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ABSTRACT

The traditional banking functions of lending, deposit-taking and payment intermediation are being unbundled in the new frontiers of money that extend from virtual currencies to crypto-assets and from shadow payments to quasi-money. The possibility for digital-centred change in the financial industry is illustrated by distributed ledger technology, of which 'blockchain' is the most prominent example of automated decision-making. Other forms of decentralised supply of money, payment services, and funding processes may allow households and businesses to obtain loans and pool risks without having recourse to financial intermediaries. This article examines the alternative provision of access to low-cost zero-friction payments from the perspective of the underbanked. Promoting innovation through alternatives to credit means integrating vulnerable and excluded customers into mainstream financial systems. Blockchain technology backed by a possible modification of the law on the recognition and transfer of property rights might prove instrumental in unlocking the value of the assets possessed by the underbanked or even the unbanked.

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A. Introduction

The digitalisation of payments systems has resulted in a large use of artificial intelligence (AI) applications, e.g. machine learning, neural networks and adaptive algorithms which automate decision-making processes while expediting the delivery of financial services.[1] Technology innovation assists firms' operating systems by supporting both risk assessment and peer comparison. But this can lead to problems. For example, where machine learning embeds manual intervention and the software for the algorithms on which the rules rely is not perfectly designed.[2] The Financial Conduct Authority (FCA) launched sandbox programmes to enhance oversight of prudential and conducts risks of fintech firms and incentivise collaborative dialogue between regulators and regulated firms.[3] This regulatory initiative has been followed by the EU Digital Finance Package,

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[1]Nils J Nilsson, *Principles of Artificial Intelligence* (Morgan Kaufmann Publishers 1980) 2–3.

[2]Joseph Lee, 'Access to Finance for Artificial Intelligence Regulation in the Financial Services Industry' (2020) 21(4) European Business Organization Law Review 731, 738.

which includes an innovative programme, the distributed ledger technology (DLT) Pilot Regime for blockchain services.[4] The EU sandbox aims to establish a harmonised framework in the decision-making process between the DLT market infrastructures, the national competent authorities and European financial regulators.[5] The FCA also launched a regulatory 'scale up box', a second generation of digital sandboxes, to improve transparency in developing fintech products and systems of internal control.[6]

Access to digital technology supports financial inclusion and data sharing, which means banks provide financial services at affordable costs to disadvantaged customers. Whether technology-based forms of payments create the conditions to improve participation in the credit market among minority groups (i.e. individuals with disabilities and mental health issues, ethnic minorities, low-income households) depends on the design of firms' internal data and their operational and management information process.[7] This article examines the alternative provision of access of low-cost zero friction payments from the perspective of the underbanked. Blockchain technology backed by a possible modification of the law on the recognition and transfer of property rights might prove instrumental in unlocking the value of the assets possessed by the unbanked.[8]

The article proceeds as follows. The next section examines the digitalisation of bank business activities along with the digital transformation of payment platforms, and analyses which elements of regulation are potentially most easily automated. It explores whether automation of know-your-customer (KYC) rules and anti-money-laundering (AML) decisions (e.g. automated blocking of unusually large payments) are 'algorithm ready' and presented in a way which would allow automated software-based compliance. This raises the question of interpretation of data to ensure consistency and consensus in the automation process.

Section C considers regulatory technology (regtech) applications in the decision-making process of bank intermediaries and illustrates how they adapt to AI systems for producing information about modelling prudential risk and capital at risk for investors and regulators. Automated systems can incentivise a greater use of principles and judgement in regulation and supervision, even though the need to make the rulebook machine-readable might initially favour a shift away from principles, and towards rigidly applied rules. It also discusses the role of automated supervisory actions and how it will be affected by the use of algorithms to mitigate undesired regulatory outcomes, and whether artificial applications will reduce the role of human judgement in monitoring compliance with principles. Achieving the full benefits of technology in regulatory oversight will therefore require standardised access to institutions' operating systems and the data they contain. The opportunities provided by technology-based products can be used to transform regulatory oversight in ways that will yield far wider benefits than are sometimes envisaged.

[3]FCA, 'Regulatory sandbox' (2 January 2020), https://www.fca.org.uk/firms/regulatory-sandbox; 'The Digital Sandbox Pilot' (23 November 2020), https://www.fca.org.uk/firms/innovation/digital-sandbox.
[4]European Commission, 'Digital Finance Strategy for the EU' COM(2020) 591 final.
[5]Wolf-Georg Ringe and Christopher Ruof, 'Regulating Fintech in the EU: The Case for a Guided Sandbox' (2020) 11(3) European Journal of Risk Regulation 604, 622–23.
[6]Nikhil Rathi, 'Levelling the playing field – innovation in the service of consumers and the market' (20 April 2021), https://www.fca.org.uk/news/speeches/levelling-playing-field-innovation-service-consumers-and-market.
[7]Thomas Philippon, 'On Fintech and Financial Inclusion', NBER Working Paper 26330, http://www.nber.org/papers/w26330.
[8]Emily Lee, 'Financial Inclusion: A Challenge to the New Paradigm of Financial Technology, Regulatory Technology and Anti-Money Laundering Law' (2017) 6 Journal of Business Law 473, 498.

Section D addresses the main issues around the use of digital payments systems for vulnerable consumers and questions about potential discriminatory outcomes of algorithmic machines which can hinder financial inclusion. Using technology to improve the information available to investors and customers allows them to better observe and anticipate business decisions, and therefore ensures that these are desired outcomes, consistent with regulatory principles. The last section sets out some concluding remarks.

B. Digital financial intermediaries

The use of technology in the banking sector generally refers to algorithms in business decision-making both in investment contracts and in the business strategy.[9] Notably, the application of algorithms by financial institutions is used for automated risk assessment. Most algorithms operate within set variables, but self-learning algorithms operate beyond the control of their programmers, which makes the role of traditional mutual forms of traditional financial intermediary (e.g. building societies and credit unions) increasingly virtual rather than face-to-face.[10] Machine learning introduces automated agents such as robo-advisors and chatbots, although it is debatable whether they could ever have the same rights as a natural person.[11]

Regulatory technologies can increase the speed of client on-boarding and reduce risk as a distributed shared ledger acts as an immutable assured audit trail of all KYC processes and the automation of account opening.[12] Digitalisation of lending transactions through automated reading of data can enhance traceability of customers (e.g. verification of a customer's identity) and disclosure of information (e.g. KYC due diligence).[13] This could be particularly useful in the area of anti-money laundering (AML) and could mitigate the cyber risk of crypto assets being used for criminal purposes.[14] AML rules are inherently affected by technological platforms (e.g. data-mining techniques) which shape the regulatory framework into a data-based regime.[15] The EU Fifth Money Laundering Directive (5AMLD) provides for centralised automated mechanisms for bank and payment accounts to protect and verify personal data when carrying out AML investigations.[16] Specifically, the 5AMLD regulates central registries and central electronic data retrieval systems so as to allow timely identification of any natural and legal persons involved in suspicious

[9]Karen Yeung, 'Why Worry about Decision-Making by Machine?' in Karen Yeung and Martin Lodge (eds), *Algorithmic Regulation* (OUP 2019) 24–25.

