trading and investment business models we have cited above. These include:

1)   *Social media data analytics companies.* The growth of the internet has been paired with significant growth in social media and metadata-based analytics companies. These companies generally use natural language processing (NLP) technology combined with machine learning to aggregate and analyse social media across various channels and identify key investor sentiment. They then sell these sentiment indicators to corporations and financial institutions, including banks, hedge funds, high-frequency traders and social trading and investing platforms. Amareos, based in Asia, is an example of a business-to-business sentiment analysis tool. Other examples include but are not limited to StockTwits, Dataminr, iSENTIUM, Market Prophit, and Scutify in the U.S. and TheySay in the U.K.

Exhibit 5: Example of sentiment analysis showing decrease in market fear
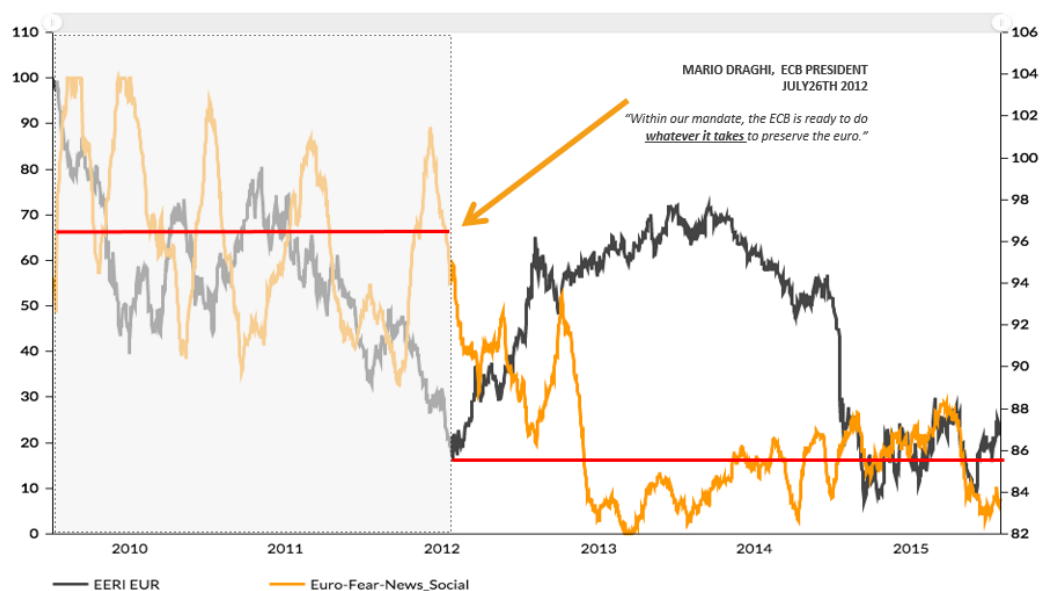
Source: Amareos[77]

2)   *Crowdsourced research networks.* Firms operate websites that seek to crowdsource ideas either from the retail public at large or from the buy-side community. The firms then overlay these crowdsourced ideas with issuer information such as analyst reports, public research, earnings estimates, news, and individual commentaries to develop "crowdsourced research" ideas and earnings estimates. Traders and hedge funds

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[77]   See footnote 61 above.

purchase such analysis to inform their trading strategies. SumZero, Estimize and Mergerize are examples of crowdsourced research networks.

3) *Social networking platforms.* Certain online brokerage websites have also started offering social networking platforms for users to share and discuss trade ideas among themselves. Broker-dealers may seek to offer this option in the hopes that facilitating the exchange of trading ideas could lead to an increase in trading volume. Examples of websites offering such features include TradeKing and SprinkleBit.

As noted above, these business models often get combined with the newer retail trading and investment models. For example, Xueqiu in China and StockTwits in the U.S. offer a combination of sentiment analysis and social networking, allowing users to tweet about stocks and share their virtual portfolios. In the U.S., online brokerage firm Robinhood has partnered with StockTwits, OpenFolio and Quantopian to combine brokerage, sentiment analysis and social networking. In China, StockRadar collects public data such as stock-related news and social media posts to perform sentiment analysis and opinion mining, in order to discover and recommend trading.

(vi) Other innovative business models

The above examples are by no means exhaustive, but rather illustrative of the Fintech innovation that is taking place in the context of automated retail trading and investment. There are many other firms that combine one or more of the features above.[78]

Exhibit 6: Example of micro-investment, enabling connection to a credit card and round-up of purchases for investment in a robo-advisory service
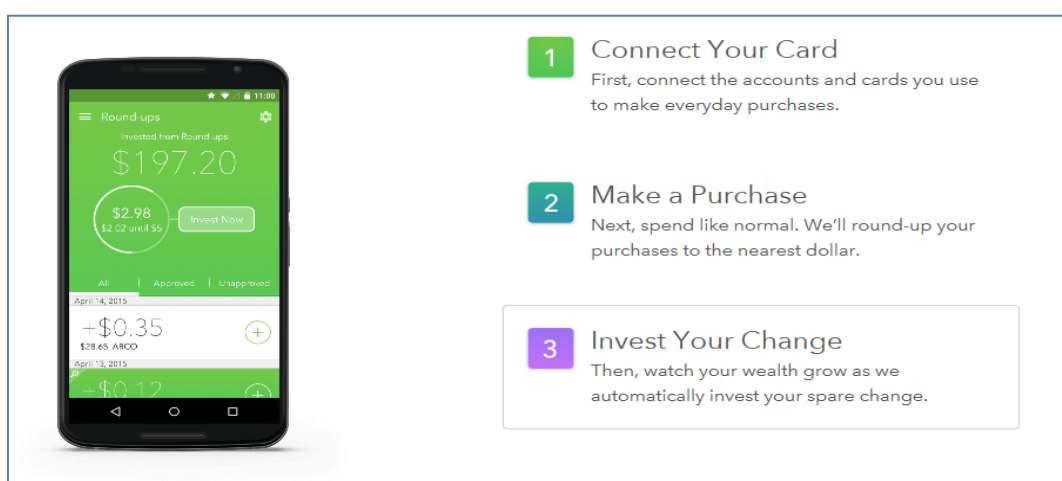
Source: Acorns[79]

3.3. Benefits/ opportunities

In view of the diversity of retail trading and investment platforms discussed above, it is a challenge to generalize the benefits and opportunities. It is more instructive to examine them by type of offering:

(i) *Comparison websites* empower investors to compare the price and features of banking, insurance and investment products before purchasing or investing. It is anticipated that an increasing number of prospective investors, especially the younger generation familiar with performing internet searches, will use comparison websites before buying banking, insurance or investment products.

(ii) *Financial aggregator platforms* give investors an overview and therefore better control over their overall spending. It is anticipated that in a world in which investment is increasingly online and self-directed, investors will increasingly make use of such websites.

(iii) *Robo-advisers* aim to change the economics and scalability of providing advice, including to traditionally underserved segments. From a business perspective, financial institutions incur lower costs when delivering advice through automated tools because these tools require the employment of fewer people. Additionally, financial institutions offering robo-advice are able to access a wider range of clients that might opt for the use of online channels as opposed to face-to-face interaction or that may have smaller investment portfolios. This type of service also helps firms deliver a more standardized user experience to meet the growing and evolving demands of its consumers.[80] From an investor perspective, robo-advisers provide access to modern portfolio theory-based investing at lower cost and in smaller size than what was previously required. Investors also benefit from the more standardized, mobile-enabled user experience.[81]

(iv) *Social trading and investing platforms and other innovative business models* as noted above display very high diversity in terms of the features and products and services offered. While it is impossible, therefore, to generalize the benefits, these business models typically place some reliance on the theory of the "wisdom of the crowds." The science behind the "wisdom of the crowds" is still subject to academic debate and research.[82]

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[80] European Securities and Market Authority (ESMA), *Joint Committee Discussion Paper on automation in financial advice*, December 4, 2015, noting: benefits to consumers (benefits relating to cost; benefits relating to consumer access; benefits relating to the quality of service) and benefits to financial institutions (benefits relating to cost, benefits relating to the size of the potential client base, and benefits relating to the quality of service), https://www.eba.europa.eu/documents/10180/1299866/JC+2015+080+Discussion+Paper+on+automation+in+financial+advice.pdf .

[81] Idem.

[82] See also *Frontiers of Financial Technology, Expeditions in future commerce, from blockchain and digital banking to prediction of markets and beyond*, edited by David Shrier and Alex Pentland of MIT, Chapter 5 on Prediction Markets.

3.4. Challenges/ risks

This section analyses risks of retail trading and investment platforms from the perspective of IOSCO's objective to achieve investor protection. It should be read in conjunction with Chapter 7 which mentions several other risks that are common to financing, investment and trading platforms, such as *cyber security risk* and *the need for investor education.*

(i)   Risks common to the different types of platforms

Below are risks that are common to the different types of online retail trading and investment platforms discussed above:

1)   *Risk of platform being operated by unregistered entities.* Many jurisdictions require firms to register with the appropriate regulatory bodies before engaging in broker-dealer or investment advisory activity. For example, platforms that obtain commissions or fees for effecting transactions in securities for users of the platform may trigger licensing requirements. Similarly, platforms that offer trading functionalities to their users, or that offer investment advice on securities (such as robo-advisers), typically also require a license. Furthermore, even if a platform is not required to be licensed in a certain jurisdiction, as noted above, the cross-border availability of its services may trigger licensing requirements, or possibly a violation thereof, in overseas markets where investors are based.

2)   *Risk resulting from conflicts of interest and insufficient cost and fee transparency.* In the case of automated information platforms or automated advice, conflicts of interest may emerge if, for example, the underlying algorithm is programmed to direct investors towards a specific range of "preferred" investment alternatives or intermediaries for which the platform or its affiliates receive higher commissions or other forms of compensation.

3)   *Risk of "execution-only" platforms crossing into offering "automated advice".* In cases where less sophisticated investors are in an execution-only environment, there is a risk that they either may make decisions with insufficient knowledge, or may begin to demand tools and services that offer more guidance and direction. The execution-only platform, in an attempt to meet client demand, may introduce various tools and services which cross the line between "execution-only" and providing "advice and recommendations." This may have different regulatory implications that the platform has failed to consider in terms of, for example, licensing and other regulatory obligations, the need to conduct a suitability assessment.

4)   *Risk of failing to "know-the-client" from an anti-money laundering and fraud control standpoint (AML KYC).* Opening an account through the internet affords an opportunity to enter false information, perhaps to mask the true identity for privacy reasons, to create a profile that would be viewed as acceptable to the firm to open an account, or for criminal reasons. These motives to falsify an identity exist regardless of the form of

service. However, when in-person, a firm asks to see proof of governmental identification or other proof of identity such as a driver's license or passport that would bear the person's photo. In an online-only situation, the firm must implement other procedures, checks and balances to guard against the potential of providing falsified or stolen information. Reference is made to Chapter 7 for more detail on onboarding.

5) *Risk of failing to "know-the-client" from a suitability standpoint (suitability KYC).* To make suitable recommendations for a client, broker-dealers and investment advisers must first develop a client profile. During this process, a traditional broker-dealer or investment adviser has the opportunity to assess each client individually and ask additional questions to clear up inconsistencies in responses or better understand unique or unusual circumstances. Despite this flexibility, there is still a risk that the intermediary does not ask enough or the proper questions to thoroughly understand the investor's situation. Yet by comparison, an automated profiling process may not be able to resolve inconsistencies or incorporate unusual client situations if the process relies only on a standard set of questions. In addition, some questionnaires used by robo-advisers are very short,[83] creating a potentially greater risk of failing to know the client well enough to make suitable recommendations.

6) *Risk that clients do not understand the services provided or products offered.* Clients may assume that the firm's online offering has become "smart" enough to replace a human advisor with significantly lower fees, but may not be aware that human advisors may be able to better understand unique circumstances, help the client better weather a market correction, or offer additional services, such as tax, estate, and insurance planning, as part of a complete financial plan. It may be the case that trading and investment platforms could offer similar services or referrals to professionals that can offer these services. However, the risk remains that, with a new type of service, clients may not understand the scope, risks and limitations of the services they are being provided. Reference is made to Chapter 7 for more detail on investor literacy.

7) *Risk of suboptimal or even unsuitable investment choices due to behavioural biases.* Financial decisions made in an automated environment are faster and more convenient than those made in any other context. However, velocity and convenience may not always benefit the quality and the outcome of the investor's decision making process. This risk can be mitigated by an attentive design of the automated tool including high quality decision trees, feed-back loops and control questions. Reference is made to Chapter 7 for more detail on investor education.

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[83] FINRA, *Report on Digital Investment Advice*, March 2016, https://www.finra.org/sites/default/files/digital-investment-advice-report.pdf .

(ii)   Risks applicable to robo-advisers

Below are risks that may be more specific to robo-advisers[84] but that can also apply to other types of platforms:

1)   *Risks of errors in algorithms.* Robo-advice is a function of two components: the observable client data and the algorithm that processes the client data into digital output constituting financial advice. As with any algorithm, unintended results can occur through incorrect design or mistakes in the programming itself. Failing to understand the methodology embedded in the algorithm and whether the algorithm aligns with a firm's desired approach could lead directly to the systematic mis-selling of investments to clients, or to the algorithm making investment decisions that may not be in the client's best interest (for example, from a tax or estate planning perspective).[85] Also, studies have documented that different robo-advice platforms, guided by different algorithms, render vastly different advice even for identical investor profiles.[86]

2)   *Risks of overly complex algorithms.* Complex algorithms may be able to generate differentiated financial advice better suited to the specific profile of individual clients. However, these algorithms may also be subject to error. Further, as the advice becomes more differentiated and complex, the process to generate that advice may become harder for investors to understand.

3)   *Risks of overly simplistic algorithms.* Robo-advice may be inappropriate if the algorithm driving it does not capture sufficient data to reflect the client's overall and unique financial situation through questions regarding, among others, the investor's cash flow constraints, tax situation, anticipated expenditures and other sources of wealth. Currently, robo-advice is often rendered in the form of a "plan" according to which a client's account is managed. The "plan" refers to the generic investment strategy established by the algorithm in response to the information provided by the client via a questionnaire. A generic investment strategy, however consistent across clients, may be ill-suited to a specific client's best interests, for example, in certain circumstances where an algorithm driving the advice may be designed to consider limited investment options from among a predetermined set of alternatives.

4)   *Risk of static client information.* A client's unique financial circumstances, as well as the overarching macroeconomic conditions may change, sometimes rapidly or dramatically. Robo-advice may fail to account for these changes if the algorithm does not gather sufficient client data over an appropriate time frame and frequency.

