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«They say things are happening at the border, but nobody knows which border» (Mark Strand)

A Reasoned Approach for the Regulation of Systemic Risk Generated by FinTech: Recognize It

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ABSTRACT: *FinTech companies are particularly vulnerable to adverse shocks, have multiple transmission channels through which such shocks can spread among market players not only FinTech, have significant information asymmetries and their market is growing. In other words, FinTech is subject to systemic risk. All of these elements indicate that FinTech could potentially act as a catalyst for larger losses in the case of extreme events, some of which may be foreseeable and some of which may not. The possibility of such externalities and the related market failures suggest the need to elaborate an adequate regulation to contain the systemic risks generated by FinTech and prevent crisis events from originating in the sector with possible spillover effects on traditional finance and then on the real economy.*

SUMMARY: 1. The systematic dimension of FinTech and the importance of its regulation. – 2. The function of regulatory authorities. The limited value of operational risk. – 3. FinTech as a problem of regulatory policies. – 4. The phenomenon of technological finance and its relevance for financial stability. – 5. The contiguity between financial stability, as a problem of FinTech, and the systemic risk generated. – 6. Some aspects and some limits of digital finance that could generate systemic risks. – 7. The characteristics of the regulation to be considered to manage the systemic risk generated by FinTech.

1. The way in which financial transactions are conducted and the way in which the interaction between participants in virtual financial markets takes place derive from the technological changes that have established themselves up to now, or from those in progress, generated by the endless drive towards innovation that characterizes digital technologies. Technological phenomena – such as artificial intelligence (AI), cloud computing, big data analytics – as well as financial products based on technological tools – such as crypto-assets and smart contracts that reside on distributed ledgers technologies (DLT) – achieve this thrust and give life to what is often perceived as the

FinTech revolution. This is accompanied by the phenomena of digitization and datafication of the social system with challenges on the previous standard categories and activities in financial services.

The phenomenon of technological finance, or of FinTech (to use the best-known abbreviation of the term financial technology) is certainly not new. The current process of consolidation of digital finance platforms, which has been going on for at least twenty years, reflects the changes in economic fundamentals that society experiences today and has opened a further phase of technological finance.

Much earlier, from a technological point of view, but not much earlier, from a temporal point of view, of the last period of FinTech just mentioned (the so-called FinTech 4.0[1]) characterized by the affirmation of BigTechs, digital platforms and sustainable development[2], Finance has long been characterized by a tendency towards scale relationships and institutional and market concentration[3]. The reflection of this widespread approach can be perceived in the causes of the global financial crisis (the Great Financial Crisis, GFC) of 2008 and the consequent regulatory frameworks developed for financial institutions, more generally, and those of systemic importance (systemically important financial institutions, SIFI), as well as the need to regulate companies considered too-big-to-fail (TBTF), or, too-complex-to-govern (TCTG)[4].

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If someone wants to try to understand the existing situation, the current idea of technological finance associated with a process of progressive *digitization* of reality and *datafication* of reality can be explained by the production, collection and processing of data generated by users' access to digital technology, which characterize current society and, more closely, contemporary finance[5]. These phenomena offer enormous potential for economies of scale and network effects[6].

At the same time, this situation entails a growing range of risks for financial stability as well as for sustainable growth and development[7]. The risks are associated with and at the same time derive from the digitization and datafication processes. These risks could be detected even before the (previous) periods of FinTech revolution have been effectively regulated, Even more realistically these problems derive from the ways in which financial regulation shape technological finance[8], or the awareness of the issue is fully understood[9], with adequate identification of the nature of the risks generated by technological finance.

The difference in the analysis that exists between these aspects makes it possible to isolate somehow these phenomena and to direct the observations separately on each of them in order to consider them holistically.

Hence, it seems useful to consider the importance of systemic risk associated with technological finance activities. It tends to coincide with "a risk of disruption in the financial system with the potential to have serious negative consequences for the financial system and the real

economy”[10].

The issue of systemic risk generated by FinTech activity is relevant due to the general impact on financial (and social) stability determined by the activity itself.

Attention to its genesis implies the possibility of delineating it independently with respect, at least in Europe, to the consideration given to “information and communication technology (ICT) and security risks”[11], or to specific risks for cyber security, classified as operational risk.

Together with the possible underestimation of systemic risk[12], there could also be a failure to take on the systemic dimension of the FinTech phenomenon and its progressive overlap with the financial phenomenon itself[13] and a consequent lack of attention to the importance of systemic risk for financial stability.