[10]Andreas Kokkinis and Christian Twigg-Flesner, 'The potential impact of digitisation upon the regulation of financial markets and products' in Daniel Cash and Robert Goddard (eds), *Regulation and the Global Financial Crisis. Impact, Regulatory Responses, and Beyond* (Routledge 2020) 133.

[11]Roger Brownsword, 'Regulating AI and Robotics: The Questions that We Ask and the Questions that We Do Not Ask', keynote speech at the RIMA Workshop, University of York, School of Law, 15 December 2020. See also Belinda Bennett and Angela Daly, 'Recognising rights for robots: Can we? Will we? Should we? (2020) 12 Law, Innovation and Technology 60, 70–71.

[12]Yvonne Lootsma, 'Blockchain as the Newest Regtech Application— the Opportunity to Reduce the Burden of KYC for Financial Institutions' (2017) 36 Banking & Financial Services Policy Report 8, 16–17.

[13]Douglas W Arner and others, 'The Identity Challenge in Finance: From Analogue Identity to Digitized Identification to Digital KYC Utilities' (2019) 20(1) European Business Organization Law Review 55, 57.

[14]Iñaki Aldasoro and others, 'The drivers of cyber risk' (May 2020) BIS Working Papers No 865, https://www.bis.org/publ/work865.pdf.

[15]Dionysios S Demetis, *Technology and Anti-money Laundering: A Systems Theory and Risk-based Approach* (Edward Elgar 2010) 133–34.

[16]Recitals 21–22 in the preamble to Directive (EU) 2018/843 of the European Parliament and of the Council of 30 May 2018 amending Directive (EU) 2015/849 on the prevention of the use of the financial system for the purposes of money laundering or terrorist financing and amending Directives 2009/138/EC and 2013/36/EU.

activities.[17] The digital environment of financial transactions is exposed to cybercrimes, which makes the risk-based approach of AML obsolete and calls in question the need to develop automated regulation.[18] In this context, the use of technological applications can reduce the costs of intermediation by automating the collection, verification and transmission of required information to the regulatory authorities.[19] At the same time, it supports regulatory objectives by improving the accuracy and comparability of information, which would also enhance the ability of supervisors to monitor regulatory compliance.

Technology replaces traditional forms of financial intermediation by digital intermediary channels which aim to include underbanked and vulnerable customers in mainstream credit systems.[20] Access to financial services through sophisticated software has led to the automation of consumer platforms, notably crowdfunding (donation-based, reward-based and equity)[21] and peer-to-peer lending (P2P).[22] As a result, digital payments have reduced the role of intermediaries in evaluating the customer's profile and the suitability of products. Payment systems are closely linked to the broader impact of technology on the financial industry and public services and to wider issues of identity and data infrastructure (Paypal, M-Pesa, AliPay, WeChat Pay).[23] While there is a very large diffusion of data through digital investment schemes (e.g. biometric identification), there is relatively scarce understanding of the policy and practice applied to cyber security.

The growth of the P2P market, mainly driven by crowdfunding platforms, has provided investors with automated access to loan portfolios and created alternative forms of funds for consumers, although policy and regulatory issues arise with respect to potential systemic risk in this new business model.[24] In P2P lending mechanisms, users lend capital to borrowers and investors receive a credit claim to document the principal's commitment without recourse to bank intermediaries.[25] Lenders and borrowers interact across automated investment tools such as artificial machines (LendingRobot) which support the lender's search cost and allow private investors to compete with institutional investors.[26] Automated customer decision-making allocates lenders' funds automatically and assists

[17]See Article 32a of the Fifth Money Laundering Directive 2018/843.

[18]Douglas W Arner, and others, 'FinTech and RegTech. Enabling Innovation While Preserving Financial Stability' (2017) 18 Georgetown Journal of International Affairs 47, 52–53. The problem of cyber-laundering is discussed in Tatiana Tropina, 'Fighting money laundering in the age of online banking, virtual currencies and internet gambling' (2014) 15 ERA Forum 69, 82.

[19]Saul Levmore and Frank Fagan, 'The Impact of Artificial Intelligence on Rules, Standards, and Judicial Discretion' (2019) 93 Southern California Law Review 1, 12.

[20]Holly Powley and Keith Stanton, 'Financial conduct in the UK's banking sector. Regulating to protect vulnerable consumers' in Cătălin-Gabriel Stănescu and Asress Adimi Gikay (eds), *Discrimination, Vulnerable Consumers and Financial Inclusion. Fair Access to Financial Services and the Law* (Routledge 2021) 210–11.

[21]Donation-based, reward-based and equity-based crowdfunding are methods of financing characterised by the motivation of investment of funders and what they expect in return for their money. See Ivo Jenik, Timothy Lyman, and Alessandro Nava, 'Crowdfunding and Financial Inclusion' (March 2017), World Bank CGAP Working Paper, 5, https://www.cgap.org/research/publication/crowdfunding-and-financial-inclusion.

[22]Gareth W. Peters and Efstathios Panayi, 'Understanding Modern Banking Ledgers Through Blockchain Technologies: Future of Transaction Processing and Smart Contracts on the Internet of Money' in Paolo Tasca and others (eds), *Banking Beyond Banks and Money* (Springer International 2016) 239–40.

[23]John Engen, 'Lesson from a Mobile Payments Revolution' (*American Banker*, 29 April 2018), https://www.americanbanker.com/news/why-chinas-mobile-payments-revolution-matters-for-us-bankers.

[24]Vincenzo Bavoso, 'The promise and perils of alternative market-based finance: the case of P2P lending in the UK' (2020) 21(4) Journal of Banking Regulation 395, 401–02.

[25]Rainer Lenz, 'Peer-to-Peer Lending: Opportunities and Risks' (2016) 7 European Journal of Risk Regulation 688, 689–90.