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[84]   See SEC's Office of Investor Education and Advocacy (OIEA) and FINRA joint alert on automated investment tools: https://www.sec.gov/oiea/investor-alerts-bulletins/autolistingtoolshtm.html .

[85]   In its *Report on Digital Investment Advice*, FINRA observed that "if an algorithm is poorly designed for its task or not correctly coded, it may produce results that deviate systematically from the intended output and that adversely affect many investors." See *Report on Digital Investment Advice*, FINRA, March 2016, https://www.finra.org/sites/default/files/digital-investment-advice-report.pdf .

[86]   *Putting Robo Advisers to the Test*, Wall Street Journal, Liz Moyer, http://www.wsj.com/articles/putting-robo-advisers-to-the-test-1429887456 .

(iii)   Risks applicable to social trading and investing platforms

As noted above, social trading and investing platforms are proliferating. It is no longer unusual to use such sites to follow other people's views, whether professional traders, research analysts or just laymen.

In view of the novelty of this business model and the large diversity of products and services provided, it is difficult to fully predict the risks this model presents. However, conceptual risks and regulatory issues include those below:[87]

1)   Potential errors in auto-trading algorithms;
2)   Advice may not be suitable for, or in the best interest of, all investors;
3)   Challenges in transparency and disclosure regarding the trading strategies advertised;
4)   Potential to develop unrealistic expectations of gains;
5)   Undue or unreasonable reliance on the creators of the virtual portfolios;
6)   Inadequate infrastructure or controls to update and test the virtual portfolios;
7)   Lack of investor understanding of potential conflicts, fees/ incentive structures, and of product and service related risks;
8)   Specific risks associated with social trading platforms offering access to highly leveraged products; and
9)   Blurred lines between information and advice and different regulatory status of service providers; risk of regulatory arbitrage.

(iv)   Risks applicable to social media sentiment, research and networking platforms

As noted above, social media sentiment, research and networking platforms are also fast proliferating, in many cases added as a service to standing brokerage services, or added as a service to some of the newer online business models discussed above.

In view of their novelty and large diversity of the products and services offered, it is difficult to fully predict the risks. However, potential risks and regulatory issues may include the below:[88]

1)   Potential errors with algorithms used by social media analytics vendors, resulting in incorrect or incomplete reading of market sentiment;
2)   Advice may not be suitable for, or in the best interest of, all investors;
3)   Sentiment analysis unduly influenced by incorrect data over social media (for example old chatter getting renewed and retweets);
4)   Inadvertent dissemination of false information;
5)   Emotional investing, increased scope for herding patterns;
6)   Lack of investor understanding of potential conflicts, fees/ incentive structures, and of product and service related risks;
7)   Obligations of registered entities to monitor social networking activities on their websites, and maintain related records; and

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[87]   A recent report from the World Economic Forum lists similar or additional risks:
http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf .
[88]   Idem.

8) Blurred lines between information and advice and different regulatory status of service providers; risk of regulatory arbitrage.

3.5. Regulatory relevance/ responses

(i) Robo-advisers and other forms of automated/ digital financial advice

Per the IOSCO Fintech survey conducted in July 2016 and consistent with the findings of a prior survey in July 2014,[89] most of the regulators surveyed rely on, among others, general suitability, know-your-customer, registration, training, best-execution, short-sale, disclosure, record-keeping, compliance and supervision rules to address robo-advice, or other forms of automated/ digital advice.

Notwithstanding the foregoing, faced with the growth of retail trading and investment platforms, an increasing number of jurisdictions have introduced relevant regulatory measures to address this area, including:[90, 91]

1) Provided guidance regarding how they expect the automated advice industry to grow;
2) Made clarifications regarding how the existing regulatory framework applies to automated advice; and

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[89] *Report on the IOSCO Social Media and Automation of Advice Tools Surveys*, July 2014, http://www.iosco.org/library/pubdocs/pdf/IOSCOPD445.pdf. See also Blackrock, Digital Investment Advice, *Robo-advisers coming of Age*, Appendix A: https://www.blackrock.com/corporate/en-at/literature/whitepaper/viewpoint-digital-investment-advice-september-2016.pdf .

[90] **Australia:** ASIC issued a regulatory guide explaining the regulatory obligations of Australian providers of digital financial advice to retail clients beyond their obligations emerging from the provision of financial advice. It provides guidance on issues that are unique to the provision of digital financial advice and clarifies some of the uncertainties that have arisen about how existing obligations apply to robo-advisers. This regulatory guide generally builds on existing ASIC guidance and does not introduce new regulatory concepts. This is because the law is technology neutral, and the obligations applying to the provision of traditional (i.e. non-digital) financial product advice and digital advice are the same. See "Providing digital financial product advice to retail clients", ASIC, March 2016, http://download.asic.gov.au/media/3583174/attachment-to-cp254-published-21-march-2016.pdf .

Canada: In September 2015, in response to some Canadian registered portfolio managers and restricted portfolio managers starting to operate as "online advisers", the Canadian Securities Administrators (CSA) clarified in CSA Staff Notice 31-342 that there is no "online advice" exemption from the normal conditions of registration for a portfolio manager. See CSA Staff Notice 31-342 expanded on guidance previously provided by the Ontario Securities Commission (OSC) in September 2014 in OSC Staff Notice 33-745, http://www.lautorite.qc.ca/files/pdf/reglementation/valeurs-mobilieres/0-avis-acvm-staff/2015/2015sept24-31-342-avis-acvm-en.pdf .

E.U.: In December 2015, the Joint Committee of the three European Supervisory Authorities – European Banking Authority, European Insurance and Occupational Pensions Authority and European Securities and Markets Authority – launched a discussion paper on automation in financial advice, aimed at assessing what, if any, action is required to harness the potential benefits of this innovation and mitigate its risks, https://www.eba.europa.eu/regulation-and-policy/consumer-protection-and-financial-innovation/discussion-paper-on-automation-in-financial-advice .

U.K.: On March 2016 the HM Treasury and the Financial Conduct Authority (FCA) published the Financial Advice Market Review (FAMR) final report on the U.K. market for financial advice, specifically addressing "automated advice models." The Review's goal is to explore ways in which Government, industry and regulators can take individual and collective steps to stimulate the development of a market which delivers affordable and accessible financial advice and guidance to everyone, at all stages of their lives, https://www.fca.org.uk/static/fca/documents/famr-final-report.pdf .

U.S. FINRA: In May 2015, the Financial Industry Regulatory Authority (FINRA), the U.S. self-regulatory organization for broker-dealers, and the Securities and Exchange Commission Office of Investor Education and Advocacy (OIEA) issued a joint Investor Alert: https://www.sec.gov/oiea/investor-alerts-bulletins/autolistingtoolshtm.html. In March 2016, FINRA published a report providing guidance for investors and advisers using such automated services. "Report on Digital Investment Advice", FINRA, March 2016, https://www.finra.org/sites/default/files/digital-investment-advice-report.pdf .

[91] See also the *Update to the Report on the IOSCO Automated Advice Tools Survey,* December 2016, http://www.iosco.org/library/pubdocs/pdf/IOSCOPD552.pdf .

3)   Issued advice and recommendations on best practices for both providers and consumers of automated advice.

(ii)   Social trading and investing platforms

The evolution of the internet has enabled the creation of retail trading platforms with diverse features such as social media sentiment analysis and social networking.

Certain regulators have issued clarifications and alerts that, among other things, clarify a platform's licensing status[92] and highlight the risks posed by certain types of social trading.[93, 94]

(iii)   The impact of automation in trading and investment on regulators

Innovation in retail trading and investment in the form of mobile offerings that are combined with automated analytics and algorithms previously reserved for professional and institutional investors, is very fast and diverse.

As retail trading and investment platforms grow in number and size and the advice rendered and the automation involved becomes more complex, traditional sample audits may become less adequate.

Regulators may need to hire specialized staff that understand and can assess the technology and algorithms driving the trading and advice. Regulators may also need to adopt a different approach towards surveillance, including asking for more frequent or different data filings.

These implications are further elaborated upon in Chapter 7 below.

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[92]   **E.U.:** In the context of the EU MiFID Directive, the European Securities Markets Authority (ESMA) has considered copy and mirror trading as automatic execution of trade signals. According to ESMA´s guidance, copy trading is classified as portfolio or investment management if no manual input is required from the account holder other than the conclusion of an agreement between the service provider and the client, https://www.esma.europa.eu/sites/default/files/library/2015/11/2012-382.pdf .

[93]   **FINRA:** Investor Alert—Binary Options: These All-Or-Nothing Options Are All-Too-Often Fraudulent in which it warns investors that trading binary options can be extremely risky. Unlike other types of options contracts, binary options are all-or-nothing propositions. When a binary option expires, it either makes a pre-specified amount of money, or nothing at all, in which case the investor loses the entire investment. Trading binary options is made even riskier by fraudulent schemes, many of which originate outside the U.S., http://www.finra.org/newsroom/2015/finra-investor-alert-binary-options-these-all-or-nothing-options-are-all-too-often , **Canada:** The Canadian Securities Administrators (CSA) also issued notices warning investors about binary option platforms, http://www.osc.gov.on.ca/en/NewsEvents_nr_20150309_binary-option.htm; http://www.osc.gov.on.ca/en/NewsEvents_nr_20160323_csa-alert-beware-binary-options.htm .

[94]   See also the *Update to the Report on the IOSCO Automated Advice Tools Survey,* December 2016, http://www.iosco.org/library/pubdocs/pdf/IOSCOPD552.pdf, and the *Report on the IOSCO Survey on Retail OTC Leveraged Products,* December 2016, http://www.iosco.org/library/pubdocs/pdf/IOSCOPD550.pdf .

Chapter 4: Institutional Trading Platforms

4.1.   Introduction

While innovation is occurring in many aspects of institutional trading[95] and in terms of trading platforms,[96] this chapter reviews the evolution in fixed income platforms in view of the linkage with the topic of liquidity in the fixed income markets which is discussed in the *2016 IOSCO Securities Markets Risk Outlook.* [97,98]

Fixed income market structure is evolving in a number of ways as market participants adapt to both external and internal drivers, including regulatory requirements, changing market conditions and the need for cost efficiencies. Market participants are embracing technological solutions, and the broader infrastructure is evolving to introduce efficiencies in connectivity and data management amongst internal systems, external vendors, clients and counterparties.[99]

4.2.   Market evolution/ size

(i)   Proliferation of market venues and trading protocols

The first generation of electronic trading of corporate bonds was largely a request for quote (RFQ) process in electronic form which added efficiencies in price discovery and permitted increased automation of record keeping and trade processing. However, innovation has been accelerating in recent years and there has been a significant increase in the number of electronic trading venues.

Market participants are more readily seeking to embrace electronic trading and a variety of alternative protocols have been offered to address various market needs. Established trading protocols are being enhanced and several new protocols are emerging to promote price discovery, including order books with live and executable orders, session based-trading, and platform-determined midpoint pricing. Platforms and technology providers are increasingly focusing on identifying and matching firm orders (rather than quotes) and connecting all market participants (including buy-side to buy-side). "Information Networks" are developing where the emphasis is on identifying pools of liquidity rather than trying to create liquidity.

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[95]   For example, trading algorithms and automation based on artificial intelligence:
http://www.recode.net/2016/8/7/12391180/artificial-intelligence-emma-hedge-fund .

[96]   For example derivatives pricing platforms such as Contineo in Asia: http://contineo.link/ .

[97]   This chapter was developed with inputs from AMCC members, including the International Capital Markets Association (ICMA), the Securities Industry Financial Markets (SIFMA) and the National Futures Association (NFA). It includes contributions by Michael Abramowitz and Jason Milton of the NFA, Liz Callaghan and Sassan Danesh of the ICMA, and Sean Davy of SIFMA.

[98]   See *IOSCO Risk Outlook* for detailed analysis of liquidity in the fixed income markets,
https://www.iosco.org/news/pdf/IOSCONEWS421.pdf .

[99]   This section is based in part on two recent reports from ICMA and SIFMA which describe recent changes in the European and U.S. corporate bond markets, respectively: http://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/Secondary-Markets/survey-report-liquidity-in-the-european-secondary-bond-market-perspectives-from-the-market/ and http://www.sifma.org/research/item.aspx?id=8589958933 .

Figure 9 below lays out the various types of protocols emerging in today's market to meet the varying needs of market participants:

Trading Protocols		
Session Trading	**Matching Session: Real-Time Matching**	
	Facilitates trading of a limited set of CUSIPs over a condensed period of time. Orders are live and executable upon submission and order matching occurs throughout the session, often at a predetermined price set by the platform.	
	Matching Session: End of Session Matching	
	Facilitates trading of a limited set of CUSIPs over a condensed period of time. Submitted orders can be modified by participants prior to the end of the session, at which point they are matched. Matching is based on prioritization across multiple dimensions such as price, size, and time.	
E-RFQ/ Auction	**Electronic Request for Quote ("E-RFQ")**	
	Transition of the traditional RFQs (voice trading) onto an electronic venue, where participants typically broadcast requests to all, or a subset, of the participants on the platform. Responders submit quotes for the initiators consideration, and on some platforms initiators have the option to negotiate.	
	Dutch Auction	
	Facilitates a bid/offer process to buy or sell securities within a set period of time. Bidders have the ability to modify bids prior to the end of the auction, and have visibility of all competing bids. At the auction deadline, the price is lowered until there are enough bids at or above the price to clear the full auction size and then all the bonds are sold at that clearing price.	
Additional Trading Protocols	**Lit Order Book/ Quote Streaming/ Click to Trade ("LOB/ QS/ CtT")**	
	Facilitates matching of buyers and sellers by displaying a variety of order information. This includes, but is not limited to, quote streaming and order books that display some or all participant orders. Information displayed is typically a combination of price, size, partial size, etc. Some protocols give participants the ability to lift orders directly from their screen while others have last looks.	
	Hidden Order Book ("HOB")	
	Facilitates trading that is fully anonymous pre-trade, with limited visibility of the orders/IOIs. These protocols typically include a displayed list of securities for which there is outstanding interest. The display does not include details such as size or direction. These protocols aim to minimize participants' market impact. Participants typically submit orders/IOIs of the full size of the desired trade.	
	Dark Pool	
	Facilitates trading that is fully anonymous pre-trade, with no visibility of the orders/IOIs. These protocols aim to minimize participants' market impact. Participants typically submit orders/IOIs of the full size of the desired trade. Some Dark Pools involve bilateral negotiation between matched counterparties.	

Source: SIFMA and AMCC FinTech TaskForce

(ii) Connectivity

The recent proliferation of electronic trading platforms has created a set of challenges for market participants in identifying which are the best counterparties and platforms to utilize for any given trade. These challenges highlight the importance of addressing connectivity as a market infrastructure issue in order to provide access to appropriate platforms and counterparties, as well as to allow aggregation and search functions across individual liquidity pools.