2. Regulators’ reviews in Europe concern the issue of technological financial activity limited to (banking or non-banking) lending or operational activities of a FinTech firm. Nevertheless, European and non-European regulators consider systemic risk as a perspective determined by the effects of contagion, or rather by connection, albeit in traditional terms, , and not as a constitutive datum of technological finance.[14].

The infrastructures created by technological finance and the activity carried out by FinTech companies generate a set of risks very similar to that generated by banks (or by some of them) and, more in general, by financial companies. However, given their still relatively small scale and widespread activity status, supervisors[15] (for example, the ESRB in Europe or the Financial Stability Oversight Council (FSOC) in the United States) [16], still appear to remain borderline exercise of supervision. In other words, they struggle to attract companies in the sector into their sphere of powers[17].

An alternative could derive from the powers invested by the EBA in matters of systemic risk[18], the profile of effectiveness of the supervision can be achieved to some extent, as is the case for the European Systemic Risk Board.

The objective of this analysis is to detect the scope of systemic risks generated by technological finance activities relevant to financial stability. The idea behind the reasoning is that the limited scope of operational risk (generally associated with the level of provision of technological services to financial activities, in particular related to ICT and cyber-security) can only be considered a causal antecedent of systemic risk. The result is to exclude the autonomous measurement of operational risk and therefore from supervision for financial stability purposes in favor of a broader understanding of the FinTech theme in relation to systemic risk.

3. The aspects mentioned in the previous paragraph affect and are themselves affected by broader problems concerning the regulation of the phenomenon of technological finance. New technology is making transactions faster, cheaper and more convenient for a wider group of the world’s population. Thanks to FinTech, a growing segment of the population can have access to finance to

meet needs that otherwise could not be met. In this sense, readings of FinTech that consider it not only as a (technological) upheaval of the financial market, but also as a force for social progress to be endorsed[19].

From a broader systemic perspective, FinTech emerges as a very complex phenomenon and, given its self-sufficiency with respect to traditional finance, autonomous for the purposes of its regulation. In this way, FinTech is a problem that is delicately dealt with by regulators and politicians who have the burden of regulating it.

There are not only technical problems ahead. The rise of FinTech is starting to distress the balance between public and private powers in relation to the direction and management of the financial resources of the whole society[20]. If it is true that new technologies can make financial services more efficient and widely accessible, it does not seem difficult to demonstrate that they can increase the dynamics currently recognized as dysfunctional in the system of excessive credit and money generation and, therefore, of speculative misallocation[21]. This confirms that the most advanced technology always remains just a tool and that the use, the purposes, the effects, are a political choice[22].

The need therefore emerges to consider what consequences FinTech choices entail and the ways in which regulatory activity can be made operational and translated into political decisions.

New financial technologies inevitably raise a number of complex questions about the appropriate methods to regulate them. Questions even concern the need to regulate them. The debate on whether to regulate FinTech, on how to adapt old regulatory regimes or devise new regulatory regimes suitable for FinTech product infrastructures involves academics, finance professionals, technologists and policy makers[23]. Central banks and other public bodies are investigating the real-world implementation of specific FinTech applications and their potential impact on global and national economies[24].

Alongside reporting, which has a very high value for understanding the phenomenon, there is a growing interest in legal and economic research for FinTech and its overall legal and regulatory implications. [25]. In particular, the legal contribution to the knowledge of the phenomenon determines a reconceptualization of legal concepts in financial law, or requires new concepts, to remodel, or to model, the rules governing specific types of market interaction.

Despite the growing interest in FinTech, however, the ability of regulators and scholars to fully grasp the potential possessed by the new technology to change the way the financial system operates and therefore how it should be regulated is limited. The urgency of bridging the various gaps that may arise in the legal systems is confronted with the political limits that often cannot understand, even only in terms of the extension of the jurisdiction, the systemic limits posed by the theme of the diffusion of new technologies in finance[26].

The problem of regulating this is quite relevant. It is argued that the dominant model of financial regulation is inherently limited in its ability to respond to the systemic challenges posed by FinTech. The existing regulatory model can be found mainly in the philosophy and functional

methods that do not allow for regulatory leaps capable of adapting to the current conformation of the problem. Even the structural subdivision along the lines that concern the type of product/entity does not allow for an adequate composition of supervision[27].

4. Even if there is a risk of underestimating some aspects, we can try to indicate the FinTech phenomenon starting from the identification of a process that takes place on a global scale characterized by the digitization of combined finance, in a progressively more intense, to the 'datafication' of society and the use of new technologies. This phenomenon develops over a long period which, going back in time, dates back to the last fifty years.