[26]Benjamin Käfer, 'Peer to peer lending: A (financial stability) risk perspective' (2016) MAGKS Joint Discussion Paper Series in Economics, No. 22-2016, 25, http://hdl.handle.net/10419/144687.

investors to design loan portfolios: well-developed P2P platforms (Lending Club, Funding Circle and Prosper)[27] offer automated lending options where a lender can auto-select lending criteria (interest rate, risk profile, market segment).[28] These options improve screening and monitoring services, replacing the chain of intermediation in the assessment of borrowers' creditworthiness and loan requests.[29] This enables the loan application and loan approval processes to be expedited, facilitating timely credit decisions for applicants.[30] Automated lending processes support the human assessment in providing a loan and substantially lower underwriting and compliance costs for lenders; the resulting data can therefore be leveraged to improve their risk management.[31] As a result, software-driven automated decision-making customises the origination and distribution of loans to consumers. However, this is accompanied by the risk of inflating the price of debt securities whilst the lack of transparency and the absence of prudential supervision can affect the quality of the lending market and increase financial instability.[32]

C. Regtech and algorithmic systems

Algorithmic systems expedite the operation of bank intermediaries through sophisticated software which affords the opportunity to analyse legal texts without manual intervention.[33] By employing digital solutions, i.e. a distributed shared ledger, an intermediary can rapidly verify the identity of its clients and assess the potential risks of illegal intentions for the business relationship.[34] Automated decision-making involves information gathering and the communication of prudential risk to investors and regulators, particularly in relation to bank capital rules (e.g. pillar 1 and pillar 2 of Basel II).[35] The use of judgement on the basis of principles rather than mechanical rules is limited in the case of bank capital and applied only for validation of capital models and to capital requirements under pillar 2, reflecting operational and other risks outside the standard categories of market and credit risk (and more recently through adjustments to the conservation buffer of Basel III).[36] Automated systems to calculate risk weights have the potential to make transparent the internal models for credit scoring and loss-absorbency capacity.

Computerised analytical models and centralised standard-setting (e.g. shared data repositories) can create the conditions to aggregate the flows of information and

[27]For an overview of various P2P platforms see Alistair Milne and Paul Parboteeah, 'The Business Models and Economics of Peer-to-Peer Lending' (5 May 2016) ECRI Research Report No 17, https://ssrn.com/abstract=2763682.
[28]Olena Havrylchyk, 'Regulatory framework for the loan-based crowdfunding platforms' (2018) OECD Economics Department Working Papers No. 1513, 13, https://www.oecd-ilibrary.org/content/paper/24ad924a-en.
[29]Kathryn Judge, 'The Future of Direct Finance: The Diverging Paths of Peer-to-Peer Lending and Kickstarter' (2015) 50 Wake Forest Law Review 603, 622–23.
[30]Ding Chen, Anil Savio Kavuri and Alistair Milne, 'Growing Pains: The Changing Regulation of Alternative Lending Platforms' (26 January 2019), 2, https://ssrn.com/abstract=3315738.
[31]W Scott Frame, Larry Wall and Lawrence J White, 'Technological Change and Financial Innovation in Banking: Some Implications for Fintech' (October 2018), Federal Reserve Bank of Atlanta Working Paper 2018-11, 2, https://ssrn.com/abstract=3261732.
[32]Moran Ofir and Ido Sadeh, 'A Revolution in Progress: Regulating P2P Lending Platforms' (17 March 2020), 10, https://ssrn.com/abstract=3530901.
[33]Lawrence Lessing, *Code and Other Laws of Cyberspace* (Basic Books 1999) 43–44.
[34]For an overview, see Kern Alexander, *Principles of Banking Regulation* (CUP 2019) 342.
[35]Douglas W Arner, Janos Barberis and Ross P. Buckey, 'FinTech, RegTech, and the Reconceptualization of Financial Regulation' (2017) 37 Northwestern Journal of International Law & Business 371, 396.
[36]Kenneth A. Bamberger, 'Technologies of Compliance: Risk and Regulation in a Digital Age' (2010) 88 Texas Law Review 669, 731–32.

coordinate more localised regulatory engagements.[37] This centralised approach of risk modelling could redefine the regulatory burden between regulators and banks: advanced predictive analytics can improve the assessment of banks' credit exposure and probability of default.[38] These are applications for AI models which generate predictions with respect to desired outcomes: the decision-making process is based on trained machine learning and underlying computer programmes which give rise to opacity in the data patterns.[39] The development of new data technologies such as blockchain and APIs (Application Programming Interfaces) in the banking industry offers the opportunity, through dialogue between regulators and industry to address this opacity.[40]

Automated methodologies for the modelling and communication of capital at risk are integrated into regulatory frameworks, making the distinction between internal models and standardised approaches meaningless. Automated decision-making could reduce reliance on banks' sources of information about the creditworthiness of borrowers and firms' lending decisions through a shared data platform.[41] This would limit the discretionary review of banks in granting loans while, in parallel, enhancing timely monitoring of risk and the predictability of unexpected losses.

The use of automated methods involves initial cost, risk of error in the system, risk of over-reliance and increased systemic risk if all firms follow similar artificial intelligence solutions that lead to highly homogeneous market behaviour.[42] In this context, recourse to machine learning by bank intermediaries may give rise to certain harms for the credit market. Intelligent systems which make decisions impact humans, and what recourse humans have to take back control when algorithms fail or demonstrate prejudice constitutes a challenge for regulators and policymakers.[43] In such a scenario, most or nearly all financial intermediaries would end up following similar strategies as the algorithms used would be likely to generate herd behaviour effects.[44] Another risk involves the implications of machine disruption for privacy protection and data security. This is evident in the MiFID II algorithmic trading requirements[45] and the widespread industry interest in using a shared third-party for KYC regulations to disclose identity information and hence achieve lower costs of on-boarding.

[37]Cristie Ford, 'Prospects for scalability: Relationships and uncertainty in responsive regulation' (2013) 7 Regulation & Governance 14, 24.

[38]Paolo Siciliani, 'The Disruption of the Prudential Regulatory Framework' (2019) 5 Journal of Financial Regulation 220, 233–34.

[39]W Nicholson Price II and Arti K. Rai, 'Clearing Opacity through Machine Learning' (2021) 106(2) Iowa Law Review 775, 784–86.

[40]The experience of the Open Banking initiative in the UK banking sector shows an innovative collaboration between regulators and regulated entities to improve sharing of data among customers with third parties. On this discussion see Nydia Remolina, 'Open Banking: Regulatory Challenges for a New Form of Financial Intermediation in a Data-Driven World' (2019) SMU Centre for AI & Data Governance Research Paper No. 2019/05, 46–47, https://ssrn.com/abstract=3475019.

[41]Ioannis Anagnostopoulos, 'Fintech and regtech: Impact on regulators and banks' (2018) 100 Journal of Economics and Business 7, 14. For a criticism of the use of machine learning in banks, see Larry D Wall, 'Some financial regulatory implications of artificial intelligence' (2018) 100 Journal of Economics and Business 55, 58.

[42]Tom CW Lin, 'Artificial Intelligence, Finance, and the Law' 88 Fordham Law Review 531, 536.

[43]Kristin Johnson, Frank Pasquale and Jennifer Chapman, 'Artificial Intelligence, Machine Learning, and Bias in Finance: Toward Responsible Innovation' (2019) 88 Fordham Law Review 499, 511.

[44]For the herding effect during the 'Flash Crash' see Christian Borch, 'High-frequency trading, algorithmic finance and the Flash Crash: reflections on eventalization' (2016) 45 Economy and Society 350, 364.

[45]See Article 17 of Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU.