Almost all platforms that have sell-side participation provide Application Programming Interfaces (APIs) [100] capabilities, but a continually increasing number of client platforms now also provide buy-side APIs. The Financial Information Exchange[101] ("FIX") is the predominant international open standard used to describe financial transaction trading and such structured data is commonly made available via APIs, although some incumbent platforms also offer proprietary APIs using proprietary data standards. We elaborate on this in more detail below.

From screen-based access to API access

Historically, buy-side access to electronic platforms was via proprietary screens supplied by each trading venue. These screens enabled traders to interact with the given market, both for viewing market prices and for entering orders or inquiries. They required relatively little technology investment from market participants but suffer from not being integrated with the trading systems of market participants, and from not allowing aggregation across different platforms. Sell-side market makers, on the other hand, have often had access to APIs that allow connectivity from the market-makers' pricing and trading systems direct into a platform. The first generation of many platform-supplied APIs was aimed at providing direct integration from sell-side trading systems to the platform.

API integration has provided large efficiency gains to the sell-side by allowing integration between the platform and market-makers' internal workflows. This integration has enabled the more technologically sophisticated market-makers to build hub and spoke systems, with a single core pricing and risk engine connecting to and interacting with multiple external platforms, and utilizing a single bank-created screen to control the interaction across all external platforms.

However, many APIs were developed using the proprietary technology of each platform, as no common technology standards existed in fixed income for the standardized creation of such APIs. These proprietary APIs have imposed significant technology costs on the sell-side, as each connection to a platform has required a substantial investment in technical resources to implement the proprietary technology stack. Furthermore, proprietary APIs have hampered integration with the buy-side, given the typically more limited technology resources available to the buy-side.

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[100] In computer programming, an application programming interface (API) is a set of subroutine definitions, protocols and tools for building software and applications. A good API makes it easier to develop a program by providing all the building blocks, which are then put together by the programmer.

[101] http://www.fixtradingcommunity.org/pg/main/what-is-fix .

These restrictions led to a second generation of APIs based on open standards:

1) *Open-Standard API Access*: The development of open APIs in fixed income markets has centred around standards defined by the FIX Trading Community, a non-profit standards body that maintains FIX as an open-source technology specification with a governance structure encompassing many of the leading industry participants across the sell-side, buy-side and vendors. The extension of FIX APIs to fixed income has enabled the sell-side to start to rationalize their connectivity infrastructure by creating a common technology stack for access to electronic markets across multiple asset classes.

2) *Execution Management Systems (EMS)*: EMS are well-established in other, more electronic, asset classes in order to provide workflow integration between external platforms and in-house systems. They enable the buy-side to connect to and interact with multiple platforms and liquidity pools, thus re-aggregating the fragmented sources of liquidity into a holistic virtual market, viewable on a single EMS screen.

Commoditization of connectivity

The fragmented nature of the fixed income market together with increased electronification has raised the importance of seamless integration to multiple platforms in order to allow re-aggregation of liquidity across disparate liquidity pools. While the sell-side has had this capability for some time, the propagation of open standard FIX APIs within fixed income has allowed EMS vendors to provide the same capability to the buy-side.

These developments are moving the industry toward the commoditization of connectivity in fixed income markets, similar to that experienced in other more electronic asset classes. Such commoditization has the potential to offer significant benefits to market participants:

1) *A richer, more diverse ecosystem.* Historically, the buy-side could rely on a few incumbent providers to service most of their needs. However, the proliferation of connectivity based on open standards has the potential to create a more diverse group of data providers, analytics providers, connectivity providers and other tools offered by vendors competing to service the needs of market participants, focusing on specific parts of the value-chain, whilst allowing integration within existing workflows.

2) *A focus on value-added services.* The success or failure of many platforms and vendors today is heavily dependent on their ability to establish a sufficiently large connectivity footprint. The commoditization of connectivity has the potential to change this model drastically, with vendors forced to compete on their unique value-propositions rather than basic connectivity.

(iii)   Increased availability of structured and unstructured market data

Recent innovations related to structured and unstructured data in the corporate bond space have led to a dramatic increase in the availability of such data for market participants. These

innovations have been driven by the proliferation of electronic trading platforms in the fixed income space as well as new regulatory record keeping and reporting requirements that mandate the capture of such data.

The increase in available data, as well as the greater capability to access and process this data, has benefited market participants through improved price discovery, liquidity sourcing, timing and overall transparency in the corporate bond market. However, market participants face challenges in parsing and filtering data streams to differentiate between types of prices received and to attempt to prevent repetitive prices from different sources that could give an inaccurate picture of market depth.

Structured data

The proliferation of electronic trading platforms has been accompanied by an increase in the availability of market data in structured formats. Trading venues often offer market data to assist in pre-trade price discovery. The data is often available via platform proprietary graphical user interfaces (GUI) or accessible programmatically via APIs. Programmatic access to the market data is often made accessible via either a proprietary API and/or a FIX protocol compliant API, as previously discussed.

For market participants, trading venue compliance with the FIX protocol makes the structure of corporate bond market data and messaging more consistent and thereby predictable across venues thereby lowering the cost of integrating with a new platform. The proliferation of trading venues exposing FIX compliant APIs has made access to corporate bond market data and liquidity more available to market participants with a lower technical hurdle to access these venues programmatically.

The availability of programmatic access to consistently represented market data and trading protocols assists market participants in price discovery and sourcing liquidity. Market participants' access to such information has led to unprecedented levels of transparency of pricing information in the corporate bond market and enabled new entrants (electronic market makers) to act as liquidity providers in the space. In the corporate bond space, this data comes from dealer-to-client execution venues such as MarketAxess, Tradeweb, and Bloomberg as well as interdealer execution venues such as ICAP, BGC, and Trad-X. Innovations in structured data exist in both the pre- and post-trade sides.

Unstructured data

In recent years, there have been a number of innovations in filtering, mining, and then interpreting unstructured data. For example, firms such as Green Key Technologies, Symphony, and Bloomberg Vault facilitate storing and transcribing of voice, chat, and email communications. The storage and analysis of this data is critical for both trade reconstruction and to satisfy compliance recordkeeping requirements and other regulatory audit trail requirements. Similarly, a host of vendors has emerged working to satisfy the market abuse monitoring and surveillance program requirements stemming from Market Abuse Regulation

(MAR) investment recommendations currently in development in Europe, including Factset, Ipreo, BDVision, Bluecurve, TIM Group, and Bloomberg's built in functionality RECO.

Data vendors are large processors of unstructured data, interpreting disparate market information ranging from chats and dealer quotes to analyst reports, corporate announcements, and ISDA Determinations Committee Request feeds into actionable data for clients that would not otherwise exist. The most prevalent use of unstructured data by vendors includes the creation of estimated pricing and liquidity ratios or scores, thereby providing greater market transparency for their clients.

Because many corporate bonds do not trade frequently and the corporate bond market is fragmented and market quotes are often unavailable or unclear, the advent of estimated pricing serves to remediate some of these problems. With estimated or suggested pricing, indicative price runs and quotes that are released throughout the trading day by dealers to potential counterparties via chat, email, and voice are consolidated and converted by data vendors such as Bloomberg, Markit, and Interactive Data Corp to develop daily and intra-daily price benchmarks. This is particularly useful for less liquid bond issuances. The same unstructured data points, along with assorted transactional data, can help these same vendors produce degrees of liquidity measurements, translating perceived market quote sizes and other intangible data into liquidity ratings or scores that traders can use as benchmarks for the market depth of contracts they look to trade.

Another recent innovation is social media data aggregation. Technology firms such as FS Wire, Bloomberg Social Velocity, Infinigon ECHO, Tradeslide, and eToro mine and analyse social media messages from platforms such as Twitter, and aggregate these messages into usable data to gauge market sentiment and identify actionable market news. Reference is made in this regard to the section on social media sentiment analysis, research and networking platforms in Chapter 3.

4.3. Benefits/ functionalities

A number of trends can be identified when examining the universe of electronic platforms and the functionality they offer to clients:

(i)   Platforms are enhancing existing trading protocols and introducing innovative new protocols in order to:

1)   *Increase market participation.* New platforms offer All-to-All trading with intermediation on a riskless principal basis through a designated dealer partner or by permitting buy-side participation with sponsored intermediation by a dealer chosen by the participant.

2)   *Identify liquidity opportunities.* Platforms host matching sessions (timed trading sessions with pre-selected securities) to concentrate liquidity. Platforms select which

securities to include in the sessions based on market events and/or direct input from participants.

3) *Enhance price discovery.* Various price discovery aids and mechanisms are being deployed by the platforms to hasten price discovery. Protocols include streaming prices from dealers, and platform provided midpoint pricing for matching sessions. In addition, platforms are increasingly providing access to historical pre- and post-trade data sources, best execution analysis, and transaction cost analysis.

(ii) Platforms are increasingly targeting larger sized trades and are shifting to firm and executable orders

1) *Several platforms have or are launching protocols targeted at round and block sized trading.* Historically, platforms have proven to be more successful in trading smaller order sizes, but are now attempting to facilitate larger trades. Some platforms leverage prices from smaller trades to assist with price discovery for subsequent larger trades. However, dealers are still viewed as the key source of liquidity when immediacy for large trades is desired.

2) *Many platforms now support firm and executable orders.* Common market execution conventions with indicative quotes or dealer last look functionality such as Request-For-Quote (RFQ), Request-For-Stream (RFS), and Click-to-Trade are slowly giving way to firm and executable anonymous order books. However, the firm and executable order type appear to still only account for a limited portion of the total volume.

(iii) Platforms are providing various methods to protect anonymity and prevent information leakage

1) *Dealer sponsored access.* Some platforms require buy-side participants to intermediate trades through a sponsoring dealer. This allows trading on a disclosed basis between the dealers on the platform, while buy-side participants remain anonymous.

2) *Preventing information leakage.* Some platforms protect participants interest/order information by matching two counterparties and disclosing initial negotiation prices only when each counterparty's price is within a defined range or near the platform's calculated price.

3) *Counterparty evaluation tools.* A few platforms are helping participants evaluate counterparties anonymously, by implementing color-coding and/or rating mechanisms, related to participants' historical execution rate or other similar metrics.

4.4. Challenges/ risks

(i)   Macro environment

Major challenges and risks faced by corporate bond Fintech start-ups and incumbent providers of electronic trading systems include current market conditions, the reluctance to or cost impediments to adopt new systems, stressed market conditions, new demand for open-end bond mutual funds, ETFs and index funds, and product diversity.

(ii)   Adoption of new systems

With the adoption of new systems, challenges primarily stem from three factors -- time, functionality and sustainability. Adopting and understanding new technology often takes time and requires some capital or resource investment. Legal and contractual papering can lead to long lead times and participants may look to follow evidence of success rather than commit resources to an unproven solution. New platform systems must navigate the sometimes competing demands of different market constituents as those same constituents are in a state of flux as they adjust role and business models.

It is clearly a challenge to ensure that new system functionality is properly tailored to the electronic corporate bond market. Many entrants provide technology solutions from other markets repurposed for corporate debt, and need to adjust to the nuances of the market. It is often difficult to reengineer consistently the buy-side relationship experience in trade initiation and negotiation, liquidity delivery, price discovery, and firm price quote features - all the while protecting buy-side client anonymity - on new technology platforms. Along this unique order custody chain, difficulties in parsing prices marketed simultaneously on multiple platforms have also emerged, creating the appearance of duplicate orders and misrepresented market liquidity. However, these growing pains are attracting numerous new entrants and creating a vibrant competitive landscape as markets identify the highest value add solutions that garner the broadest participation.

(iii)   Competitive environment

In the face of proliferation, sustainability is a challenge. For example, Deutsche Borse-backed dark pool BondCube failed after only three months in 2015 when more than 500 buy-side to buy-side participant matches yielded only a handful of trades.[102] New trading venues may struggle with the capital and resources needed to withstand the high level of competition and long ramp up time often necessary to gain sufficient market support to build a revenue base. There remains some market concern that the sheer number of corporate bonds available to trade, the lack of a centralized liquidity pool, and many different execution preferences by

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[102]   For more information, refer to
http://www.efinancialnews.com/story/2015-07-23/bondcube-and-the-low-cost-corporate-bond-gamble .

market participants will make it difficult to achieve rapid increases in efficiencies for locating and pricing securities.

To address this, there are a number of current industry initiatives, such as Project Neptune,[103] now Neptune Networks, which initially began in Europe as a means to standardize data and offer cross-platform market pricing representation, and has since expanded to a number of global institutions. EMS are also trying to fill that cross-platform aggregator role. Even buy-side investment management firm AllianceBernstein recently created ALFA, an in-house system that aggregates market information to execute orders on multiple trading platforms, is now looking to roll out to other investors.[104]

Within electronic platform offerings, participants can vary from RFQ quote driven or RFQ/Order book hybrid incumbents, such as MarketAxess, Tradeweb, and Bloomberg, to new pure play electronic order book and dark pool entrants, such as TruMid, Electronifie, OpenBondX, and Liquidnet. In addition, new corporate bond issuance platform Fintech start-ups have sought to innovate the private placement process, maintaining the existing structure but allowing for the participation of more individuals. To accomplish this, companies like Overbond, Symbiont, and Origin are incorporating secure communications, market analytics, and elements of blockchain technology.

(iv)   Transparency

In addition, users of new trading platforms, which create a more transparent market, fear information leakage and market impact of their orders, such as the potential of an order not being filled or filled for an undesirable price.

(v)   Liquidity

When compared to equities, the corporate bond market has low price transparency-discovery and low transaction volume, all of which hamper electronic trading adoption.[105] The proposed platform solutions, many of which originated in the equities market, may not yet be fully transferable and still require further evolution in order to gain transactional market share.

(vi)   Performance during stressed market conditions

How electronic platforms will perform during stressed market conditions, and the potential for wide bid/ask spreads and gaps in liquidity, is another challenge. There are numerous current stress scenarios involving global interest rate policies, high-yield sector debt defaults, sovereign issues, effects of European asset purchase programs, and more. However, the

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[103] http://www.thetradenews.com/Asset-Classes/Fixed-income/JP-Morgan,-Goldman-Sachs-and-Credit-Suisse-join-Neptune-board/ .

[104] http://www.businessinsider.com/a-500-billion-fund-manager-built-2016-6 .