Finance has therefore undergone a transformation process that makes it the most globalized segment of the world economy and among those with the greatest digitization and with the greatest production and processing of data.

A greater level of specification of the factors involved in tech finance can come from the widely accepted definition of the Financial Stability Board (FSB), which considers FinTech as «technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services»[28].

The elements that can be deduced from the FSB definition concern: i) technological innovation; ii) its use to identify the business activity; and iii) the offer of services. It therefore seems that a double function is attributed to technological innovation: the formation of the market infrastructure and the production of the services dealt with in the market.

With some approximation, going to the heart of the topic, it can be said that the phenomenon of FinTech corresponds to the use of technology to provide financial services that are new in concept and use or have improved performance and diffusion capacity[29].

When we go to motivate the emergence of the phenomenon, we note that while information technology has made a lot of things and services functional and more economical, the unit cost of financial intermediation apparently has not changed much in over a century.[30] One of the promises of FinTech is to find cheaper ways to overcome the friction produced by financial trading and lower the cost of financial services to improve consumer well-being. The evidence provided by more recent research suggests that this promise could be real[31], although it is not always believed that the probable well-being produced provides a valid legitimation of the phenomenon in regulatory and social terms[32].

However, it can be considered that even if FinTech does not necessarily constitute a process of evolution [33], in the same way as what happens, more generally, for historical processes, it is at least part of the process of financial innovation, which although up to now has proved to be only theoretically risky, proves to increase in value in absolute economic terms[34] and, as more recent evidence is acquired, for investors[35].

A topic that is only apparently institutional should not be underestimated. The mere idea that risk can be produced by FinTech involves the interest of both the Financial Stability Board (FSB) and the Basel Committee. The breadth of the definition adopted by FSB and BCBS may prove useful in light of the current fluidity of FinTech developments. It can allow for the identification of a broad

spectrum of situations with which to associate the phenomenon for the purposes of its regulation. The implicit meaning that seems to be inferred from the interest of FSB and BCBS in technological finance coincides with the institutional function of the two policy makers. It signals the importance of technological finance for financial stability and the opportunity to proceed with its regulation and supervision[36].

5. The objective of financial stability is probably the most widespread of those pursued by regulators, although its importance for the management of the financial company is not always clear. Its relevance in the context of the FinTech phenomenon can be associated with more recent and common concerns regarding climate change and data collection problems. These profiles can be closely connected to FinTech[37].

If we want to adopt a point of view that allows us to investigate the topic, we can consider that financial stability describes a state in which the institutions and markets that make up our financial system are able to continue to provide the intermediation of capital and the payment services on which the economy in general is based and, at the same time, risk management[38].

The scope of the meaning of financial stability is greater than the simple absence of a financial crisis: it also requires a level of robustness that allows the system to absorb shocks and continue to perform its socially useful functions[39]. However, regulating financial stability is neither an easy nor well-defined task: regulators should ask questions about how different developments in financial activity combine and where invisible risks might be hidden[40]. These investigations are, in many respects, a data-driven activity and it is therefore necessary to understand if and how to frame the collection of such data and its analysis within the regulatory competence of a supervisory institution.

At the same time, it cannot be denied that systemic risk transcends both the realm of macroeconomic analysis and the assessments by the supervisory authorities of individual institutions, in other words micro-prudential supervision.[41]. Therefore, the technological supervision (SupTech) entrusted to a supervisory authority should take into account the limits entailed by the exclusive adoption of own macroeconomic analytical models or, conversely, the attention devoted only to consolidated channels for the transmission of risks by a financial institution.

If the most recent objectives of regulation, climate and digitalisation, can be considered prominent features of current financial activity, financial regulators therefore have to face another new condition for regulation which takes the form of FinTech innovation, or, in perhaps no longer just evocative terms, of a FinTech revolution[42], characterized by the adoption of new technologies.

To understand how all of this affects financial stability, it seems useful to proceed bearing in mind that FinTechs are affected by: i) technologies; ii) the financial use of; and, therefore, that iii) they can also influence financial stability on the infrastructural and functional level.