AI models such as deep learning can assist public authorities to expedite the supervisory functions of risk assessment, crisis management and investor protection. For instance, smart contracts and DLT can be used to automate the execution of financial transactions. Code governing a variety of applications could be designed so as to reflect regulatory standards and thus guarantee full compliance.[46] Regtech can support regulators in formulating substantive rules and allow supervisors to assess the impact of a firm's risk models by transferring the underlying data sets into the supervisor's risk model systems.[47]

I. The potential of regtech for firms' operating processes

Regtech is often viewed as a technological response to the vastly increased burden of compliance on financial firms since the global financial crisis.[48] A major part of this increase in regulation has been introduced to enhance the resilience of the financial system, by strengthening prudential rules at the level of both the individual institution and the wider system. There has also been a marked growth in requirements of other forms of regulation, notably conduct of business and also KYC and AML reporting requirements.[49]

The opportunity for making revenues from reducing compliance burdens is an attractive one and has led to a substantial number of regtech start-ups.[50] This is a natural application, with the emergence of new financial technologies running in tandem with the substantial rise in regulatory burden since the crisis.[51] There are however clear limitations to what can be achieved from such automation of compliance. The use of technology in this manner to reduce compliance costs and strengthen supervision can conflict with the exercise of manual or judgmental intervention of regulators, for example in authorisation processes, detection of financial crime, or the identification of mis-selling practices.[52] The technology is often applied to regulatory requirements in the design of financial products in a way that ensures compliance with rules, without the need for human input.[53] In this sense, regtech might be seen as a more 'natural' partner for the rule-based variety of financial regulation, and it is likely that only a relatively small part of the existing

[46]Bart van Liebergen, 'Machine Learning: A Revolution in Risk Management and Compliance?' (2017) 45 Journal of Financial Transformation 60.

[47]Dirk A Zetzsche and others, 'Regulating a Revolution: from Regulatory Sandboxes to Smart Regulation' (2017) 23 Fordham Journal of Corporate & Financial Law 31, 94.

[48]Veerle Colaert, 'Regtech as a Response to Regulatory Expansion in the Financial Sector' (2018) 3 Revue internationale des services financiers/International Journal for Financial Services (RISF) 56.

[49]In the aftermath of the global financial crisis, myriad rules, regulations and guidelines have characterised the KYC and AML framework: the EU Fifth Money Laundering Directive, the FATF principles and MiFID II introduced a greater degree of reporting requirements. See Douglas W Arner, Janos Nathan Barberis and Ross P. Buckley, 'The Emergence of Regtech 2.0: From Know Your Customer to Know Your Data' (2016) 44 Journal of Financial Transformation 79.

[50]A Cambridge Centre for Alternative Finance report Emmanuel Schizas and others, 'The global regtech industry benchmark report' (2019), https://www.jbs.cam.ac.uk/wp-content/uploads/2020/08/2019-12-ccaf-global-regtech-benchmarking-report.pdf, estimates that by early 2019 regtech start-ups worldwide had raised a cumulative $9.7bn of venture capital investment, earned total 2018 revenues of $4.9bn and had 44,000 employees.

[51]Kari Larsen and Shariq Gilani, 'RegTech is the New Black - The Growth of RegTech Demand and Investment' (2017) Journal of Financial Transformation Capco Institute 22.

[52]Mark Carney, 'New Economy, New Finance, New Bank', speech given at The Mansion House, London, 21 June 2018, https://www.bankofengland.co.uk/speech/2018/mark-carney-speech-at-the-lord-mayors-bankers-and-merchants-dinner-mansion-house.

[53]Bank of England and Financial Conduct Authority, 'Machine learning in UK financial services' (October 2019), https://www.bankofengland.co.uk/report/2019/machine-learning-in-uk-financial-services.

financial rulebook can be easily translated into code for use in this manner. Since principles and outcomes remain widely used, this appears to place a fairly substantial limitation on the potential of regtech. It is also conceivable that following on from this, the expanded use of computer code in financial regulation might itself introduce undesirable pressure to shift back to a more command and control-focused regulatory style, raising broader questions about the shift to technology.[54] The potential of regtech is not limited to reduce compliance costs and expedite decision-making processes: it extends to reshape the way customers engage with financial services. Specifically, the regulatory transformations of market infrastructures to include digital identities and blockchain-enabled technologies lead to the use of regtech solutions to foster financial inclusion.[55] Thus, regtech has the potential to support regulators in the supervision of digital payments system in order to maintain financial stability and integrity. In this context, regtech promotes financial inclusion by providing real-time information and data to map financial access and usage to identify gaps in provision.[56] As a result, the employment of regtech to design better financial and regulatory systems to achieve policy objectives facilitates inclusionary services for the underbanked through open access to digital data and wide offer of credit products.[57]

II. The transition to data-driven finance

Modern data technologies have the potential to provide regulatory authorities with near-complete oversight of prudential and conduct risks, both for individual institutions and at the systemic level. One particularly vivid expression of this point of view envisages using technology for the real-time tracking of the global flow of funds.[58] The principal motivation for this broad interpretation of regtech is macroprudential. The global financial crisis strongly reinforced the need for a sufficient degree of system-level oversight to work in addition to the 'microprudential oversight' carried out at the individual-firm level.[59] This suggests a new regime of 'smart' regulation that would harness the transition to data-driven finance in order to allow for something closer to full, real-time oversight, and thereby answer the call of analysts who expressed the desire for such capability in their visions for a safer post-crisis financial system.[60] Hildebrandt argues that smart

[54]On this point, see Katharina Pistor, *The Code of Capital. How the Law Creates Wealth and Inequality* (Princeton University Press 2019) 183–84.

[55]Blockchain-backed regtech supports to create digital identities not only as a regulatory instrument but also to allow market participants to access cross-border financial services. See Soumaya Bhyer and Seyoung Lee, 'Banking the Unbanked and Underbanked: RegTech as an Enabler for Financial Inclusion' in Janos Barberis, Douglas W Arner and Ross P Buckley (eds), *The RegTech Book* (Wiley 2019) 318–19.

[56]Nora Gurung and Leon Perlman, 'Use of Regtech by Central Banks and its Impact on Financial Inclusion' (2018), 46, https://ssrn.com/abstract=3285985. In this context, it is argued that 'the use of regtech to strengthen supervisory capacities of central banks can indirectly impact financial inclusion' (at 50).

[57]Douglas W Arner, and others, 'Sustainability, FinTech and Financial Inclusion' (2020) 21(1) European Business Organization Law Review 7, 16.

[58]Andrew Haldane, 'Managing global finance as a system' (2014) Maxwell Fry Annual Global Finance Lecture at Birmingham University, Bank of England, 9, https://www.bankofengland.co.uk/-/media/boe/files/speech/2014/managing-global-finance-as-a-system.pdf.

[59]Claudio Borio, 'Implementing the macroprudential approach to financial regulation and supervision' in Christopher J Green, Eric J Pentecost and Tom Weyman-Jones (eds), *The Financial Crisis and the Regulation of Finance* (Edward Elgar 2011) 101–02.