[105] According to a TABB Forum 2015 study, the ratio of liquid to illiquid products is 80/20. In the bond market, the ratio of liquid to illiquid is 30/70. However, due to the nature of the debt/fixed income market, only 11 percent of all securities make up 53 percent of all volume and 57 percent of crossable volume, http://tabbforum.com/ .

diversification of price makers beyond the traditional dealer community should help to support a healthy market across an array of scenarios and circumstances.

(vii)   Product diversity

Product diversity, with the tens of thousands of unique corporate bond issues, coupled with the predominantly buy and hold nature of bond investors is perhaps the most significant challenge in fostering a market structure that provides price transparency and access to liquidity.

4.5.   Regulatory relevance/ responses

Regulators face the challenge of enhancing monitoring as activity shifts to new trading venues and counterparties. Trading platforms offer a variety of services and are structured in ways that lead them to not always fit neatly under the existing regulatory regime. For example, a trading platform may only facilitate an initial matching of parties interested in a transaction, while the execution is completed off the platform.

Regulators can leverage the increase in available data, as well as the greater capability to access and process this data, including through the use of data analysis tools and software to evaluate compliance with regulatory requirements (for example best execution, trade reconstruction). Regulators can also explore leveraging new compliance software and surveillance tools to monitor traders and detect rogue trading or quoting conduct issues. This area may warrant further comparative research of available technologies (often referred to as regulatory technologies or Regtech).

Chapter 5: Distributed Ledger Technologies (DLT)

5.1. Introduction

A distributed ledger is a consensus of replicated, shared, and synchronized digital data geographically spread across multiple sites, countries, and/or institutions. Distributed Ledger Technologies (DLT) are technologies used to implement distributed ledgers.

There is a wide range of DLT. For the purpose of this chapter, and in line with the approach of the financial services industry, we use the term DLT to include blockchain technologies and shared ledgers. As explained below, shared ledgers are quite different from the blockchain concept.

DLT has caught the attention of the financial services industry for a variety of reasons, including the possibility that:

- *Permissioned DLT* present *an opportunity* to save costs if they are used to replace legacy systems and associated back office processes, and
- *Permissionless DLT* could potentially present *a risk* if, for example, they are used to disintermediate financial institutions and central counter-parties.[106]

The growing awareness of DLT is best illustrated by reference to figures published by the World Economic Forum in August 2016:[107]

- Over USD1.4 billion venture capital investments in DLT since 2013;
- More than 2,500 DLT patents filed since 2013, including many by financial institutions;
- More than 24 countries currently investing in DLT;
- More than 90 central banks engaged in DLT discussions;
- More than 90 corporations have joined DLT consortia; and
- 80% of banks are predicted to initiate a DLT project by 2017.

In this introductory section, we believe it is important to set out a series of key foundational concepts that facilitate understanding of the topic.[108]

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[106] Bitcoin is an example of the disintermediation of traditional payment services, while the Ethereum DAO is an example of the disintermediation of venture capital raising. See §5.2(x).

[107] See World Economic Forum, *The future of financial infrastructure - An ambitious look at how blockchain can reshape financial services*, 2016, www3.weforum.org/docs/WEF_The_future_of_financial_infrastructure.pdf .

[108] For more detailed literature see:
U.K. Government Office for Science, *Distributed Ledger Technology: beyond block chain*, 2016, www.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf .
Gareth W. Peters and Efstathios Panayi, *Understanding Modern Banking Ledgers through Blockchain Technologies*, UCL, 2015, www.weusecoins.com/assets/pdf/library/Understanding%20Modern%20Banking%20Ledgers%20through%20Blockchain%20Technologies.pdf .
McKinsey & Co., *Beyond the Hype: Blockchains in Capital Markets*, 2015, www.the-blockchain.com/docs/Blockchains%20in%20Capital%20Markets.pdf .
Goldman Sachs, *Blockchain – Putting Theory in Practice*, 2016, www.the-blockchain.com/docs/Goldman-Sachs-report-Blockchain-Putting-Theory-into-Practice.pdf .
R3CEV, *The Weekend Read Blog* http://r3cev.com/blog/ and the *Research Library,* http://r3members.com/#Library .

(i)   Traditional versus distributed ledgers

A traditional ledger is a centralized database that is accessible by designated users and is overseen by one or more "system notaries" who regulate the access to, and integrity of, the data contained in the ledger. Relational database management systems (RDBMS) commonly used by financial institutions are examples of traditional ledgers. They enable sharing of data across trusted and known entities.

A distributed ledger is a decentralized database accessible and collectively controlled by multiple users. These users are referred to as the "nodes" of the decentralized database network. Users participating in the network as "full nodes" have the ability to enforce all the rules of the decentralized database network. Other users participating in the network as "lightweight nodes" are passive participants in the network.[109] Any update of the data is validated by full nodes who come to an agreement about the state of the ledger through a specific consensus mechanism.

(ii)   Blockchain technology as one type of DLT

A blockchain provides a digitally signed time series of data or records, put together as blocks with the linkage also digitally signed, thereby making it hard to tamper with.

The Bitcoin blockchain is the first, the world's largest and the most widely researched DLT. It uses a highly complex consensus mechanism ("mining" based and referred to as "proof of work" as explained later in this chapter) to validate and authorize new information added to the ledger. The *distributed nature* of the Bitcoin blockchain through the use of blocks and hashes (overcoming the need for a central counterparty or central database), combined with the sophisticated *consensus mechanism* (overcoming the trust problem that characterizes the internet and any networks between unknown, distributed parties) are the most important, and therefore the most researched, innovations brought about by the Bitcoin blockchain.

A research report from Goldman Sachs offers a concise summary, explaining the core concept of how the consensus mechanism functions in a blockchain: [110]

1)   It is a database containing transactions between two or more parties, where the copies of this database are replicated across multiple locations and computers being the nodes.
2)   This database is made of "a chain of blocks", with each block containing data such as details of the transactions - the seller, the buyer, the price, the contract terms and other relevant details.
3)   The transaction detail contained in each block is validated by all nodes in the network via an algorithm called "hashing". The transaction is valid if the result of hashing is confirmed by all nodes.

ECB, *Occasional Paper Series: Distributed ledger technologies in securities post-trading,* 2016, www.ecb.europa.eu/pub/pdf/scpops/ecbop172.en.pdf .

ESMA, *Discussion Paper - The Distributed Ledgers Technology Applied to Securities Markets*, 2015, www.esma.europa.eu/sites/default/files/library/2016-773_dp_dlt.pdf .

[109]   See Bitcoinwiki https://en.bitcoin.it/wiki/Full_node .

[110]   Goldman Sachs, *Blockchain – Putting Theory in Practice*, 2016.

4)   A block is added to the chain of prior transactions only if such is validated.

Figure 10: The following process shows the creation and validation of a block containing the details of a particular transaction. The cryptographic hash function is often employed for assuring integrity of transmitted data such as authentication and encryption.
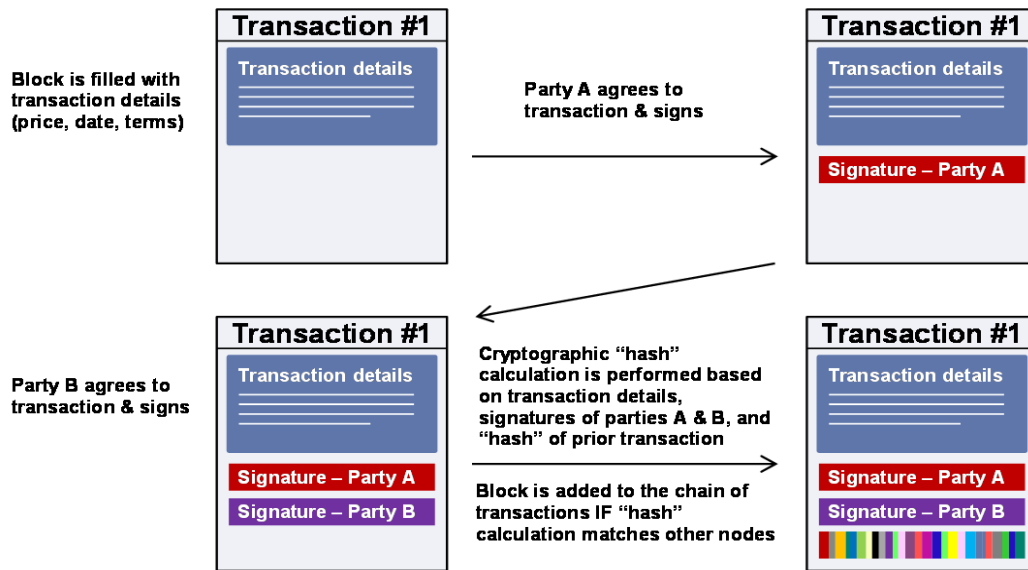
Source: Goldman Sachs Global Investment Research

Figure 11: The blockchain ledger is replicated across multiple locations (a total of six nodes in the example, can be many more) and each maintains its own copy, which is separately updated based on new transaction data. In the first two transactions, data and signature information are properly validated by all six nodes with matching "hash" values. However for Transaction #3 at Location #5, the hash does not match the others, and will be corrected by the others via "consensus."
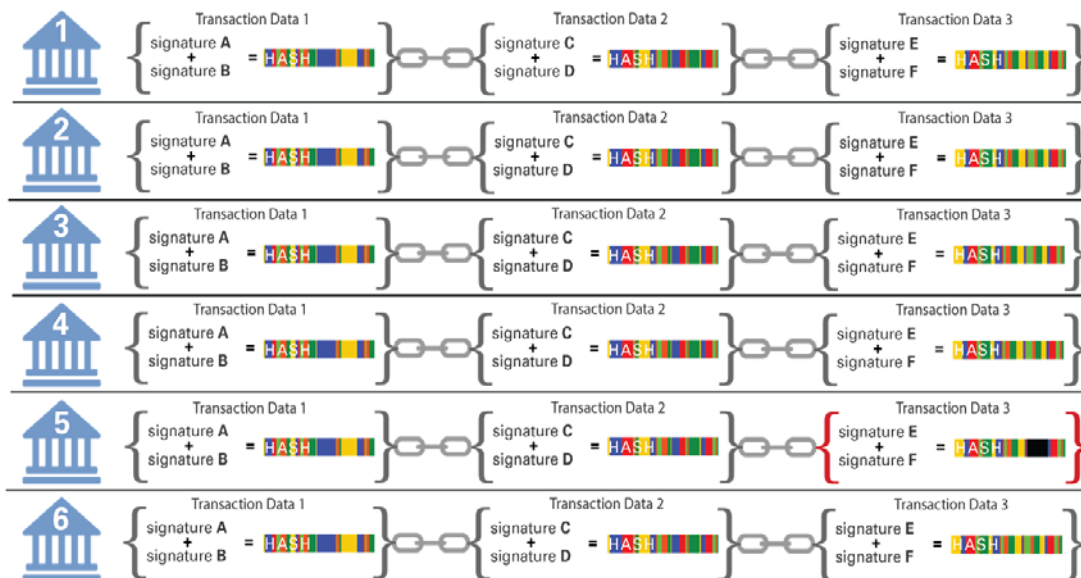
Source: Goldman Sachs Global Investment Research

(iii)   Permissionless versus permissioned DLT

Permissionless DLT, such as the Bitcoin and Ethereum blockchains, are open systems that have no restriction on participation. Participants function as nodes in the network, have the right to access the data in the ledger, to add to the ledger, and to participate in the validation process. Permissionless DLT do not need a central counterparty or trusted participants. Instead, trust is replaced by the mathematical consensus algorithm built in the DLT.

Permissioned DLT, including many of the potential areas of application and "proofs-of-concept" set out in 5.2. below that are being studied by the financial services industry, are privately shared systems between trusted parties that are permitted to access the system. The governing entities in the DLT (including shared ledgers) approve admission of new participants under certain predefined criteria, and specify nodes responsible for the verification process.

As shown in *Figure 12* below, permissioned DLT is not fully decentralized and involves trusted/ permissioned parties. These are fundamentally different from the Bitcoin blockchain, which is a fully decentralized ledger between anonymous parties.

Figure 12: Degrees of centralisation

100% Decentralised	Permissionless, Public, Shared Systems (eg Bitcoin)	Permissioned, Public, Shared Systems	Permissioned, Private, Shared Systems	Today's Typical Systems	100% Centralised

Distributed Ledger Technology Covers a Broad Set of Usages

Centralised Ledgers

Source: Walport, 2016

(iv)   Consensus algorithms

Consensus algorithms are techniques that eliminate the need for trust between the participants in the distributed ledger network. The two most commonly used consensus algorithms are "proof-of-work" (PoW) and "proof-of-stake" (PoS). PoW is intensive in terms of its use of computational power and energy, while PoS is capital intensive, meaning both of them are not free.

Proof-of-work (PoW) is the consensus algorithm that is usually used in permissionless DLT, including the Bitcoin blockchain. The PoW consensus algorithm has a number of "full nodes" in the network that voluntarily validate the data. Incentives, generally a certain form of digital asset, will be given to the node that is the fastest to finish the validation by finding the hash value.

The PoW mechanism has its strengths as it is hard to tamper with. However, it also has a weakness as it requires very high amounts of computational power and energy usage. The larger the permissionless blockchain, the more centralized the network becomes as fewer nodes

have the computational power to verify the transactions. In addition, the latency of processing increases with the number of transactions in each block.

Figure 13 below shows the evolution of the Bitcoin Blockchain capacity from 2013 to 2016:

	August 2014	**August 2015**	**August 2016**
Confirmed Bitcoin Transactions per Day	60,000	120,000	220,000
Average # of Transactions per Block	500	800	1,500
Average Block Size (MB) – Limit 1MB	0.25	0.55	0.80
Median Confirmation Time with Miner Fee (min)	7	8	8.5
Total Transaction Fee (Bitcoin)	12	25	60

Source: https://blockchain.info . Note: these are approximate figures.

Proof of Stake (PoS) is the consensus algorithm that is used in some permissioned DLT. The PoS consensus algorithm requires nodes to tie up (referred to as bonding) a certain amount of digital assets to validate and add new blocks onto the blockchain. The more digital assets are bonded, the higher the probability that a node will validate the block the fastest and get the incentives. Bonded assets are similar to the concept of provision of collateral and drain financial resources.

(v)   Role of tokenization of assets and fiat money

Tokenization is the process of digitally representing an asset or ownership of an asset. A *"token"* represents an asset or ownership of an asset. Such assets can be currencies, commodities, securities or properties.

For DLT to achieve wide adoption in trading and settlement of securities, securities would be "tokenized" and the tokens recognized by law to constitute valid proof of ownership of the securities. Also, fiat money would be tokenized so that it can function as a medium to settle transactions processed on the DLT. As explained in further detail in section 5.4. (iii), an alternative solution currently being experimented with by the industry is the use of "settlement coins" to settle transactions in a permissioned distributed network.