In particular, as well as exemplifying, distributed ledger technology and machine learning seem to play an important role in the composition of financial stability problems[43]. Distributed ledger technology is the technology behind cryptoassets that have become popular in recent years. Basically, a distributed ledger is a record of transactions hosted by a dispersed group of computers

or servers[44]. This makes the ledger more robust, precisely because it is distributed. It should also remain unharmed even if a single server is down, and it is imperative that the ledger is robust because it is not only a record of cryptographic transactions, but it is also needed to process them[45]. In essence, the transaction does not occur unless the ledger is updated to reflect the transaction. Each distributed ledger has its own protocol for determining which transactions will be approved and added to the ledger, with some verification procedures much more complicated than others[46]. Financial assets recorded on distributed ledgers are often governed by smart contracts: algorithms designed to autonomously execute the pre-programmed rights and obligations of the parties involved[47].

Machine learning is a type of artificial intelligence that creates its own decision rules by studying large datasets and then follows those rules in performing an assigned task[48]. The decision rules that are developed depend on the data the algorithm is trained with, so the involvement of a good data scientist is critical to the process. [49] The final decision rules of the algorithm will also depend on the learning approach of the algorithm itself[50]. In general, however, machine learning's probabilistic approach means that these algorithms are likely to be fooled or confused by low-probability events. Unfortunately, low-probability but high-consequence tail risk events are the very types of events that tend to trigger financial crises[51].

For a long time, the financial stability implications of these new technologies have been largely ignored (although there have been voices signaling specific issues)[52]. Widespread considerations on the implications for the financial stability of cryptoassets are recent, even more neglected is the analysis of the risks involved.

6. By trying to examine some aspects of digital finance that could generate systemic risk to which the necessary attention is not paid, we can consider the speed of evolution of FinTech. The technology of DLT facilitates the fast and automated execution of smart contracts hosted on those registries. Even if tolerance were in the interest of the parties themselves or of the financial system as a whole[53], this method of executing contracts could not take it into account. It certainly generates problems precisely with reference to the possibility that the tolerance exercised in the execution of financial contracts to avoid more complex economic effects is frustrated and defaults, in a broad sense, can automatically trigger crises that generate destructive effects more quickly.

If one of the most relevant aspects of the legal theory of finance is taken into consideration, it can be recalled that elasticity assumes fundamental importance among the characteristics of financial law[54], proving to be necessary on several occasions to avoid the complete collapse of the financial system, and it seems one cannot help but consider technological finance as a necessary regulatory element.

The rapid self-execution of smart contracts deprives the financial system of some elasticity, bank runs, virtual or otherwise, and fire halls, which have been central to the development of past financial crises. These could become more widespread and serious than they have been until now[55] because they are favored (or triggered) by the same technology that determines their increase and speed of execution. The scale of such disruptions could also be augmented by the ease with which cryptocurrencies, or cryptoassets, can proliferate. The fact that the underlying

asset is a digital token potentially removes any natural constraints on market participants' ability to ramp up trading in these continuous synthesized cryptoassets, unlike they might in the presence of issued equities[56]. More generally, the same tokenization of financial instruments involves a multiplication of the effect[57].

The complexity of the governance structures of many distributed ledgers means that attempts to resolve problematic transactions would take perhaps more time than more traditional ways of logging and perhaps come too late to avoid systemic consequences[58]. Such a cumbersome governance structure means that even purely technical problems with the ledger are difficult to resolve. For example, an operational problem can block transaction processing until enough nodes agree to revise the ledger's operational code[59].

Operational risks, more generally, are increasingly becoming a matter of financial stability and changing the scope of their nature. Indeed, as the technology underlying the provision of financial services becomes more complex, technological failures could overburden the remaining financial market infrastructure. This could then generate a cascading failure that renders the financial system unable to perform the functions upon which the economy depends[60]. Therefore, it seems simplistic to continue to consider the significance of operational risks with reference only to the business unit of reference, or, at most, with respect to the counterparty. The chains of risk transmission – through contagion or contact – should therefore be independently assessed as systemic risk factors.

Another risk to financial stability is that machine learning can be used to make coordinated financial decisions on an unprecedented scale. Machine learning is increasingly being used internally at financial institutions, including large banks and insurers, to manage their financial risks. It is also used to select investments for retail investors in a business model known as robo-investing[61]. If many traders rely on the same machine learning algorithms, or similar algorithms, using the same, or similar data, then they could all handle similar financial assets in the same or similar ways[62]. Trends towards widespread herding behavior in finance could be exacerbated in tech finance, with runs and sell-offs potentially operating on a larger scale than seen during the 2007-2008 financial crisis. Even if machine learning algorithms underestimate low probability tail events (tail risk), but with harmful consequences, it is likely that such events, if they occur, can become particularly harmful due to coordinated behavior in a FinTech system. [63]. So far, these types of risks have not received enough attention. Many think of these technologies, and of FinTech in general, as the exclusive territory of small start-ups that are thought of as too-small-to-care companies[64]. However, this lack of attention is misleading and potentially dangerous because technologies are increasingly used throughout the financial sector, including the largest and systemically important financial companies[65] that serve as a multiplier of the effect of the crisis. Financial regulators cannot standardize these technologies without understanding that this process depends on a correct assessment of the importance of the phenomenon and its effects. It is perhaps useful for regulatory interventions to take on a technological form[66], in the direction of Supervision Technology (SupTech[67]).