[60]Douglas W Arner and others, 'The Future of Data-Driven Finance and RegTech: Lessons from EU Big Bang II' (2020) *25* Stanford Journal of Law, Business & Finance 245, 252.

regulation should identify a code-driven system of cryptographic law capable of taking decisions which affect legal subjects.[61] There are other advocates of this broader interpretation of regtech. Zetzsche and others emphasise the transformative potential of regtech as being where its real 'prize' may lie.[62] Kavassallis and others evidence the potential improvements of risk monitoring where digital standardised documents are made available to all relevant parties, including the supervisory and regulatory authorities.[63] Butler and O'Brien note the transformative potential of such practices for the supervision of the financial system, although greater international harmonisation of regulatory regimes is likely to be required in order fully to harness this wider potential.[64]

A comprehensive market-wide information system in which the regulator sees and responds to every undesired development is not something that is imminently achievable. Rather, the opportunity lies in using technology to improve institutional operations and governance. Technology should be applied to strengthen both management information (making it available, understandable and actionable) and the governance of systems and data within institutions, in order better to achieve both business and regulatory outcomes. This approach to regtech, emphasising its use to facilitate improved data and information availability and hence improve governance and controls, will allow it to be applied to the full range of regulatory operations, not just to the enforcement of reporting and other rules but also to the principle-based approaches that cannot be directly translated into code.

As well as maintaining the present balance in the regulatory regime between rules and principles, this can help avoid other unwanted consequences such as the possibility that increased levels of automated and mechanistic compliance in turn will reduce emphasis on culture and values within financial institutions.[65] This is above all a challenge of governance, for individual firms, for the financial services industry, and for the regulatory authorities. Technology is increasingly central to financial firms, so it is a board responsibility to oversee and ensure effective application of technology in operational and business processes. One challenge is overcoming the divides within firms, between specialists such as those in information technology and data science, and other staff with client facing and operational roles, by 'orchestrating' the adoption of technology so that business understanding and control are maintained. Another challenge is ensuring that senior management and board members have an adequate grasp of both technological opportunities and technological risks.

Achieving the potential of technology requires an unfamiliar degree of co-operation between financial services firms, on data and technology standards, on the sharing of data and on exploring opportunities for shared processing, all pursued with a view to achieving improved long-term outcomes for clients and other stakeholders.[66] This may

[61]Mireille Hildebrandt, 'Algorithmic regulation and the rule of law' (2018) 376 Philosophical Transactions of the Royal Society A, 2, https://doi.org/10.1098/rsta.2017.0355.
[62]Dirk A Zetzsche and others, 'From Fintech to Techfin: The Regulatory Challenges of Data-Driven Finance' (2018) 14(2) New York University Journal of Law & Business 393.
[63]Petros Kavassalis and others, 'An innovative RegTech approach to financial risk monitoring and supervisory reporting' (2018) 19 Journal of Risk Finance 39, 39–40.
[64]Tom Butler and Leona O'Brien, 'Understanding regtech for Digital Regulatory Compliance' in Theo Lynn and others (eds), *Disrupting Finance. FinTech and Strategy in the 21st Century* (Palgrave 2019) 85–86.
[65]Karen Yeung, 'Algorithmic regulation: A critical interrogation' (2018) 12 Regulation & Governance 505, 514–15.
[66]Carolyn Abbot, 'Bridging the Gap – Non-state Actors and the Challenges of Regulating New Technology' (2012) 39 Journal of Law and Society 329, 338.

however meet with resistance from managements that have been routinely focused on short-term profit performance. Regulators have a central role going beyond their traditional mandates of oversight from a distance, intervening only when there is an imminent prudential or conduct threat. They will need to take some responsibility for co-ordinating the technological developments and engaging in ongoing dialogue with regulated firms about the most effective means of employing technology to achieve both business and regulatory outcomes.

D. Financial inclusion and digital payments systems

The use of digital payments platforms has exploited the potential of inclusionary services for market participants while increasing the employment of artificial systems to automate decision-making processes. Promises of financial technologies have been lauded in various quarters as advancing both opportunities for regulatory innovation and transaction costs savings.[67] Technology-based payments have become instrumental in promoting small business lending, access to financial services at fair pricing for customers with disabilities and credit for low-income households. The innovation brought about by M-Pesa in Kenya first and then also in Uganda is often cited as integrating unbanked customers to mainstream financial systems.[68] The possibility for technology-centred change in the financial industry is illustrated, for example, by the case of China which has seen rapid shifts to both mobile payments (Alipay, WeChat Pay) largely displacing notes and coins in urban areas; and to non-bank loan intermediation through the dramatic growth in the Chinese version of P2P lending.[69]

The adoption of automated procedures to support manual decisions embeds sophisticated computational techniques driven by algorithms that elaborate the flow of information received from autonomous predictive models. Despite the positive aspects of digital technologies, a growing debate about the data-gathering and the datasets used to elaborate inputs into computerised programmes raises questions about the accuracy of outcomes for final users.[70] The algorithmic codes formulate a series of statements which might reflect the behaviour and routine habits of consumers. However, algorithms may contain biased methodologies inherent because of human error which are apt to amplify undesirable practices, such as the marginalisation and exclusion of protected customers.[71] Further, algorithms are not objective: they do not provide accurate predictions of desired outcomes because they cannot possess the necessary accurate data. As

[67] Irina Mnohoghitnei and others, 'Embracing the Promise of Fintech' (2019) Q1 Bank of England Quarterly Bulletin, 4–5; Douglas W Arner, Janos Barberis and Ross P Buckley, 'The Evolution of FinTech: A New Post-Crisis Paradigm' (2015) 47(4) Georgetown Journal of International Law 1271; Emilios Avgouleas and Aggelos Kiayias, 'The Promise of Blockchain Technology for Global Securities and Derivatives Markets: The New Financial Ecosystem and the 'Holy Grail' of Systemic Risk Containment' (2019) 20(1) European Business Organization Law Review 81, 102–03.

[68] Njuguna Ndung'u, 'The M-Pesa Technological Revolution for Financial Services in Kenya: A Platform for Financial Inclusion' in David Lee, Kuo Chuen and Robert Deng (eds), *Handbook of Blockchain, Digital Finance, and Inclusion, Volume 1: Cryptocurrency, FinTech, InsurTech, and Regulation* (Elsevier 2018) 37–38.

[69] Kieran Garvey and others, 'Cultivating Growth. The 2nd Asia Pacific Region Alternative Finance Industry Report' (September 2017), 57, https://ssrn.com/abstract=3621288.

[70] Jennifer Graham, 'Risk of discrimination in AI systems. Evaluating the effectiveness of current legal safeguards in tackling algorithmic discrimination' in Alison Lui and Nicholas Ryder (eds), *FinTech, Artificial Intelligence and the Law* (Routledge 2021) 215–16.

[71] Lindsay Sain Jones and Goldburn Maynard Jr., 'Unfulfilled Promises of the FinTech Revolution' (2023) 111 California Law Review, forthcoming.