(vi)   Role of smart contracts

Smart contracts are computer programs written on the distributed ledger. These computer programs are pre-written logic[111] stored in, and executed by the nodes in the DLT.[112] Upon the

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[111]   For example, the "if-then-else" conditional statement saying "If X happens, do Y, else do Z."
[112]   While the first generation of blockchains was designed to perform a small set of simple operations – mainly, transactions of a currency-like token – techniques have been developed to allow blockchains to perform more complex operations, defined in full-fledged programming languages. This brings three useful features:
   • The program itself is recorded on the blockchain, giving it permanence and censorship resistance qualities
   • The program can itself control blockchain assets, i.e. by transferring digital assets recorded on the blockchain
   • The program is executed by the blockchain.

execution and verification of the actions triggered by the smart contract, the latest state (outcome) associated with the business activities will be recorded and stored in the block.[113]

Securities market applications of smart contracts that are currently being explored include trading of securities, settlement and clearing, corporate actions, and management of margin positions and collateral.

That said, for smart contracts to take root, legal finality must be clear and the smart contract must be enforceable in law.[114,115] Another challenge is that smart contracts are deterministic by nature and thereby exclude the flexibility and optionality common in physical contractual agreements, necessitating mechanisms that allow the code to be halted or terminated in certain agreed scenarios.[116]

5.2.   Market evolution/ potential areas of application

Notwithstanding the large number of "proofs of concept" that are underway in the financial services industry, including in innovation hubs, accelerators, incubators, consortia and partnerships with start-ups, it remains to be seen whether DLT, and if so which type of DLT, is the right solution for the problems being analysed.

The examples referenced below include the most noteworthy publicly announced proofs of concept. It should be noted that most are permissioned DLT (including shared ledgers).

Permissioned DLT are easier to implement because they are ledgers between known and identified, trusted parties. Furthermore, it is understood that some financial institutions may view them as more suitable for the highly regulated financial services industry: while small transfers and transactions can happen (and are already happening) through the use of permissionless ledgers, the interbank markets and global securities markets involve very large sums of money and cannot function without trust.

Although many of these proofs of concept of permissioned DLT and shared ledgers are "blockchain inspired", as shown in *Figure 12* they differ materially from the original Bitcoin blockchain concept, which is fully decentralized and permissionless. Permissioned DLT and

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[113]   As noted by Antony Lewis, author of Bitsonblocks.net, "if blockchains give us distributed trustworthy storage, then smart contracts give us distributed trustworthy calculations." See Bits on blocks: https://bitsonblocks.net/

[114]   See, for example, a list of legal questions on page 57 of an joint HKMA and ASTRI Whitepaper: http://www.hkma.gov.hk/media/eng/doc/key-functions/finanical-infrastructure/Whitepaper_On_Distributed_Ledger_Technology.pdf .

[115]   See Oxford University blog, *Smart Contracts: Bridging the gap between expectation and reality*, suggesting a "wrapper": "the legal wrapper should incorporate the smart contract code by reference into the contract, but the dumb contract should take priority over the code if there was some conflict between the two", https://www.law.ox.ac.uk/business-law-blog/blog/2016/07/smart-contracts-bridging-gap-between-expectation-and-reality .

[116]   See Oxford University blog, *Smart Contracts: Bridging the gap between expectation and reality*, noting: "There should be a 'fail-safe' in the smart contract code that allows the code to be halted or terminated in certain agreed scenarios by a party to the contract (e.g., by trusted authorities with multi-signatory keys)".
See also http://www.nortonrosefulbright.com/files/smart-contracts-coding-the-fine-print-excerpt-137900.pdf ; and http://f.datasrvr.com/fr1/416/66238/2.pdf .

shared ledgers often constitute an application of the distributed ledger concept to standing business models with the same or similar intermediaries and counter-parties.

Meanwhile, on the other end of the decentralization spectrum (see *Figure 12*), companies such as Ethereum, Ripple, Circle and TransferWise continue to explore a broad range of possible proofs of concept and applications offered by permissionless DLT, including potential areas of application outside the financial services industry, such as movie rights; record keeping of provenance of art, diamonds and other valuables; and private trading of solar energy.

This section highlights noteworthy publicly announced proofs of concepts in the securities industry. The examples are consistent with the thematic findings from the WFE/ AMCC survey.[117]

(i)   Keeping corporate records

In October 2015, NASDAQ unveiled LINQ, a blockchain-enabled platform for managing electronic records of ownership of pre-IPO shares issued by private companies.[118] LINQ is a technology solution enabling private companies to digitally represent a record of share ownership using DLT. It is intended to provide a complete historical record of issuance and transfer of securities and increase auditability.

LINQ is a *permissioned DLT*. In December 2015, Chain.com, a private blockchain development company, in a press release, reported its issuance of shares to a private investor through the Nasdaq LINQ platform.[119]

Certain crowdfunding platforms are similarly exploring the use of blockchain technology for the tracking of ownership of private securities. Combining blockchain technology with the concept of crowdfunding platforms could potentially reduce the costs associated with the underwriting process and the tracking of ownership and corporate actions.

Another example may be on-line retailer, Overstock.com, which stated that, through its financial technology subsidiary T0, it was making a corporate bond offering of USD5M of crypto-bonds in July 2015.[120]

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[117]   The survey showed that "exchanges and post-trade infrastructures are exploring a variety of potential applications including: clearing and settlement (also the area which respondents believe DLT will have the greatest impact on the securities industry); trade matching and confirmation (not in traditional exchange-traded areas but rather in relatively lower volume assets such as fixed income, OTC derivatives, the repo market and the private securities market); corporate actions (voting rights and dividend payments); securities issuance particularly for private issuances; crowdfunding; trade registration; regulatory reporting and transparency; know your client (KYC)/anti-money laundering (AML) registries; trade finance facilities; asset registration facility (such as real estate); and digital assets and associated products." www.world-exchanges.org/home/index.php/files/18/Studies%20-%20Reports/349/WFE%20IOSCO%20AMCC%20DLT%20report.pdf .

[118]   http://ir.nasdaq.com/releasedetail.cfm?releaseid=948326 and http://ir.nasdaq.com/releasedetail.cfm?releaseid=938667 .

[119]   Item.

[120]   Overstock Launches Corporate Bond Billed as World's First Cryptosecurity (Wall Street Journal; June 5, 2016), http://www.wsj.com/articles/overstock-launches-corporate-bond-billed-as-worlds-first-cryptosecurity-1433549038 .
Retail Giant Overstock to Issue its Own Stock on Blockchain Platform (Coindesk; March 16, 2015), http://www.coindesk.com/overstock-blockchain-stock/ .
Overstock's TØ to Issue First Public Blockchain Equities (Bitcoin.com; September 17, 2016).

(ii)   Making corporate actions processes more efficient

A corporate action is an event initiated by a company that affects the investors of the securities it issued. Typical corporate actions include payments of stock dividends or bond coupons, early redemption of debt securities, right issues, stock splits and proxy voting.

The processing of corporate actions requires information exchange among multiple parties such as the issuing companies, investors, intermediaries (custodians or registrars), exchanges and regulatory authorities. Such information exchange usually results in duplicated processes, and in transferring, verifying and updating the same data on multiple databases.

DLT and smart contracts are being experimented with to address these inefficiencies. For example:

- Corporate actions that trigger a change in the value of the securities or in the holdings of investors, such as stock splits, dividend and coupon payments, can be programmed in smart contracts to automate such changes.
- Corporate actions that require decision making, such as proxy voting or an invitation to participate in a right issue, can be processed through DLT.

NASDAQ and the Republic of Estonia that Estonia's e-Residency platform will be facilitating a blockchain-based e-voting service to allow shareholders of companies listed on Nasdaq's Tallinn Stock Exchange, Estonia's only regulated securities market, to vote in shareholder meetings.[121]

Delaware, the state in which most companies in the U.S. are incorporated, also announced a blockchain initiative to automate paperwork-intensive processes, including share registry, capital-table management, and shareholder communications for private companies.[122]

(iii)   Revamping post-trading operations of exchange-traded equities

In January 2016, the ASX and the DLT start-up Digital Asset Holdings announced a project to revamp the clearing and settlement processes of cash equities (CHESS).[123] The goal of the project is to simplify and speed up the post-trading process, which takes two days in the Australia stock market. ASX also included in the announcement it engaged SWIFT to assist with mapping the functionality, technical requirements and business processes of the suite of current CHESS messages to the equivalent ISO 20022 messages during the requirements definition phase of the project.[124]

This project involves a *permissioned DLT* that operates the clearing, settlement and asset servicing cycle. The ability to settle near real-time could result in the reduction of counterparty

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[121]   http://ir.nasdaq.com/releasedetail.cfm?releaseid=954654 .

[122]   http://global.blogs.delaware.gov/2016/06/10/delaware-to-create-distributed-ledger-based-share-ownership-structure-as-part-of-blockchain-initiative/ .

[123]   www.asx.com.au/documents/about/ASX-Selects-Digital-Asset-to-Develop-Distributed-Ledger-Technology-Solutions.pdf ; http://www.asx.com.au/documents/public-consultations/ASX-Consultation-Paper-CHESS-Replacement-19-September-2016.pdf ; https://digitalasset.com/press/asx-selects-digital-asset.html .

[124]   See also https://www.swift.com/insights/press-releases/swift-examines-application-of-financial-business-standards-to-distributed-ledger-technology-and-smart-contracts .

risks in settlement. Operational risks would be lower through data standardization and automation. Compliance and audit costs would also be reduced as a result of the immutability and transparency characteristics of the blockchain database.

(iv)   Trading and settling OTC derivatives

Derivative contracts are financial instruments that derive their value from some underlying assets, such as stocks, bonds, commodities or interest rates. Counterparties to derivative contracts need to manage their cash flows due to the change of contract values and the corresponding margin or collateral positions. Moreover, there are multiple information exchanges between counterparties on a daily basis in relation to valuation and the resulting cash flows over the life of the derivative contract.

By programming OTC derivatives into smart contracts and settling the cash flows on a DLT, the information exchange and cash flows could potentially be streamlined, which could reduce settlement and operational risks.

Barclays was reported to test the usage of blockchain technology and smart contracts to trade derivatives in April 2016. [125] Certain clearing houses such as the DTCC have indicated their studies in this area as well.[126]

(v)   Facilitating loan syndication

The standard life cycle from syndication initiation all the way through due diligence, underwriting, closing and post-sales administration normally takes weeks and involves a high amount of manual processes. Also, there is no common technology platform to record and communicate the information which leads to a lot of duplicated processes.

Smart contracts programmed in a *permissioned DLT* are being tested to reduce operational risks, costs and time incurred in the various processes.

In January 2016, JP Morgan was reported to partner with Digital Asset Holdings to launch a trial blockchain project to facilitate the syndicated loan transactions.[127]

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[125]   http://www.cnbc.com/2016/04/19/barclays-used-blockchain-tech-to-trade-derivatives.html .
[126]   http://www.dtcc.com/news/2016/january/25/new-dtcc-white-paper-calls-for-leveraging-distributed-ledger-technology ;
         http://www.dtcc.com/news/2017/january/09/dtcc-selects-ibm-axoni-and-r3-to-develop-dtccs-distributed-ledger-solution
[127]   www.ft.com/cms/s/0/2d3f9296-c5ef-11e5-b3b1-7b2481276e45.html#axzz4HJQwkme5 .

(vi)   Tracking repo transactions and re-hypothecation

A repurchase agreement (repo) is a method of obtaining short-term financing from financial institutions by pledging securities as collateral. The process of repo transactions involves record keeping of fund flows to the borrower and of collateral positions of the lender. The market practice of re-hypothecation allows the recipient of the collateral to pledge the same collateral from one financial institution to another until reaching the regulatory limit.

Tokenization of collateral and record keeping of repo and subsequent re-hypothecation transactions on DLT could help to increase the transparency of the collateral positions and automate the enforcement of the regulatory limits.

The DTCC and Digital Asset Holdings announced a study of the application of DLT to manage repo transactions.[128] Certain financial regulators have also expressed interest in such a proof-of-concept as it could potentially offer more insight into repo and re-hypothecation (which have been considered by some as a form of "shadow banking").[129]

(vii)   Trading short-term debt

R3, a DLT consortium, led forty financial institutions in early 2016 to explore different blockchain solutions for commercial paper transactions.[130] Commercial paper was chosen as the pilot due to its short lifecycle (commercial paper settles on the same day and typically matures within 270 days).

The goal of the project was to standardize the transaction process with traceable records and to shorten the settlement to hours. The participating financial institutions were tasked to model the transactions by coding smart contracts using different approaches, and to determine which could best enhance the efficiency of issuing, trading, transferring and redeeming commercial paper.

(viii)   Automation of KYC and AML Compliance Processes among Financial Institutions

Client information and transaction history are usually stored in fragmented systems in financial institutions. Achieving know-your-client (KYC) and anti-money-laundering (AML) compliance requires significant manual intervention to acquire, aggregate, and verify information from different sources.

Conceptually *permissioned DLT* can be used to streamline the compliance processes by: (a) sharing client information among financial institutions to reduce duplicative efforts in client onboarding; (b) codifying client accounts to enhance greater transparency in transaction surveillance; and (c) keeping all transaction records on one ledger to simplify surveillance and

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[128]   https://digitalasset.com/static/documents/PRESS_RELEASE_DTCC_Digital_Asset_Repo_POC.pdf .

[129]   http://blogs.wsj.com/moneybeat/2016/06/07/blockchain-technology-gets-a-hearing-inside-the-feds-headquarters/ .

[130]   https://www.r3cev.com/press/2016/3/9/ex3a0t79rq7ddy3cfunvyszl47tbva .

audit procedures.[131] However, issues of personal data privacy would need to be overcome in order to achieve this outcome.

(ix) Individual Digital ID

A number of blockchain start-ups are focused on proofs of concept of Digital ID. The concept consists of creating a record of identity on a blockchain. This record can include not only traditional identity factors such as address, copy of ID and phone numbers, but also biometric records as well as records acknowledged/ verified by third parties such as universities, government authorities, employers and financial institutions.[132]

This concept, while hard to achieve without public/ government involvement, would offer many benefits, including financial inclusion and better KYC controls for financial institutions.[133]

(x) Alternative financing

The Decentralized Anonymous Organization (DAO) is the world's first virtual, fully decentralized venture capital fund. The DAO was launched on the Ethereum blockchain platform in July 2016.[134] It achieved funding of over USD150 million by investors who exchanged Ether (ETH, the virtual currency of Ethereum) for DAO tokens. DAO tokens represent voting and ownership rights of the investors in the virtual venture capital fund. The mission of the DAO is to provide seed capital to start-up projects.[135]

The difference between the DAO and any other private equity or investment fund is the absence of known investment managers. All investment decisions are fully decentralized and are taken by the pseudonymous DAO token-holders through digital voting. The rules of such voting are encoded in the smart contracts that govern the DAO. In other words, coding replaces asset management, establishing a direct link between investors and the implementation of the investment strategy. The DAO invests based on the input of the crowd of its investors.