Perhaps nowhere else in finance is the need for a flexible designation tool more evident than in the FinTech sector. In this context, the decentralization of the financial system challenges the existing regulatory tools that have been designed for a financial system in which banks and broker-dealers

intermediate the financial activity[68]. Increasingly, FinTech companies are replicating or replacing traditional banking services and functions. This trend suggests that some players in the FinTech sector could emerge as systemically important in the coming years.

7. FinTech is transforming financial markets in ways that directly undermine the underlying premises of the regulatory model that underpins them. New technologies are dramatically increasing the size and reach of the financial system, making it move at unprecedented speed, shifting the decision-making center of gravity of financial markets from humans to algorithms, making finance less transparent and more complex, and blurring jurisdictional boundaries traditional[69].

In this financial universe, which is fluid and where transaction cost friction does not appear to occur, it is increasingly difficult to isolate and target, in a controlled way, specific actionable elements – product types, entities, functions or legal effects – and assume that the ability to regulate and govern the system will ensue, unless it poses a risk to the system itself.

Despite this awareness, current regulatory responses to FinTech generally use and reinforce, at best, old tools to fill some specific technology-driven gaps captured at the entity rather than the system level. Just to exemplify, the regulatory sandboxes, some special FinTech disciplines[70], as well as, on another level, the technological improvements of the processes are all regulated by considering the single factors separately[71].

More generally, the choice of solutions that operate at the micro level, without considering systemic effects and risks, keeps financial regulators in a reactive (or, if you will, and in some cases, reactionary) attitude, presumably giving up the initiative and control over technology to private actors. However, acting on the basis of recovering the distance, or the need to recover the disadvantage, does not appear to be a strategy capable of acting effectively on the problems raised by FinTechs[72] or of producing an attitude capable of imposing the game (it goes without saying) and the rules.

Tackling the problems posed by FinTech requires a qualitatively different, more explicitly systemic regulatory strategy, starting from the risks generated, which are often overlooked. The characteristics of regulation should consider: (i) that a FinTech strategy requires a fundamentally proactive, rather than reactive, regulatory stance with respect to technology; (ii) to elevate the role and significance of structural rather than transactional regulatory measures; (iii) the incorporation of specific instruments of direct public participation in the financial markets, in addition to the traditional forms of regulation and supervision[73]; (iv) bespoke systems of regulation and supervision of Fintech activities. This way of approaching the problems raised by the phenomenon, and more generally, the regulation involves the possibility of adopting analyzes that take into account the systemic dimension of FinTech starting from the inherent risk associated with FinTech.

[1] See Arner, Barberis, Buckley, *The Evolution of FinTech: a New Post-crisis Paradigm?*, *Georgetown Journal of International Law*, 47, 2016, p. 1271 ff., p. 1276 ff., p. 1279 ff., p. 1286 ff., p. 1295 ff., respectively, up to *FinTech 3.5*; and Arner, Buckley, Charamba, Sergeev, Zetzsche, *Governing FinTech*

4.0: *BigTech, Platform Finance, and Sustainable Development*, *Fordham Journal Corporate & Financial Law*, 27, 2022, p. 1 ff., *passim*, for FinTech 4.0.

[2] See Arner, Buckley, Charamba, Sergeev, Zetsche, *Governing FinTech 4.0*, cit., *passim*.

[3] See Omarova, *FinTech and the limits of financial regulation. A systemic perspective*, in Chiu-Deipenbrock (eds.), *Routledge Handbook on Financial Technology and the Law*, Abingdon-New York, 2021, p. 44 ff., p. 48 f.

[4] Or *too-big-to-jail*. See Schwarcz, *Too Big to Fool: Moral Hazard, Bailouts, and Corporate Responsibility*, in *Minnesota Law Review*, 102 2017, p. 761 ff., p. 763.

[5] On process of *digitalization e datafication*, see Buckley, Arner, Zetsche, Selga, *Techrisk*, *Singapore Journal of Legal Studies*, 2020, p. 35 ff., p. 36 f.