Sunstein argued, 'algorithms may lack information that human beings have, and for that reason, some human beings might be able to outperform algorithms'.[72] Poor training data and discriminatory proxies taint decision-making systems and exploit consumers' behaviour, although it is debated whether the discrimination is intentional or it is a result of mere defective software.[73] Intelligent machines are trained by gathering data which may not necessarily be representative of all classes of consumers considered by the software so as to provide the full range of services. The training data cannot offer a complete reflection of individuals' profiles simply because it is unlikely to incorporate information about inscrutable factual criteria (e.g. financial condition, sexual orientation, level of disability).[74] The reliance on training data has been questioned in terms of poor disclosure and the opaque methods by which the 'black-box' of predictive judgement design is embedded in the internal models.[75] Machine learning analysis can produce wrong assessments of protected categories which replicate manual decisions and lead to the redlining of applicants belonging to the category of disadvantaged customers. Therefore, the quality of financial services available to vulnerable persons is limited in terms of what is on offer on account of constraints affecting the sources of information and unfamiliarity with the operating procedures of artificial systems.[76]

A range of new applications, often based on the transactions data made available through the experience of Open Banking, offers support for savings and decisions[77], along with programmes making automated investment decisions and robo-advisors proffering investment advice.[78] Technology underpins the growth of comparison sites and their use as an alternative to advice from brokers or the media in making saving and investment decisions and is increasingly used in both passive and active investment vehicles. The massification of data and advent of Open Finance create a new environment of inclusionary services for underserved customers.[79] Automated market making and trade execution maintains the net asset value of exchange traded funds against their benchmark and the index tracking of passive mutual funds. A range of active investment funds are increasingly using machine learning and other technology-based decision making in their portfolio allocations alongside management judgements.[80] In this context, new technology-supported asset classes are emerging, including loan-based crowdfunding and crypto asset-based payment systems, such as the 'Libra' initiative launched by Facebook, which operate as crypto stablecoin in smart contract

[72]Cass R Sunstein, 'The Use of Algorithms in Society' at 9, https://ssrn.com/abstract=4310137.
[73]Jeremias Adams-Prassl, Reuben Binns and Aislinn Kelly-Lyth, 'Directly Discriminatory Algorithms' (2023) 86(1) Modern Law Review 144, 148–49.
[74]Christine Riefa, 'Protecting Vulnerable Consumers in the Digital Single Market' (2022) 33(4) European Business Law Review 607, 612–13.
[75]Kimberly A Houser, 'Can AI Solve the Diversity Problem in the Tech Industry: Mitigating Noise and Bias in Employment Decision-Making' (2019) 22(2) Stanford Technology Law Review 290, 341–43.
[76]Peter Cartwright, 'Understanding and Protecting Vulnerable Financial Consumers' (2015) 38(2) Journal of Consumer Policy 119, 120–21.
[77]Markos Zachariadis and Pinar Ozcan, 'The API Economy and Digital Transformation in Financial Services: The Case of Open Banking' (2017) SWIFT Institute Working Paper No. 2016-001, https://ssrn.com/abstract=2975199.
[78]Tom Baker and Benedict Dellaert, 'Regulating Robo Advice across the Financial Services Industry' (2017) 103(2) Iowa Law Review 713, 728–30.
[79]Francesco De Pascalis, 'The Journey to Open Finance: Learning from the Open Banking Movement' (2022) 33(3) European Business Law Review 397, 401–02.
[80]Reinhard Steennot, 'Robo-advisory services and investor protection' (2021) 3/4 Law and Financial Markets Review forthcoming.

platforms.[81] Cryptoassets have the potential to overcome the current barriers of decentralised blockchain networks but constitute a challenge to policymakers, regulators and stakeholders because of the risk of altering the money market.[82] They operate outside the central banks' arena, bringing an innovative mechanism of lending and free money transfers: this would certainly be a new frontier for cross-border payment systems.[83] In this context, open banking and regtech relate to decentralised provision of financial services which employs technology to provide market participants access and control of the data. As Zetzsche and others argued, 'financial inclusion […] comes from the decentralization of finance enabling the embedding of local compliance standards and customs which tend to reduce costs of access to financial services'.[84] Decentralized Finance (DeFI) has the potential to reduce intermediary costs, increase transparency through blockchain-based records, provide round-the-clock access to financial markets, expedite settlement transactions, and increase financial inclusion by allowing anyone globally with an internet connection to access DeFi platforms.[85] For example, cryptoassets could have significant potential inclusionary services for remittances by foreign workers which are subject to excessive transfer fees and use obsolete technology.[86] Using technology to enable speedy transfer of remittances at nearly zero costs (including as a major innovation FX conversion) in an environment that is safe from external threats can have an appreciable impact on financial inclusion, especially where remittances are an important part of a family's annual income.[87] Through the use of digital ID and other identification techniques it can secure access to the unbanked giving the opportunity to keep the bulk of the remittances in safe storage. Currently, remittances by migrant workers are subject to high transfer fees. Whether a social media company such as Facebook – whose leadership has identified the need for efficiency in cross-border transfers and retail remittances – can improve the lives of migrant workers and the families that those workers support back in their home countries is an open question.[88]

Safe storage of savings emanating from the remittances, once a part of them has gone into consumption, gives poor households and the previously unbanked the possibility to receive stable and predictable returns on savings, which would allow for better planning of the households' consumption and investment needs. Then, the transfer of some of the balances into a savings account would allow the very poor and the unbanked to use some of the funds to buy insurance to cover the impact on earnings of health and other

[81]Libra can rely on a platform of nearly 2.5 billion Facebook users and aims to have reserve backing and regulatory approval. For an overview of the potential of cryptocurrencies see Edmund Schuster, 'Cloud Crypto Land' (2021) 84 (5) Modern Law Review 974, 984–85.

[82]Michael Anderson Schillig, ''Lex Cryptographi(c)a,' 'Cloud Crypto Land' or What? – Blockchain Technology on the Legal Hype Cycle' (2023) 86(1) Modern Law Review 31, 49–50.

[83]Nydia Remolina, 'The Regulatory and Legal Issues of Decentralized Finance' (2023) Singapore Management University School of Law Research Paper, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4243544.

[84]Dirk A Zetzsche, Douglas W Arner and Ross P Buckley, 'Decentralized Finance' (2020) 6(2) Journal of Financial Regulation 172, 184.

[85]Steven L Schwarcz and Robert Bourret, 'Fractionalizing Investment Securities: Using FinTech to Expand Financial Inclusion' (2023) 84(1) Ohio State Law Journal, forthcoming.

[86]Whether a social media company such as Facebook – whose leadership has clearly identified the need for efficiency in cross-border transfers and remittances in particular for individuals and SMEs – can improve the lives of foreign workers and the families that those workers support back in their home countries is an open question. On this discussion, see Kavita Datta, ''Mainstreaming' the 'Alternative'? The Financialization of Transnational Migrant Remittances' in Ron Martin and Jane Pollard (eds), *Handbook on the Geographies of Money and Finance* (Edward Elgar 2017) 539–40.