This technology-enabled new governance structure raised a number of legal questions that are still being actively debated, including but not limited to: (a) what is the legal status of the DAO; (b) which jurisdiction is it subject to; (c) can it legally enter into contracts; and (d) are the

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[131] Goldman Sachs, *Blockchain – Putting Theory in Practice*, 2016. See also Hong Kong SFC: http://www.sfc.hk/web/EN/files/ER/PDF/Speeches/SFC%20Regtech%20and%20Fintech_07112016.pdf .

[132] http://www.sfc.hk/web/EN/files/ER/PDF/Speeches/SFC%20Regtech%20and%20Fintech_07112016.pdf ; http://www.ibtimes.co.uk/consensys-digital-identity-wallet-system-uport-integrates-digix-gold-platform-1541580 .

[133] http://www3.weforum.org/docs/WEF_A_Blueprint_for_Digital_Identity.pdf .

[134] An Ethereum-based distributed autonomous organization (DAO) is a blockchain entity that operates according to a set of pre-defined rules that empowers the members to govern the DAO and to make collective decisions. A DAO is principally created as a vehicle to achieve or maintain a shared purpose, and that will both receive and distribute funds (often in the form of cryptocurrencies or other blockchain-based tokens of value) and control actions designed to help promote or further the purpose of the DAO. The creator of this particular DAO is Slock.it, a blockchain and internet-of-things technology solution company in Germany.

[135] www.coindesk.com/the-law-of-the-dao/?utm_source=CoinDesk+subscribers&utm_campaign=c82b48a412-EMAIL_RSS_CAMPAIGNT2&utm_medium=email&utm_term=0_74abb9e6ab-c82b48a412-79359605 .

contracts valid and enforceable; (e) can it be sued and where. Of all experiments cited above, the DAO is the most novel and the most challenging from a legal and regulatory standpoint.

These questions became even more acute when in June 2016 the DAO was hacked:[136],[137] a hacker used a programming feature in the smart contracts to transfer funds (3.6 million ETH, worth about EUR 41 million at that time) to a "child DAO." The entity claiming to be the hacker maintained that such actions were rightful as they were possible because of coding errors/ weaknesses in the DAO smart contracts.[138]

This example demonstrates the risk of disintermediation of financial services intermediaries that can result from DLT deployment. It also demonstrates the risk of flaws in smart contract coding, as well as questions about the application of the law to smart contracts. See also 5.1 (iv) above.

5.3. Benefits/ opportunities

The benefits of DLT are dependent on the proofs-of-concept which can be difficult to generalize. The list below shows a few of the more frequently cited potential benefits as they apply to financial services.

(i)   Cost reduction in settlement

Various analyses point to the conclusion that a sizable amount of costs can be saved by eliminating inefficiencies in settlement.[139] Savings can include less human intervention and lower regulatory capital charges resulting from the reduction in operational and settlement risks.

(ii)   Faster speed of settlement

One of the benefits of DLT is that it can be used to achieve real time settlement. However, considerations regarding settlement times are likely to vary based on the asset type, the volume of transactions, liquidity requirements, impact on market makers, and the current relative efficiency of a particular segment of the securities market. As a result, the adoption of DLT may not necessarily lead to implementation of real-time settlement, it has the potential to make settlement time more a feature of the actual market needs of the parties instead of being based on operational constraints.[140]

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[136]   Reference to the "Potential DLT Adoption and Use-Cases" section - Disruption of Alternative Financing

[137]   http://www.wired.com/2016/06/50-million-hack-just-showed-dao-human/
https://blog.slock.it/white-hat-siphoning-has-occurred-what-now-f7ba2f8d20ef#.4hp1wro05 .

[138]   http://pastebin.com/CcGUBgDG .

[139]   Santander Innoventures, *The Fintech 2.0 Paper – rebooting financial services*, June 2015, mentioned an annual saving of USD 15 to 20 Bn on global infrastructural costs by 2022.
www.finextra.com/finextra-downloads/newsdocs/the%20fintech%202%200%20paper.pdf;
Goldman Sachs, *Blockchain – Putting Theory into Practice*, May 2016, mentioned an annual saving of USD 11 to 12 Bn on global settlement costs for cash securities.

[140]   See FINRA, *Report on Distributed Ledger Technology: Implications of Blockchain for the Securities Industry*, 2017:
http://www.finra.org/industry/report-distributed-ledger-technology-implications-blockchain-securities-industry .

(iii)   Reliability and traceability of records

Another benefit of DLT is the reliability and traceability of the records. In particular, if a *permissionless DLT* is used, the records are said to be immutable. Any attempt to change a historical record, for example a historical block in a blockchain, requires re-calculation of all of the block hashes that were entered subsequent to that historical record. If a record needs to be amended or cancelled, an offsetting transaction is required, which itself is another fully traceable data entry. If a *permissioned DLT* is used, each data block is signed by the block adder. If a historical record is to be amended, only a defined set of participants in the permissioned distributed ledger can validate and accept such changes. Such amendments are traceable.

(iv)   Automatic and real-time filings to regulators

Many DLT proponents note that one of the benefits of DLT is that regulators can participate as one of the nodes in the DLT, thereby having automated access to all the data. This in turn would allow regulators to have more complete and more traceable, real time records.

(v)   Inclusion of new asset classes

Many DLT experts note that one of the benefits of DLT is that assets that are expensive to source, transact, and deliver such as commodities, energy products, art pieces, real estate, and private equities can be "tokenized" for securitization, which in turn makes them available for trading and as collateral.

(vi)   Efficiency enhancement

DLT can replace multiple centralized ledgers to facilitate information and data flow. The time to validate data in a distributed ledger varies with the structure of the network and the validation mechanism. The settlement of securities using DLT shortens from days to minutes, while payment transfer using the Bitcoin blockchain is done in a matter of seconds or minutes, as opposed to the current correspondent banking service practices which can take 2 to 3 days.

(vii)   Enhancement in security

Security is built into the blockchain through encryption of the blocks and the linkages between the blocks. Furthermore, attacking every node in a blockchain is more difficult with present state technology than to attack a central database.

5.4.   Challenges/ risks

As demonstrated above, a large number of "proofs of concept" are ongoing. Even if such tests are proven to be successful, the implementation of DLT in the securities markets likely may raise various technological, operational, business and regulatory challenges. The challenges/

risks highlighted in more detail below are consistent with the WFE/ AMCC survey of their members.[141,142]

Most experts observe that the technology is still in very early phases and immature, implying that broad-based adoption is still some way away. Also, any DLT applications that place reliance on smart contracts are challenging, because coding of contracts into smart contracts is still very new, and the legal status of smart contracts is still uncertain.

(i)   Technological Challenges

Scalability

Depending on the type of DLT that is used, including the consensus mechanism, scalability is a concern. For example, the Bitcoin blockchain, a permissionless DLT, as demonstrated in *Figure 13* above is facing scalability challenges. The number of transactions it can handle per second is not enough for real time settlement of securities. On the other hand, in a permissioned DLT, scalability is a lesser challenge.

Interoperability

Financial institutions are not likely to aggressively overhaul the existing infrastructures, but instead are more likely to prudently implement changes in parallel with legacy systems. Therefore, protocols for communication between DLT networks and legacy systems are critical. In the absence of such interoperability, coexistence will bear additional costs, in turn reducing the incentives of moving to DLT. For example, in the potential area of application for post-trading settlement, it will be important to ensure interoperability among the systems of all current market participants (brokers, issuers, investors, trading venues and financial market infrastructure operators).

It is also essential for different DLT networks to communicate and operate with each other. Before standardization is achieved, it is highly likely that many DLT networks and applications will run in parallel. Successful protocols for interoperation are yet to be developed. Options such as using escrow or a smart contract to intermediate the transfer of data or digital assets across different DLT networks are being explored.

Cyber Resilience

Encryption offers partial protection against cyber risk. For example, under the PoW used by the Bitcoin blockchain, a malicious node in theory requires more than 50% computational

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[141]   The WFE/AMCC survey respondents related concerns about security, scalability, throughput capacity, and the ability to ensure data privacy as potential impediments to large-scale DLT adoption. One respondent noted however: *"We are undertaking efforts to identify, understand and address known technical constraints. To the extent that we have identified constraints, they have not raised any concerns."* Another was less concerned about technical challenges and more concerned about integration with existing infrastructure and securing requisite 'community-wide' commitment to transitioning to a new solution.

[142]   See also Euroclear and Slaughter and May, *Blockchain Settlement: Regulation, Innovation and Application*, November 2016, https://www.euroclear.com/en/campaigns/Blockchain-settlement-Regulation-innovation-and-application.html .

power in order to control the blockchain and the validation process.[143] Based on the experience of the Bitcoin blockchain network, acquiring this capacity is expensive.

The PoS validation process assigns validation rights according to participants' stake in the network. This validation process is far less expensive than PoW. It shifts the computational cost embedded in the PoW to a method where the validating nodes would suffer a reputational cost or a loss of collateral if they attempt to falsify the ledger.

Rather than attacks on the network, more common issues have involved the theft or loss of private keys. The private keys allow the owners to control their digital assets, and if lost, the owners will lose such control. Private keys have been stolen in various high profile incidents. For example, hackers managed to steal nearly USD500 million worth of Bitcoin from Mt. Gox in 2014 without breaching the Bitcoin blockchain protocol, which eventually led to the collapse of this Bitcoin exchange.[144] In the case of the DAO, noted above, the hacker deployed another method to steal funds: he exploited an error in the code. The entity claiming to be the hacker maintained that his actions were rightful as they were possible because of coding errors/ weaknesses in the DAO smart contracts.[145]

It should be noted for completeness that quantum computers, although still in the experimental phase, in theory, can crack cryptography technologies such as RSA,[146] DSA[147] or all procedures based on ECC[148] using super-computational power. Entities possessing such equipment can, in theory, threaten systems relying on such cryptography technologies and in turn create systemic risks in the global economy.[149] However, DLT is no more vulnerable to this potential future evolution than any other existing central database.

(ii)   Operational challenges

Governance

DLT can reduce operational risk by eliminating duplicated information flows and maintaining a single, immutable source of historically recorded data. However, if an error occurs, it is difficult to reverse or correct.

Furthermore, as noted above under scalability, the operational risk unique to permissionless DLT involves the maintenance and sustainability of the network. The verifying nodes can quit

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[143]   However, according to Eyal and Sirer (2014), it may be sufficient to hold 25% of computational power to validate malicious transactions, http://fc14.ifca.ai/papers/fc14_submission_82.pdf .

[144]   http://www.wired.com/2014/03/bitcoin-exchange/ .

[145]   http://pastebin.com/CcGUBgDG .

[146]   Rivest-Shamir-Adleman (RSA) is one of the first practical public-key cryptosystems and is widely used for secure data transmission. In such a cryptosystem, the encryption key is public and differs from the decryption key which is kept secret, https://en.wikipedia.org/wiki/RSA_(cryptosystem) .

[147]   The Digital Signature Algorithm (DSA) is a Federal Information Processing Standard for digital signatures. Key generation has two phases. The first phase is a choice of algorithm parameters which may be shared between different users of the system, while the second phase computes public and private keys for a single user, https://en.wikipedia.org/wiki/Digital_Signature_Algorithm .

[148]   Elliptic curve cryptography (ECC) is an approach to public-key cryptography based on the algebraic structure of elliptic curves over finite fields, https://en.wikipedia.org/wiki/Elliptic_curve_cryptography .

[149]   In recent years computer scientists and physicists are also developing quantum cryptography to exploit the quantum mechanical properties to perform cryptographic tasks, https://en.wikipedia.org/wiki/Quantum_cryptography .

the network if there are insufficient incentives to validate the transactions or if the computational power required becomes too expensive.

This risk is smaller in a permissioned DLT since the governing body has control over the operation and governance of the network. In a permissioned DLT, in order to reduce the operational risk caused by any of the nodes, the governing body needs to define reasonable common rules and governance arrangements, including management rules, participation criteria and conduct rules.

Smart contracts

Smart contracts in theory reduce human error through automation. However, if an error occurs, it is more difficult to resolve as the operations are linked and embedded in the blockchain, and are self-executing according to the code written in the smart contracts.

Also, smart contracts introduce a different type of human error: coding error. The programming code of the smart contract may not necessarily accurately reflect human intent for the contract and can be a source of operational risk. See also 5.1 (iv) and 5.2 (x) above.

(iii)   Trading and settlement related challenges

The following are some challenges specific to deployment of DLT in securities trading and settlement:

Management of the cash leg of transactions

A securities transaction involves an exchange between the asset and the cash. In order to achieve full Delivery-versus-Payment (DvP) settlement on a distributed ledger network, both the asset leg and the cash leg need to be processed simultaneously. Unless a fiat currency is tokenized, there is a need to operate a separate cash ledger for settlement. This in turn reduces the efficiency of deploying DLT.

An alternative solution currently being tested by the industry is to use "settlement coins" to settle transactions in a permissioned distributed network. Settlement coins are tokens issued by the controlling or designated node(s) to facilitate settlement in the absence of tokenized fiat currencies. The settlement coins are backed by cash deposits made by the issuing node(s) to a trusted third party, such as a custodian bank in the same network. When the participants in the permissioned distributed network need cash, they can redeem their settlement coins with the trusted third party. There are different proofs-of-concept in settlement coins being tested such as the "Citicoin" by Citigroup, "SETLcoin" by Goldman Sachs, and the "Utility Settlement Coin" by UBS with other partners including, BNY Mellon, Deutsche bank, ICAP and Santander.

Recourse mechanism

One of the most important features of DLT is the irrevocability of transactions: once validated and logged in the blockchain, the transactions cannot be modified, cancelled or revoked. Since there does not appear to be a recourse mechanism, the counterparty that entered an erroneous

transaction can modify it only by recording a reverse transaction. The recourse mechanism therefore requires further consideration. See also 5.1 (iv) above.

Position and collateral netting

The current design of DLT records and sends each transaction on a gross basis, without fungibility or netting. This mechanism is at odds with standard practice in securities markets for products, such as derivatives, whose margin and collateral requirements are netted. The absence of netting leads to an increasing requirement for collateral and operating capital. However, efforts are currently underway by financial institutions to achieve netting on DLT.