[6] On *platformization, FinTech, TechFin and BigTech as FinTech 4.0.*, see Arner, Buckley, Charamba, Sergeev, Zetsche, *Governing FinTech 4.0*, cit., *passim*, p. 5, fn. 8.

[7] See Macchiavello-Siri, *Sustainable Finance and Fintech: Can Technology Contribute to Achieving Environmental Goals? A Preliminary Assessment of 'Green Fintech' and 'Sustainable Digital Finance'*, *European Company and Financial Law Review*, 2022, p. 128 ff., p. 145 ff.

[8] See Omarova, *FinTech and the limits of financial regulation*, cit., *passim*.

[9] For an examination of the relationship between Blockchain and law, see De Filippi, Wright, *Blockchain and the Law. The Rule of Code*, Cambridge, MA-London, 2018, *passim*, p. 13 ff., p. 59 ff.

[10] See art. 1 (1) (10), CRD, Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC.

[11] See EBA, *Final Report on Guidelines on ICT and security risk management*, EBA/GL/2019/04 29, November 2019.

[12] See EBA, *Guidelines on ICT Risk Assessment under the Supervisory Review and Evaluation process (SREP)*, EBA/GL/2017/05), specifying how financial institutions should manage outsourcing (see EBA, *Final Report on EBA Guidelines on outsourcing arrangements*, EBA/GL/2019/02) and describing expectations for ICT and security risk management for financial institutions, see EBA, *Final Report on Guidelines on ICT and security risk management*, cit, *passim*, p. 3.

[13] See Knight, *Federalism and Federalization on the FinTech Frontier*, *Vanderbilt Journal of Entertainment and Technology Law*, 20, 2017, p. 129 ff., p. 135.

[14] See EBA, *Report on prudential risks and opportunities arising for institutions from Fintech*, 3 July 2018; EBA, *Final Report on response to the non-bank lending request from the CfA on digital finance*, EBA/Rep/2022, 8 April 2022.

[15] See Amorello, *Macroprudential Banking Supervision and Monetary Policy. Legal Interaction in the European Union*, Cham, 2018, p. 81, p. 314 ff. In the previous institutional context, see Ferran, Alexander, *Can Soft Law Bodies be Effective? Soft Systemic Risk Oversight Bodies and the Special Case of the European Systemic Risk Board*, *European Law Review*, 35, 2010, p. 751 ff.

[16] On the function of the FSOC in the context of US supervision see Weber, *The FSOC's Designation Program as a Case Study of the New Administrative Law of Financial Supervision*, *Yale Journal on Regulation*, 36, 2019, p. 359 ff.

[17] See Skinner, *Regulating Nonbanks*, cit., p. 1419.

[18] About the EBA's powers on systemic risk v. art. 1 (5)(3); art. 8(1)(i); e in particolare att. 22 and 23 EBA Regulation (UE) n. 1093/2010. See Levi, *The European Banking Authority: Legal Framework, Operations and Challenges Ahead*, *Tulane European & Civil Law Forum*, 28, 2013, 51 ff., 90; after *Single Supervisory Mechanism*, see Gortsos, *The Role of the European Banking Authority (EBA) After the Establishment of the Single Supervisory Mechanism (SSM)*, in Andenas, Deipenbrock (eds.), *Regulating and Supervising European Financial Markets*, Cham, 2016, p. 277 ff., p. 281.

[19] See Omarova, *Technology v Technocracy: FinTech as a Regulatory Challenge*, *Journal of Financial Regulation*, 2020, 6, pp. 75–124.

[20] See Omarova, *New Tech v. New Deal: FinTech as a Systemic Phenomenon*, *Yale Journal on Regulation*, 36, 2019, p. 735 ff., p. 742.

[21] For an in-depth analysis of the fundamental dynamics of the generation and modulation of credit money in modern financial systems, in lieu of many, v. Hockett, Omarova, *The Finance Franchise*, in *Cornell Law Review*, 102, 2017, p. 1143 ff.

[22] See Omarova, *Technology v Technocracy*, cit., p. 76.

[23] See Omarova, *Technology v Technocracy*, cit., p. 76.