[87]Marc Pilkington, 'Blockchain Technology: Principles and Applications' in F Xavier Olleros and Majlinda Zhegu (eds), *Research Handbook on Digital Transformations* (Edward Elgar 2016) 225–26.

[88]Kavita Datta, *Migrants and their Money: Surviving Financial Exclusion in London* (The Policy Press 2012) 141–42.

contingencies (e.g. a bad harvest). Moreover, turning part of the remittances into savings in a seamless process constrains consumption for instant gratification and can boost the long-term investment plans of low-income households.[89] Further, carefully planned savings balances may eventually be used for the purpose of human capital development including private investment on education. Finally, cash balances can be used as collateral to enable very poor households and the previously unbanked to acquire capital assets such as machinery, which can boost the productivity and income of a small business. However, a number of issues related to financial stability, privacy considerations and compliance with money laundering and countering the financing of terrorism rules remains a potential stumbling block for DeFI platforms.[90]

Financial services firms are increasingly automating credit and insurance risk assessment, fraud detection, and other financial services processes. There is a shift from more mechanical rules to algorithms that utilise a wide range of data sources ('big data') and software that can update itself and learn from its own performance; this is one definition of artificial intelligence, software that learns from data rather than having all rules pre-programmed.[91] Automated tools are increasingly used in credit scoring and in loan and insurance origination, substantially lowering costs and offering potential improvements in risk measurement and management.[92] These technological innovations prompt questions about oversight and transparency.[93]

Notable episodes of undesired outcomes of algorithmic systems are found in the biased pricing of credit or insurance products, based not on actual risk of loss but other customer characteristics such as age, religion or ethnicity.[94] Discriminatory results of sophisticated algorithms employed to assess the creditworthiness of customers led to evident bias against 'people of colour' in the widely used Fair Isaac Corporation (FICO) credit scoring in the United States, perpetuating a dual credit system.[95] The key question is therefore not whether a new technology is biased or not (all processes contain some bias), but rather ensuring it is adopted in a way that is consistent with desired regulatory outcomes. The adoption of any new technologies should therefore be expected to reduce bias, alongside improvements in process efficiency.[96] This should not only be articulated as a regulatory principle, but also supported by dialogue between regulators and industry; in the case of FICO, it should explore the development of a more sophisticated credit scoring assessment more accurately reflecting default risk, with less bias.[97]

[89]Friederike Rühmann and others, 'Can blockchain technology reduce the cost of remittances?' (April 2020) OECD Development Co-operation Working Papers, No 73, 16–17.

[90]Igor Makarov and Antoinette Schoar, 'Cryptocurrencies and Decentralized Finance (DEFI)' (2022) NBER Working Paper 30006, 27–28, http://www.nber.org/papers/w30006.

[91]Yavar Bathaee, 'The Artificial Intelligence Black Box and the Failure of Intent and Causation' (2018) 31 Harvard Journal of Law & Technology 890, 898–99.

[92]W Scott Frame, Larry Wall and Lawrence J White, 'Technological Change and Financial Innovation in Banking: Some Implications for fintech' (October 2018), Federal Reserve Bank of Atlanta Working Paper 2018-11, 2.

[93]Tal Zarsky, 'The Trouble with Algorithmic Decisions: An Analytic Road Map to Examine Efficiency and Fairness in Automated and Opaque Decision Making' (2016) 41 Science, Technology, & Human Values 118, 122–23.

[94]Tal Z Zarsky, 'Transparent Predictions' (2013) 2013 University of Illinois Law Review 1503, 1549.

[95]Lisa Rice and Deidre Swesnik, 'Discriminatory effects of credit scoring on communities of color' (2013) 46 Suffolk University Law Review 935, 966.

[96]Aaron Klein, 'Reducing bias in AI-based financial services' (2020) AI Governance Series, Brookings Institute, https://www.brookings.edu/research/reducing-bias-in-ai-based-financial-services/. See also Caroline Conway, 'Fico's dominance in US credit scoring under challenge' (*Financial Times*, 22 June 2021), https://www.ft.com/content/046dd89d-7047-4ed4-af31-0e126f59eb00.

[97]Alex Gano, 'Disparate Impact and Mortgage Lending: A Beginner's Guide' (2017) 88 University of Colorado Law Review 1109, 1167. For example, one source of racial bias in FICO is its 30% weight on mortgage and other credit repayment

Another significant example of undesired outcomes of automated decision-making process is found in the UK Post Office scandal, a case of faulty accounting software which caused reporting shortfalls and resulted in postmasters being wrongly convicted as a result of computer errors.[98] The Post Office's sophisticated IT system, the Horizon software, was at the epicentre of false statements about incorrect missing money from branch accounts.[99] Defective data used to feed cloud-based machines produced inaccurate information about the financial profile of employees. Poor management decisions and failures of investigation and disclosure were involved, calling in question the reliability of technology products and a big tech company supplier.[100] This also evidenced a lack of monitoring of the dataset and predictive models, which employed flawed variables elaborated in the software.[101] The transparency and the fairness of the computer methodologies are the crux of the matter for the quality of the output. Trustworthy in mechanical instruments may hide practices that are designed (intentionally or in self-interested unfamiliarity) to perpetuate biased procedures: the experience of the British Post Office revealed an inherent dependency on the vulnerability of automated programmes.[102]

The potential benefits of digital payments system should be weighed carefully against the risks.[103] In the long term, there is scope for AI to be used as a service-provider for network interconnectedness and as a tool to monitor the business conduct of financial institutions.[104] Although machines can be more reliable than humans, new risks can be built into systems. The question arises as to whether the use of AI automatically excludes certain classes of consumers.[105] The risk of discrimination is also associated with the disruption of computer programmes, which cause lack of transparency and unfair practices.[106] Weaknesses in managing and interpreting the amount of data provided by machines constitute a barrier to the application of AI in the financial sector.

history; with no weight on rent repayment history, biasing against renters including many people of colour. An amendment of FICO with a supporting record of rental repayment data, while clearly challenging, would reduce bias.

[98]Nick Wallis, *The Great Post Office Scandal* (Bath Publishing 2021). See also Ian Lloyd, 'Lessons on Robustness and Reliability of Software Solutions from the Horizon System for UK Post Offices' (2022) 23(1) Computer Law Review International at 6–7.

[99]Camilla Cavendish, 'Britain's Post Office scandal claimed hundreds of victims, but what of its villains?' (*Financial Times*, 18 February 2022), https://www.ft.com/content/315f7a16-1549-4558-8520-27621bd9132a.

[100]Jeremy Weinstein, Rob Reich and Mehran Sahami, *System Error: Where Big Tech Went Wrong and How We Can Reboot* (Hachette 2021) ch3.

[101]Rory Cellan-Jones, 'The Great Post Office Scandal — a shameful story of justice denied' (*Financial Times*, 9 December 2021), https://www.ft.com/content/77a3b8cd-26f1-4328-b226-84200fc14808.