Transparency

DLT permits some of the transaction details (such as identity of the counterparty, balance of cash and assets and type of assets) to be disclosed on the network for validation purposes. This is also at odds with standard market practices where such details are kept confidential. While efforts are underway to address this problem, adding privacy to the blockchain may defeat some of its other benefits such as transparency.

(iv)   Legal challenges

The implementation of DLT and smart contracts in the securities markets may raise many important legal questions including, but not limited to, the validity of tokens as a representation of ownership and legal finality of smart contracts. See also 5.1 (iv).

(v)   KYC and AML

In permissioned DLT, there is at least one entity in charge that keeps records of all data and participating nodes. It is therefore relatively easy for regulators to keep track of the entities in the network. In permissionless DLT, it may not be possible to know who is operating unless a procedure is established. It is also challenging to designate who can be the supervisor of the permissionless DLT as it is composed of nodes potentially located in different jurisdictions.

Figure 14, below, visualises key considerations, including many of those set out above:

Source: SWIFT

5.5. Regulatory relevance/ responses

(i) Regulatory node

As set out above, DLT proponents note that one of the benefits of DLT is that regulators can participate as one of the nodes in the DLT, thereby having access to all the data. This in turn would allow regulators to have more complete and more traceable, real time records.

Regulators would, however, need to assess whether they want access to extensive real time data or whether standing filings suffice. If the former, and if regulators want to become a node in a DLT, it would require the development of highly automated surveillance function and the hiring of technology experts.

(ii) Regulatory responses to date

While it is still early days, certain authorities have issued views on DLT:[150]

- In June 2016, the European Securities and Markets Authority (ESMA) issued a discussion paper, which includes an analysis of how DLT would (or would not) fit in the existing EU regulatory rulebook (mainly on post-trading issues) in order to draw stakeholders' attention on the key requirements likely to apply to the entities or group of entities willing to use the DLT, depending on the type of securities and related activities that they envisage to undertake.[151]

- In June 2016, the French Parliament voted a law which allows some securities vouchers to be issued and exchanged on a DLT (referred as "securities electronic and distributed recording facility"). It empowers the government to issue a decree to specify how these securities vouchers, as well as how securities that are neither listed on a platform nor admitted to a central securities depository, would be exchanged through DLT. This in turn would result in a regulatory framework for DLT.

- In January 2017, FINRA issued a paper intended to be an initial contribution to an ongoing dialogue about the use of DLT in the securities industry, requesting comments on matters for which it would be appropriate to consider additional guidance, consistent with the principles of investor protection and market integrity, based on DLT applications and their implications for FINRA rules.[152]

In addition, many regulatory authorities are familiarizing themselves with DLT through research, labs, innovation hubs and proof-of-concept projects. Furthermore, international organizations such as the IOSCO, the FSB and the BIS are observing the developments of DLT under their respective objectives.

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[150] In addition, many global regulators have issued circulars on risks entailed in virtual currencies. Certain regulators have issued regulations on Bitcoin such as the Monetary Authority of Singapore. www.mas.gov.sg/~/media/resource/publications/consult_papers/2016/Proposed%20Activity%20Based%20Payments%20Framework%20and%20Establishment%20of%20a%20National%20Payments%20Council.pdf .

[151] www.esma.europa.eu/press-news/esma-news/esma-assesses-usefulness-distributed-ledger-technologies .

[152] FINRA *Report on Distributed Ledger Technology: Implications of Blockchain for the Securities Industry*, January 2017, http://www.finra.org/industry/report-distributed-ledger-technology-implications-blockchain-securities-industry .

Chapter 6: Fintech Developments in Emerging Markets

6.1. Growth and financial inclusion agenda

The potential for Fintech to leapfrog current technology due to the presence of fewer legacy systems, combined with the potential to bring about greater financial inclusion, access to capital and economic growth, have led many emerging markets to place significant emphasis on efforts to spur developments in this area.

The extent of Fintech development across emerging markets differs significantly from country to country, though it is clear that Asia is an area of significant development. The amount of Fintech related investment in the Asia Pacific region has more than quadrupled in 2015 as compared to 2014 to USD4.3 billion; about 45 percent of that amount is attributed to developments in China and 38 percent to India.[153]

6.2. Mobile-based innovation

A trend particularly pronounced in emerging markets is the correlation between mobile-based innovation and Fintech development. Close to half of the respondents to the GEMC survey expect mobile and internet technology to drive the growth of digitalisation and innovation in capital markets. It is expected that smartphone shipments within key emerging markets including India, Indonesia and Russia will see a 200 percent rise between 2014 and 2018.[154] The number of broadband connections in emerging markets will be twice that of developed markets by the end of 2016.[155] The rate of social media penetration is said to be positively correlated with the rise of crowdfunding platforms in a jurisdiction.[156]

The widespread adoption of mobile and internet technology is in turn being driven by a change in demographics in emerging markets with a more technology savvy and connected generation of middle income investors. Investors between the ages of 18 to 34 are more likely to be internet and smartphone users and to participate in social media networks, compared to those aged 35 and older.[157] As the income of this younger generation increases over time, it will further drive the market size for Fintech.

For example, as shown in *Figure 4* (page 11), Chinese technology companies such as Alibaba, Tencent and Baidu are leading mobile-based innovation through financial applications that are challenging traditional incumbents (such as banks) and offering online digital banking, investing and lending services.[158] An example of their rapid growth is reflected in the case of Yu'E Bao. This is a money market fund launched by Alipay that features on the Alipay mobile

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[153]   Accenture, *Fintech Evolving Landscape 2016*.
[154]   http://www.ey.com/Publication/vwLUAssets/EY-riding-the-new-wave/$FILE/EY-riding-the-new-wave.pdf .
[155]   Idem.
[156]   See *Crowdfunding's Potential for the Developing World*. 2013. infoDev, Finance and Private Sector Development Department.
[157]   See Pew Global Research, *Smartphone Ownership and Internet Usage Continues to Climb in Emerging Economies,* 2016.
[158]   http://www.bloomberg.com/news/articles/2015-08-19/wechat-baidu-and-alibaba-help-chinese-embrace-digital-banking.

wallet application and allows a minimum deposit of one yuan. Within one year of its launch, the number of investors on Yu'E Bao grew from 42 to 185 million.[159] It has over 260 million users with the majority under the age of 30.[160]

In Africa, mobile-based innovation has played a critical role in promoting financial inclusion through mobile money accounts and various mobile-based investments. Mobile-based innovation allows for widened retail access to a range of capital market products and services. For example, one of the most successful mobile-based innovation is Kenya's M-PESA, a mobile phone-based platform for money transfer and financial services that has facilitated financing to thousands of small businesses in Kenya[161] and spurred other forms of mobile-based solutions that cater to the needs of the region. Potential investors in Kenya will also be able to purchase retail government bonds through a mobile phone-based trading platform, M-Akiba, that is expected to enhance liquidity which will lead to greater price discovery and deeper secondary markets.[162,163]

In Tanzania, a mobile phone-based system was used for an IPO subscription which led to the doubling of retail investor subscription. The use of mobile trading also increased investor participation on the national exchange by 42.8 percent within the span of four months.[164]

Another example is Zidisha, a non-profit P2P lending platform with a presence in nine emerging markets (Burkina Faso, Ghana, Guinea, Haiti, Indonesia, Kenya, Niger, Senegal and Zambia) that offers lower cost of capital given the absence of bank intermediation. Zidisha provides greater reach to investors and entrepreneurs by partnering with mobile payment companies to disburse loans (M-PESA, MTN Mobile Money and Indosat Dompetku).

6.3. Areas of emerging market Fintech focus

(i) P2P lending and ECF platforms

Within emerging markets, P2P lending and ECF platforms are observed to be the fastest growing Fintech areas. More than half of the GEMC survey respondents indicated a presence of P2P lending and ECF in their respective jurisdictions.

The acceleration of P2P lending and ECF platforms within emerging markets stems largely from their potential ability to address the financing needs of SMEs. The estimated credit gap for the formal SME sector in emerging markets is around USD1.2 trillion while the total credit gap for both formal and informal SMEs is approximately USD2.6 trillion. In particular:

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[159] http://www.alizila.com/ant-financials-money-market-fund-tripled-in-size-last-year-2/ .

[160] http://www.ft.com/cms/s/0/66f85d72-b949-11e5-bf7e-8a339b6f2164.html#axzz4GneE4FPF .

[161] http://www.safaricom.co.ke/mpesa_timeline/timeline.html .

[162] http://www.mygov.go.ke/?p=5052 .

[163] Investors will be able to check statements and receive interest paid directly into their mobile phones. Secondary trading of bonds is expected to take place at the Nairobi Securities Exchange.

[164] https://www.african-markets.com/en/stock-markets/dse/tanzania-dse-s-trading-through-mobile-phone-up-42 .

- Approximately 70 per cent of small enterprises in emerging markets lack access to credit, with Africa and Asia facing the largest financing gaps.[165] More stringent capital requirements implemented following the global financial crisis has led to tighter bank lending conditions; this has made SMEs' access to bank lending more challenging.[166] P2P lending can help close this gap.

- China is home to some of the largest and fastest growing P2P lending platforms globally, including Lu.com (originally known as Lufax), CreditEase, China Rapid Finance and Dianrong. Lu.com has seen significant growth since its launch in 2012, with over 9 million registered users.[167] Similar to some of the larger P2P lending platforms in China, Lufax also offers investors access to a range of investment products and services, such as access to secondary trading and avenues to reinvest mature funds into money-market products. In 2015, the consumer arm of CreditEase, Yirendai, became the first Chinese online P2P lending firm to list on the New York Stock Exchange and raised USD75 million.[168] In aggregate, P2P lending platforms raised more than 400 billion yuan of funds in China as of November 2015, according data of the China Banking Regulatory Commission.[169] See also *Figure 6* (page 12) for estimates from the Cambridge Centre for Alternative Finance and University of Sydney.

- In terms of the need for equity capital, ECF may help to address the need for seed/ early stage capital. For example, Korea has approved thirteen platforms and issuers have raised KRW7 billion through these platforms; Malaysia has approved six platforms through which issuers have raised more than RM4 million in just a few months; and Israel also has several active financing platforms with the largest having raised over USD200 million for over 90 companies since its launch in 2013.

As analysed in more detail in Chapter 2.5, the regulatory environment for P2P lending platforms and ECF varies considerably across emerging markets: in some jurisdictions there is no tailored regulatory framework for ECF or P2P lending, and platform operators need to comply with existing rules and regulations,[170] while other jurisdictions have enacted tailored rules and regulations for P2P lending[171] and ECF.[172]

Examples of these include:

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[165] http://www.worldbank.org/en/topic/financialsector/brief/smes-finance .

[166] IOSCO Growth and Emerging Markets Committee Report, *SME Financing Through Capital Markets*, July 2015

[167] https://www.lu.com/en/Real-time%20data.html .

[168] http://www.wsj.com/articles/yirendai-ipo-could-pave-way-for-more-Fintech-listings-1450435842 .

[169] See the *Peterson Institute for International Economics*, quoting data of www.wdzj.com https://piie.com/blogs/china-economic-watch/p2p-series-part-1-peering-chinas-growing-peer-peer-lending-market .

[170] Abu Dhabi, Argentina, Australia, Brazil, Brunei, Bulgaria, Canada, Chinese Taipei (with respect to P2P), Columbia, Czech Republic, Dominican Republic, Dubai, Hungary, India, Ireland, Mauritius, Mexico, The Netherlands, Romania, Singapore and Turkey.

[171] Malaysia, Russia

[172] Chinese Taipei, France, Israel, Korea, Malaysia, Portugal, Spain, Thailand, United Kingdom, U.S.

- The Securities Commission of Malaysia introduced a regulatory framework for P2P lending in 2016, and in 2015, Malaysia became the first country in ASEAN to introduce a regulatory framework for ECF. Platform operators are regulated as recognised market operators and the framework allows the regulator the flexibility to continuously reassess and redefine the regulatory framework to accommodate the introduction of new products and structures.

- In Korea, ECF platforms are regulated as intermediaries and subject to less stringent licensing rules, and to lower business conduct and prudential regulation compared to existing intermediaries.[173]

- Crowdfunding portals in Kenya can operate on condition that the funds raised must be from outside the jurisdiction and that proceeds be used to promote domestic SMEs.

- In Brazil, it is possible to make a crowdfunding offering through public offering regulations provided the amount does not exceed a specified threshold.

- Other jurisdictions such as Mexico, Argentina, Dubai International Financial Centre, Romania and Turkey are also working on introducing relevant regulations on financing platforms including the types of services allowed and relevant disclosure and conduct requirements.

The above list shows a high divergence of regulatory approaches, likely due to the still nascent nature of these business models and the fact that the full benefits and opportunities, as well as the risks and challenges, are not yet fully known. A continued regulatory dialogue on the evolution of regulation in this area is therefore seen as important.

(ii) Investment platforms

Online fund distribution platforms[174] are also observed to be gaining traction in emerging markets as they offer an easy and convenient access to fund investment.[175] Cross-border regional initiatives such as the ASEAN Collective Investment Schemes (CIS) Framework and Asian Region Funds Passport (ARFP), which facilitate the offering of funds across multiple markets, may further drive the growth of online distribution platforms.[176] Given the speed of innovation and developments of these fund distribution platforms, there is also potential for these platforms to offer other services such as robo-advice.[177]

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[173] Crowdfunding operators are required to register with the Korean FSC with a minimum capital of KRW500 million, whereas existing investment brokers need to be authorized by the FSC with a minimum capital of KRW3 billion.

[174] Examples include Alipay and Taobao in China, Funds Online Korea (Korea), Fundsupermart (operations across both developed and emerging markets including Hong Kong, India, Malaysia and Singapore), WealthMagik (Thailand)

[175] Argentina, Brazil, China, Chinese Taipei, Columbia, Domican Republic, Kenya, Korea, Malaysia, Mexico, Thailand, Turkey.

[176] http://www.pwc.com/gx/en/industries/financial-services/asset-management/publications/asset-management-insights/the-future-of-funds-distribution-in-asia.html .

[177] http://www.ft.com/cms/s/0/8140cdd6-b521-11e4-8362-00144feab7de.html#axzz4G0DHPIhu .

As robo-advisers charge lower fees and often have a lower minimum investment account size than traditional intermediaries, the trend seems to be for robo-advisers to attract younger investors who may have fewer options for traditional investment management.[178,179] The securities regulators in Brazil, Chinese Taipei, Malaysia, Mexico and South Africa are considering the regulation of robo-advisers in their respective markets. We also refer to Chapter 3.5 above for further detail on regulatory responses to this trend.