[24] For examples, see Financial Stability Board (FSB), *Financial Stability Implications from FinTech*, 27 June 2017; EBA, *Report on response to the non-bank lending request from the CfA on digital finance*, cit.; UK Cryptoassets Taskforce, *Final Report*, October 2018 (sul sito <http://www.gov.uk>); US Department of the Treasury, *Report to President Trump: A Financial System That Creates Economic Opportunities: Nonbank Financials, FinTech, and Innovation*, July 2018 (sul sito <http://www.home.treasury.gov>); World Economic Forum, *Realizing the Potential of Blockchain: A Multistakeholder Approach to the Stewardship of Blockchain and Cryptocurrencies*, June 2017 (sul sito <http://www.weforum.org>); Schindler, *FinTech and Financial Innovation: Drivers and Depth*, Federal Reserve Finance and Economics Discussion Series Paper No 2017-081, 2017 (sul sito <http://www.papers.ssrn.com>).

[25] Among other, see Allen, *Driverless Finance*, *Harvard Business Law Review*, 10, 2019, p. 157 ff.; Ead., *Experimental Technologies for regulating Fintech*, *Journal for Law and Innovation*, 3, 2020, p. 1 ff.; Arner, Barberis, Buckley, *FinTech, RegTech, and Reconceptualization of Financial Regulation*, *Northwestern Journal of International Law and Business*, 37, 2017, p. 371 ff.; Brummer, Yadav, *FinTech*

and the Innovation Trilemma, *The Georgetown Law Journal*, 107, 2019, p. 235 ff.; Magnuson, *Regulating FinTech*, in *Vanderbilt Law Review*, 71, 2018, p. 1167; Zetsche, Buckley, Arner, Barberis, *From FinTech to TechFin: The Regulatory Challenges of Data-Driven Finance*, *New York University Journal of Law & Business*, 14, 2018, p. 393 ff. For examples of financial regulators' attempts to encourage technological innovation and to develop their own technological capabilities, see Van Loo, *Rise of The Digital Regulator*, *Duke Law Journal*, 66, 2017, p. 1267 ff.; Allen, *Regulatory Sandboxes*, *George Washington Law Review*, 87, 2019, p. 579 ff.

[26] See Omarova, *Technology v Technocracy*, cit., p.77.

[27] See Omarova, *Technology v Technocracy*, cit., p. 79 ff.

[28] See Financial Stability Board, *Financial Stability Implications from FinTech: Supervisory and Regulatory Issues that Merit Authorities Attention*, June 2017. On topic see Arner, Barberis, Buckley, *The Evolution of Fintech*, cit., *passim*.

[29] See Thakor, *Fintech and banking: What do we know?*, *Journal of Financial Intermediation*, 41, 2020, 100833, p. 1 ff., p. 1.

[30] See Thakor, *FinTech and banking*, cit., p. 1. In 2014, the unit cost of financial intermediation in the United States was estimated to have remained at approximately 2% of the overall cost of the brokered transaction over the past 130 years. See Philippon, *Has the finance industry become less efficient? On the theory and measurement of financial intermediation*, *American Economic Review*, 105, 2014, p. 1408 ff.

[31] See, Thakor, *FinTech and banking*, cit., p. 2; Fuster, Plosser, Schnabl, Vickery, *The role of technology in mortgage lending*, *Review of Financial Studies*, 32, 2019, p. 1854 ff., providing evidence that FinTech has improved the productivity of mortgage lending.

[32] See Omarova, *FinTech and the limits of financial regulation*, cit., *passim*.

[33] So instead Thakor, *FinTech and banking*, cit., p. 2.

[34] Among others, Thakor, *Incentives to innovate and financial crises*, *Journal of Financial Economics*, 103, 2012, pp. 130–148.

[35] See Chen, Wu, Yang, *How valuable is FinTech innovation?*, *The Review of Financial Studies*, 32, 2019, pp. 2062–2106.

[36] Arguments it seems can be gleaned from Financial Stability Board (FSB), *Financial Stability Implications from FinTech*, 27 June 2017; BCBS, *Sound Practices*, cit.

[37] See Macchiavello, Siri, *Sustainable Finance and Fintech*, cit., *passim*.