[102]Alexander Hicks, 'Transparency, Compliance, And Contestability When Code Is(n't) Law' in NSPW '22: New Security Paradigms Workshop, 24–27 October 2022, New Hampshire, USA, https://arxiv.org/pdf/2205.03925v2.pdf. See also Archie Drake and others, 'Legal contestation of artificial intelligence-related decision-making in the United Kingdom: reflections for policy' (2022) 36(2) International Review of Law, Computers & Technology 251, 271–72.

[103]Cristie Ford, *Innovation and the State: Finance, Regulation, and Justice* (CUP 2017) 152–53. See also Iris HY Chiu, 'A Rational Regulatory Strategy for Governing Financial Innovation' (2017) 8(4) European Journal of Risk Regulation 743.

[104]Marshall W Van Alstyne, Geoffrey G Parker and Sangeet Paul Choudary, 'Pipelines, Platforms, and the New Rules of Strategy' (April 2016) 94 Harvard Business Review at 54–55.

[105]Amit Datta, Michael Carl Tschantz and Anupam Datta, 'Automated Experiments on Ad Privacy Settings. A Tale of Opacity, Choice, and Discrimination' (2015) 1 Proceedings on Privacy Enhancing Technologies 92. See also Izabella Kaminska, 'Algorithmic discrimination' (*Financial Times*, 29 November 2016), https://ftalphaville.ft.com/2016/11/29/2180424/algorithmic-discrimination/.

[106]Matthew U Scherer, 'Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies' (2016) 29 Harvard Journal of Law & Technology 353, 359.

E. Conclusion

The range of digital technologies used in financial services is very broad, including household and small business lending, online and mobile payments, insurance, capital market transactions, wealth management and regulatory reporting and compliance. Likewise, a wide range of digital initiatives seek to promote financial inclusion. With the advent of digital payments systems, lenders have the possibility to access more information in order to assess the credit quality of borrowers and to make decisions on whether (and how much) to lend more quickly. Promoting technological innovation through alternatives to credit means integrating vulnerable and excluded customers into mainstream financial systems.

The use of algorithms and computer systems to coordinate supervisory authorities has become a key component in facilitating the delivery of transactions and improving firm's operational processes, although it can pose risks of undesired biases.[107] In this context, regtech can facilitate compliance processes, while ensuring information disclosure and contractual certainty and predictability of enforcement actions in order to avoid poor outcomes for customers.[108] The 'narrow' interpretation of regtech seeks to automate compliance and hence reduce its costs; while the broad interpretation presents an ambitious vision of comprehensive regulatory oversight that anticipates and prevents undesired outcomes. The central challenge of regtech is not simply 'automated regulation', but rather establishing the appropriate governance of technology in financial services, involving regulators, regulated firms, and technology suppliers.

Regulators employ technology to monitor compliance requirements and prevent suspicious activities (e.g. cybercrime, money laundering, fraudulent transactions). However, the adoption of intelligent machines raises concerns about the appropriateness of supervisory authorities' policies to ensure that making data machine-readable entails accurate control and permissioning for access to and use of data which can reduce regulatory burdens and transaction costs.[109]

An automated decision-making process can enhance the governance of data: it encompasses risk management and minimises reputational risk, legal risk and operational risk.[110] Furthermore, automated procedures can expedite real-time information, particularly with respect to the asset quality of banks' balance sheets (automatic credit scoring) and for compliance with rules on conduct (e.g. mis-selling or rogue trading).[111] Automated practices such as sandboxes experiment with fintech products through natural language processing and cognitive computing in order to secure compliance with regulatory process and supervision.[112]

[107]On this point see an interesting editorial of Gillian Tett, 'Artificial intelligence is reshaping finance' (*Financial Times*, 19 November 2020), https://www.ft.com/content/c7d9a81c-e6a3-4f37-bbfd-71dcefda3739.

[108]Douglas W. Arner, Ross P. Buckley and Janos Barberis, 'A FinTech and RegTech Overview: Where We Have Come From and Where We Are Going' in Arner, Buckley and Barberis (n 5) vi.

[109]Jay P Kesan, Carol M Hayes and Masooda N Bashir, 'Information Privacy and Data Control in Cloud Computing: Consumers, Privacy Preferences, and Market Efficiency' (2013) 70 Washington & Lee Law Review 341, 365. It is argued that 'machine learning is the process of training a computational model to accomplish a task with data'. See also John Nay, 'Natural Language Processing and Machine Learning for Law and Policy Texts' (7 April 2018), https://ssrn.com/abstract=3438276.

[110]Alison Lui and George William Lamb, 'Artificial intelligence and augmented intelligence collaboration: regaining trust and confidence in the financial sector' (2018) 27 Information & Communications Technology Law 267, 268–69.

[111]Christine Lagarde, 'Central Banking and FinTech. A Brave New World' (2018) 12 Innovations: Technology, Governance, Globalization 4, 6.

[112]Hilary J Allen, 'Regulatory Sandboxes' (2019) 87 George Washington Law Review 579, 582–83.

Technological applications in banking services have attracted much attention from stakeholders and regulators, both because of the perception that they should support domestic capacity in what is a nascent and rapidly growing new industry with potential global impact, and because digital technology can address some of the perceived shortcomings of the traditional financial services industry (e.g. lack of consumer protection, weaknesses in governance, gaps in compliance and improved provision to previously underserved regions). The UK Government has launched a Fintech Sector strategy, which includes the formation of a 'Cryptoassets Taskforce' with the aim of positioning the UK at the forefront of harnessing the potential benefits of the underlying technology, while guarding against potential risks.[113] Supervisory authorities are also taking steps to support innovation with a leading role played by 'Project Innovate' and regulatory sandboxes programmes at the FCA, which allow automated machines to reduce the manual intervention of regulators.[114] Banks are adapting to this innovation and technology offers opportunities and risks to payment intermediation.

The alternative provision of payments promotes financial inclusion globally, widening access to banking and insurance services both for vulnerable households and small businesses. However, financial services innovation (cryptographic security, massive data processing, distributed computing, artificial intelligence) and new software solutions for delivering financial services (crowdfunding platforms, cryptocurrencies, blockchain) require constant dialogue between regulators and regulated institutions on the appropriate design of regulation and its technological implementation. This dialogue needs to align itself with the ongoing widespread digital transformation of the operational processes, business organisation and market structure across technology products. The increasing mainstreaming of the cryptoasset industry provides customers access to decentralised forms of finance, particularly in relation to remittances, although it has the potential to alter the global payments system while, in turn, potentially leading to market disruption.

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[113]HM Treasury-Financial Conduct Authority-Bank of England, 'Cryptoassets Taskforce: final report' (October 2018), https://www.gov.uk/government/publications/cryptoassets-taskforce.

[114]FCA, 'The Impact and Effectiveness of Innovate' (April 2019), https://www.fca.org.uk/publications/research/impact-and-effectiveness-innovate.