(iii)   Distributed ledger technologies (DLT)

There are several emerging markets with cryptocurrency platforms operating within their jurisdictions.[180] Cryptocurrency-based transfers also are increasingly common, especially in emerging markets with weak bank infrastructure or with capital controls. For example, companies such as Circle make use of the Bitcoin blockchain for real time transfer of money at lower cost than the traditional transfer channels. Ripple does the same through the use of its own crypto-currency.

Aside from the current use of blockchain for money transfer to and from emerging markets, the underlying distributed ledger technology has received significant attention from both regulators and the financial services industry. Regulators in many emerging markets are studying the potential applicability of this technology within financial markets and the regulatory implications. There is a growing number of financial and technology firms, from both developed and emerging markets, that have joined blockchain consortiums to develop solutions using the applications of the technology in financial markets.[181]

Examples of blockchain developments in emerging markets include:

-       The Korea Exchange announced a collaboration with other market participants, local stakeholders and regulators to develop an OTC trading platforms based on blockchain technology.[182]

-       NASDAQ and the Republic of Estonia have implemented a blockchain-based e-voting service to increase shareholder participation of companies listed on NASDAQ's Tallinn Stock Exchange.[183]

[178]   https://www.accenture.com/_acnmedia/PDF-2/Accenture-Wealth-Management-Rise-of-Robo-Advice.pdf .
[179]   Average age of the investor base at Betterment, which is the largest independent robo-adviser globally with AUM over USD5 billion is 35 years old and about two-thirds of investors are millennials.
[180]   Brazil, Bulgaria, Columbia, Dominican Republic, Israel, Kenya, Mexico, Peru, Portugal, Vietnam
[181]   http://www.coindesk.com/financial-blockchain-shenzhen-consortium-launch/ .
[182]   http://www.coindesk.com/korea-exchange-blockchain-innovation/ .
[183]   http://ir.nasdaq.com/releasedetail.cfm?releaseid=954654 .

Chapter 7: Other Regulatory Considerations

7.1. Implications for the regulatory perimeter

International challenges

While firms can operate globally, regulation is overseen within national or sub-national borders. This may create challenges in terms of regulatory consistency, as well as cross-border supervision and enforcement. It also creates a potential risk of regulatory arbitrage. The global nature of Fintech may therefore contribute to challenges that may be addressed by international cooperation and the exchange of information among regulators.

Regulators have engaged in greater multilateral collaboration on the topic digital innovation at IOSCO, the CPMI, the FSB and the BIS. The present report is an example of such multilateral regulatory communication and information exchange. In addition, regulators continue to enter into bi-lateral memoranda of understanding to collaborate, enabling regulators to share information about financial services innovations in their respective markets, including emerging trends and regulatory considerations.[184]

National challenges

The emergence of new Fintech players that offer innovative financial products and services which sometimes cut across different industries within the wider economy could impact current regulatory perimeters within jurisdictions.

Many jurisdictions have engaged in greater national regulatory coordination. For example, Hong Kong created a cross-regulatory collaboration group established at the level of the Financial Services and Treasury Bureau. Representatives of the Fintech offices of Hong Kong's three regulatory bodies are part of this collaboration group.[185] Similarly, in Japan, a new Working Group of the Financial System Council, which is the advisory body of the Financial Services Agency ("JFSA"), was formed and findings were submitted. As a result, two major legislative amendments (i.e. amendments to the Payment Services Act (PSA) and the Banking Act) will be enacted by June 2017.[186]

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[184] For example:
https://www.fca.org.uk/publication/mou/fca-korean%20fsc-co-operation-agreement.pdf
https://www.fca.org.uk/publication/mou/fca-asic-cooperation-agreement.pdf
https://www.fca.org.uk/publication/mou/fca-monetary-authority-of-singapore-co-operation-agreement.pdf .

[185] The group is the continuation of Hong Kong SAR Steering Group on Fintech, that released its conclusions in January 2016: http://www.fstb.gov.hk/fsb/ppr/report/doc/Fintech_Report_for%20publication_e.pdf .

[186] Under the revised PSA, virtual currency exchange operators will be required to register with the relevant supervisory authorities and comply with various obligations (for example maintenance of books and records, and submission of audited reports to the relevant authorities).

7.2.   Increased regulatory complexity

The rising use of technology in the delivery of financial services may increase the complexity of supervision, surveillance and enforcement. Regulators may face challenges addressing Fintech development while fulfilling their regulatory mandate, such as promoting investor protection, market fairness and financial stability.

Regulators have increased their policy focus, for example by issuing new regulations and guidance on specific Fintech areas (as shown in Chapters 2-5 under the section on "Regulatory relevance/ responses"). Regulators have also increased supervisory focus over new technologies including, for example, algorithmic trading, crowdfunding, P2P lending, financial platforms, use of cloud storage, cyber security, authentication and fraud control.

Looking forward, regulators could, if desired, continue to explore how to best benefit from the trends in Fintech and the closely associated Regtech. For example, regulators may leverage the increase in available data, as well as the potentially greater capability to access and process this data, including through the use of data analysis tools and software to evaluate compliance with regulatory requirements. Regulators also may explore leveraging new compliance software and surveillance tools.

7.3.   Digital onboarding

Jurisdictional differences

Fintech has enabled new distribution and business models for products and services through internet or mobile based interfaces. Emerging from this is the shift towards digital customer onboarding and e-KYC, which can reduce compliance costs and increase accessibility to a broader investor base.

Based on the CER and GEMC joint survey, there are differences in the regulatory approaches towards digital onboarding, heightening the importance for Fintech platforms to be cognizant of and comply with such jurisdictional differences, while also possibly increasing the risk of regulatory arbitrage between jurisdictions.

Non-face-to-face account opening

Based on the CER and GEMC joint survey, over half of the jurisdictions indicated that non-face-to-face customer identification was permitted within their jurisdiction in some manner. Some responses noted that their laws allow for non-face-to-face identification methods only in certain situations where a face-to-face meeting is not possible for the investor, while others recognized that accounts can be opened by telephone, mail, or over the Internet.

Generally, in those jurisdictions where the laws and regulation allow for non-face-to-face customer identification/verification, it is subject to conditions that appropriate anti-money laundering and counter-terrorist-financing (AML/CFT) safeguards (including customer identification and verification, and KYC documentation) are in place.

A number of survey participants indicated that the AML/CFT law allows opening second and further accounts at a credit institution without physical presence of the customer. However, where there were provisions that allow for non-face-to-face account opening, the institution is required to take additional measures to verify or validate the identity of the customer for all first-time accounts.

There is an increasingly wide range of KYC Regtech offerings that may warrant further comparative research.

7.4. Cyber security risks

Automation and cyber risk are closely related

Cyber security and data protection concerns associated with Fintech and increasing internet connectivity have been exacerbated by the frequency and sophistication of cyber-attacks and breaches observed in both developed and emerging markets.[187] These involved interruptions to the operations of platforms, theft of investors' personal details or sensitive financial information and losses to client assets, amongst others. Cyber-attack can undermine investor confidence in Fintech firms and activities.

While cyber risk is common to both developed and emerging markets, emerging markets may be faced with additional risks due to more limited budgets assigned to investment in cyber security protection. Further, the growing role of emerging markets in global supply chains also may increase their risk of being used as a backdoor into larger markets.[188]

Cyber risk preparation

In order to help capital market participants navigate cyber security challenges and raise awareness of cyber security risks, several emerging market regulators such as India and Malaysia have developed or are in the process of developing cyber security frameworks and guidelines.[189]

In order to strengthen regulatory preparedness for a cyber incident, the IOSCO GEM Committee held a regulatory exercise featuring a cyber-attack simulation involving participants across more than 40 jurisdictions. The simulation focused on the role of securities regulators when dealing with cyber-attacks on regulated entities. It provided a platform to raise awareness of the consequences of the evolving cyber-threat and to discuss effective responses.[190]

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[187] IOSCO has also conducted significant work in the area of cyber resilience. See *Cyber Security in Securities Markets – An International Perspective* https://www.iosco.org/library/pubdocs/pdf/IOSCOPD528.pdf and *Guidance on cyber resilience for financial market infrastructures* https://www.iosco.org/news/pdf/IOSCONEWS433.pdf .

[188] https://home.kpmg.com/za/en/home/insights/2015/04/cyber-risks-in-emerging-markets.html .

[189] https://www.sc.com.my/post_archive/sc-releases-guidelines-to-enhance-cyber-resilience-of-the-capital-market/ .

[190] https://www.sc.com.my/post_archive/emerging-market-regulators-reinforce-commitment-to-strengthen-resilience-while-ensuring-fair-and-orderly-markets/ .

7.5.   Investor literacy and investor education

Risks associated with financial illiteracy

Trading and investment in securities through Fintech is more self-directed and a significant segment of investors may be retail-based. In view of this, regulators may consider strengthening financial literacy and investor education.

Some respondents to the December 2015 GEMC survey expressed concern with the extent of investors' assessments and understanding of risks and benefits, particularly in relation to financing platforms that have been experiencing exponential growth and adoption in some emerging markets, while presenting not insignificant investment risks. Some respondents expressed concern that retail investors may be motivated by possible short-term gains, while lacking the ability to evaluate the longer-term viability of the issuer's business models and risks, and while holding unrealistic expectations of the return on investment. This, in turn, may trigger overreaction when faced with market shocks or volatility.

Investor education

Increasing the level of investor education might better equip investors with the necessary tools and skills to navigate the investment process using various types of Fintech.

Given that investors may have different literacy gaps[191] and given that behavioural biases may be accentuated by the use of online tools and platforms, some regulators suggest that education initiatives can be designed according to an "evidence-based approach". Such approach is directed at ascertaining the actual needs of specific target populations.[192] For example, the young generation of investors may have different investment priorities and expectations than previous generations. This includes having greater affinity for technology, shorter-term investment outlook and demanding maximum convenience at lowest available costs, among others.[193] The investor education needs of this generation may be different from that of other generations.

Other related measures

New distribution and marketing channels for Fintech that engage investors through social media platforms and mobile devices may also pose risks to investors making decisions without adequate information.

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[191]   For example, depending on their familiarity with investment decision making, their investment styles, their digital skill and education level.

[192]   See report by members of the Italian Consob on *Financial Investments of Italian Households. Behavioural Attitudes and Approaches - 2016 Survey* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2847539 .

[193]   See for example: http://www.goldmansachs.com/our-thinking/pages/millennials/ and http://www.schroders.com/en/SysGlobalAssets/digital/insights/pdfs/2016/sgis-2016/sgis-investment-outcomes-full-report.pdf .

Most regulators view transparency and disclosure of information as critical to facilitate informed assessment and decision making by investors. For example, some securities regulators require financing platforms to prominently display relevant information relating to the issuers and also to provide communication channels, such as discussion forums and live chat applications that facilitate discussions relating to offerings on the platform.

Also, in order to manage the risk of "too-fast-click-decisions" some regulators may impose specific requirements aimed at slowing down on-line decisions. For example, the Italian Consob Crowdfunding Regulation was designed taking into account an impact assessment and investors' survey. It asks online decision-makers to read some mandatory educative information sheets and to fill in a questionnaire aimed at ascertaining the true understanding of the main characteristics and risks of using automated advice services.

7.6. Staying in step with financial innovation

As innovative start-ups and technology firms may not necessarily be familiar with the financial sector and how their products or services intersect with financial regulation, several regulators have established dedicated Fintech offices, contact points and hubs.[194] Dialogue between regulators and the industry through these dedicated Fintech offices has also helped in bridging potential knowledge gaps.[195] Furthermore, some regulators are exploring the possibility of introducing regulatory sandbox frameworks, under which Fintech companies offering financial services may be granted certain regulatory flexibilities in order to experiment with Fintech solutions in a defined environment within specified timeframes.[196] Other regulators consider that a sandbox may contribute to creating an unlevel playing field across market participants between those innovative firms selected to be part of the sandbox program, and other innovative firms and incumbent players. These regulators are of the view that sound regulation may help firms win the confidence of investors, and may lend credibility to their international development efforts.[197] Finally, some regulators have set up labs and accelerator programmes to explore whether certain new technologies can assist the regulator itself in better achieving its regulatory objectives.[198]

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[194] Including Australia, Abu Dhabi, Botswana, Brazil, Canada, Chinese Taipei, Dubai, France, Hong Kong, India, Japan, Malaysia, Singapore, Saudi Arabia, The Netherlands, Russia, Thailand, U.A.E., U.K.

[195] See, for example: http://www.sfc.hk/web/EN/sfc-fintech-contact-point/ , and http://www.sfc.hk/web/EN/about-the-sfc/events/sfc-regtech-and-fintech-contact-day-2016.html .

[196] Including U.K., Australia, Singapore, Malaysia and Canada. https://letstalkpayments.com/international-fintech-regulatory-sandboxes-launched-by-forward-thinking-financial-authorities/. See also the Hong Kong HKMA: http://www.hkma.gov.hk/media/eng/doc/key-information/guidelines-and-circular/2016/20160906e1.pdf .

[197] See, for example, the French AMF which has created a "Soundbox". *"The AMF is creating a dedicated welcome programme for management firms and FinTech companies based in the UK: AGILITY,"* September 28, 2016: "The AMF's approach to outreach and innovation is based on the idea that complying with the European regulatory framework will help firms win the confidence of retail investors and FinTech backers, and will lend credibility to their international development efforts." http://www.amf-france.org/en_US/Actualites/Communiques-de-presse/AMF/annee-2016.html?docId=workspace%3A%2F%2FSpacesStore%2F3ba641b9-c2f7-48a0-bd2c-6814bab06c88 .

[198] See, for example, the U.K. BOE, http://www.bankofengland.co.uk/Pages/fintech/default.aspx .

CONCLUSION

As this report illustrates, Fintech is truly at the intersection of *finance* and *technology*.

The observation of key trends -- such as the greater availability of data, exponential growth in computing power allowing the analysis of ever larger data sets, broader access to and the decreasing cost of goods and services, increasing disintermediation and re-intermediation, and demographic and generational changes -- all point towards a crossroads of significant technology-driven change in the offering of financial services.

Fintech applications are developing at an increasingly faster pace, creating new opportunities to achieve better outcomes for investors. At the same time, as with any change, new risks and vulnerabilities may arise.

It is clear from the illustrations in this report that, taken together, the changes already underway as a result of Fintech are substantial, in certain cases leading to disintermediation and re-intermediation, and in other cases testing the boundaries of full disintermediation through the use of technology.

We hope this report may be useful to a diverse readership to form a better understanding of the transformation that is already underway, so that each may be prepared for the benefits and opportunities, as well as the risks and challenges this presents.

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