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- [39] See Allen, *What is "Financial Stability"?*, cit., p. 943
- [40] See Hellwig, *Financial Stability and Monetary Policy*, MPI WP 162/2015, 2015, p. 1 ff., p. 20.
- [41] See Hellwig, *Financial Stability and Monetary Policy*, cit., p. 17.
- [42] See Cortina, Schmukler, *The Fintech Revolution*, cit., *passim*; Gomber, Kauffman, Parker, Weber, *On the fintech revolution*, cit., *passim*.
- [43] For *FinTech technologies*, see Allen, *Driverless Finance*, in *Harvard Business Law Review*, 10, 2019, p. 157 ff., p. 166, analyzing FinTech business models driven by algorithms.
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- [45] For an analysis of regulation problems, Jaikaran, *Blockchain: Background And Policy Issues*, Congressional Research Service, R45116, Feb. 28, 2018, p. 1 ff., p. 4 s. (on <http://www.crs.gov>).
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- [47] See Werbach, Cornell, *Contracts Ex Machina*, *Duke Law Journal*, 67, 2017, p. 313 ff., p. 333.
- [48] Lehr, Ohm, *Playing with the Data: What Legal Scholars Should Learn About Machine Learning*, *U.C. Davis Law Review*, 51, 2017, p. 653 ff., p. 655.
- [49] On *data scientists and machine learning*, see Lehr, Ohm, *Playing with the Data*, cit. p. 670.
- [50] Lehr-Ohm, *Playing with the Data*, p. 690.
- [51] Allen, *Driverless finance*, cit., p. 174.
- [52] Allen, *Driverless finance*, cit., p. 174.
- [53] Allen, *Driverless finance*, cit., at p. 180.
- [54] See K. Pistor, *A Legal Theory of Finance*, *Journal of Comparative Economics*, 41, 2013, p. 315 ff., *passim*, p. 321, See also Ringe, *COVID-19 and European banks: no time for lawyers*, in Gortosos, Ringe, *Pandemic Crisis and Financial Stability*, Frankfurt, p. 43 ff., *passim*, p. 60; Bevivino, *La sospensione della distribuzione degli utili delle banche nei periodi di crisi economica esogena. Misura macroprudenziale e strumento di politica economica (?) della BCE e problemi dell'impresa bancaria*, in *Analisi Giuridica dell'Economia*, 2, 2020, p. 685 ff., p. 689.
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- [56] See Omarova, *New Tech v. New Deal: FinTech As A Systemic Phenomenon*, *Yale Journal Regulation*, 36, 2019, p. 735 ff., p. 775.

- [57] On the use of decentralized technologies for the purpose of circulation of financial instruments see OECD, *The Tokenisation of Financial Assets and Potential Implications for Financial Markets*, 2020 (on <http://www.oecd.org>).
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- [59] See Allen, *Driverless finance*, cit., p. 180.
- [60] For an analysis of cascading operational failures in the financial system see Allen, *Payments Failure*, *Boston College Law Review*, 62, 2021, pp. 453 ff., p. 502.
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- [62] Van Loo, *Making Innovation More Competitive: The Case of FinTech*, *UCLA Law Review*, 65, 2018, p. 232 ff., p. 235, p. 251.
- [63] Allen, *Driverless finance*, cit., p. 185 f.
- [64] The expression *too small to care* is of Arner, Barberis, Buckley, *FinTech, RegTech, and the Reconceptualization of Financial Regulation*, cit., p. 403.
- [65] See Allen, *Resurrecting OFR*, cit., p. 20 and ftt.
- [66] See Allen, *Experimental Strategies for Regulating FinTech*, in *Journal of Law & Innovation*, 3, 2020, p. 1 ff., p. 28.
- [67] SupTech, which is the abbreviation for Supervision Technology, refers to innovation by financial regulators that is informed by technological advances themselves. See. Allen, *Experimental Strategies for Regulating FinTech*, cit., p. 26.
- [68] See Zetsche, Arner, Buckley, *Decentralized Finance*, *Journal of Financial Regulation*, 2020, 6, p. 172 ff., p. 175 ff.
- [69] See Omarova, *Technology v Technocracy*, cit., p. 87 ff., analyzing the limits of current regulation and supervision in relation to the problems raised by FinTech activity
- [70] For an overview of European initiatives on digital regulation see v. Wojcik, Annoscia, Kerr, *Report from Brussels: Pending legislative initiatives by the European Commission in the area of financial services in the EU – content and state of play*, ZBB / JBB, 2022, p. 322 ff. The framework includes: i) MICA (*Proposal for a Regulation on Markets in Crypto-Assets*); ii) DLT Regulation; iii) DORA (*Digital Operational Resilience Act for financial services*); iv) FinTech Directive Proposal.
- [71] See Omarova, *Technology v Technocracy*, cit., p. 108 ff., p. 110 ff.
- [72] See Omarova, *Technology v Technocracy*, cit., passim, where a deep inside analysis on the matter of policies regulation of technology.
- [73] See Omarova, *Technology v Technocracy*, cit., p. 117 ff.

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Though the considerations expressed in the paper are shared by both authors, sections 2 and 3 should be attributed to Gianni Lo Schiavo, while sections 4, 5, 6 should be attributed to Vito Bevivino. Sections 1 and 7 should instead be attributed to both authors.

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